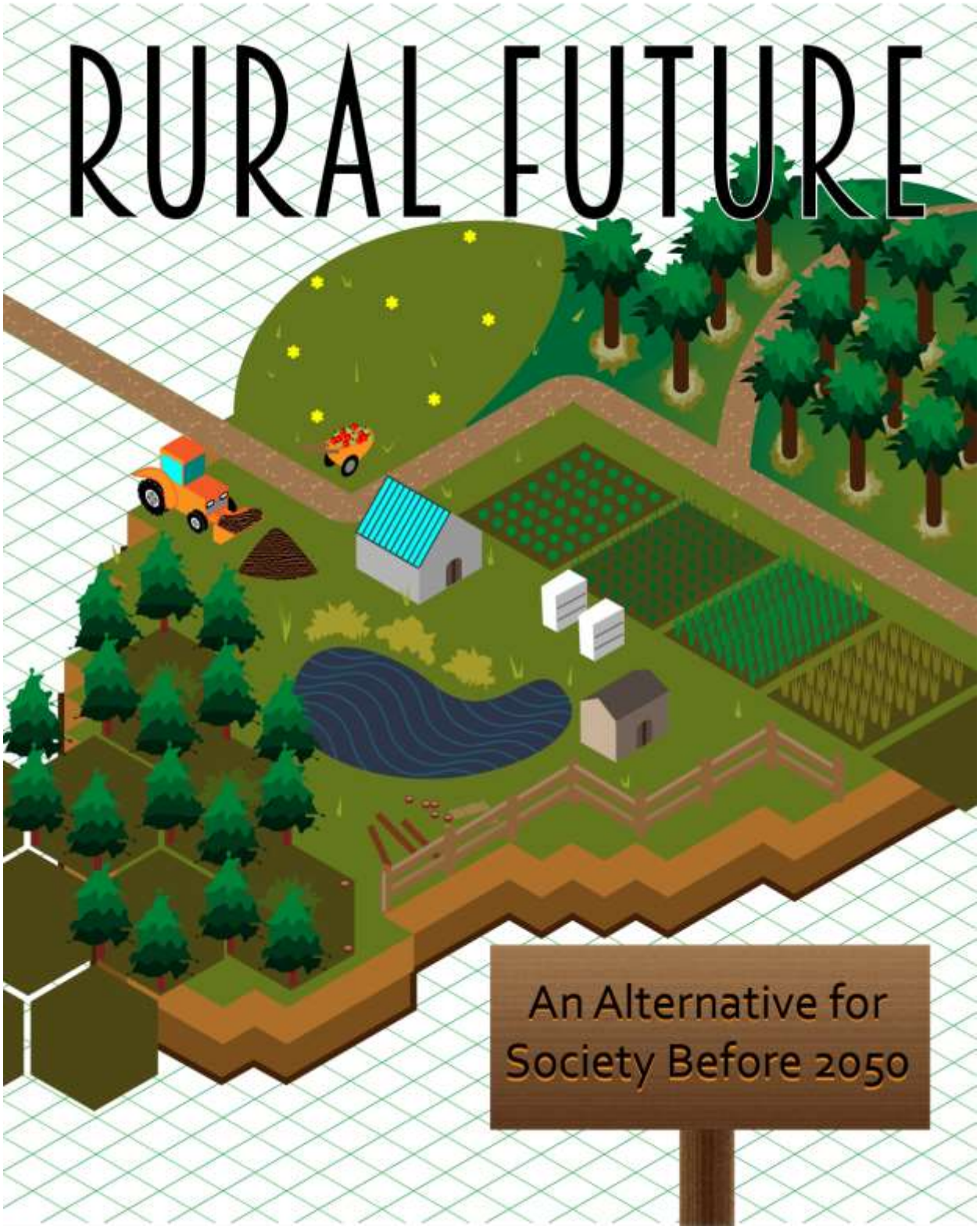
RURAL FUTURE



Rural Future

An Alternative for Society Before 2050 AD

By: Robert H. Giles, Jr., Ph.D.

Edited by: Laurel Sindewald

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Acknowledgements

I told faculty colleagues about my enthusiasm for Rural System in 1997, retired in ’98, interviewed 2 attorneys, hired one, hired an accountant, appealed within a competition to a local “Shark-Tank-like” organization within the Virginia Tech Corporate Research Center, gained constructive comments about starting a business, and was not funded. A loyal group of correspondents continue commentary on blogs and texts I send to them. I remain delighted with conversations, editing, questions, and ideas about Rural System’s potentials … and limitations (which I continue to attempt to address wisely and creatively). Many former graduate students, and other students, have made suggestions. I’ve hired part-time assistants over the years, as well as typists and programmers. My daughter, Anne Giles, now assists with coordinating business operations.

Valuable advisors and participants influencing Rural System in many ways have included: Paige Baldasarro, Dale and Stuart Black, Dave Brotman, Ellen Brown, Marie Cirillo, Tom Clarke (of Kissito, Inc.), Dr. Iain Clelland, Jim Flowers, Jessica Furlong, Margaret Galecki, Stan Grigsby, Dr. Ed Hampton, Dr. Holly Hartman, Blair Jones, Sarah Beth Jones, Dr. Greg Koeln, Ken Maready, Lance Moore, Wallace Newton, Charley Patterson, Risa Pesapane, Gordon Sowder, Loretta Uzell, Jeff Waldon, and Tamim Younos. Laurel Sindewald took on significant editorial work in 2016.

Editor's Introduction

Dr. Giles is a rare person who, identifying with and feeling compassion for humanity on an Earth-scale, sees the problems looming and multiplying and wants desperately to convince people to do *something* before it is too late to address predicted shortages of resources, particularly water shortages by 2030 and food shortages by 2050.

The *something,* specifically, is an idea at once wholly new, and filled with the very familiar. With so many problems converging at once, all inter-connected in their origins, Dr. Giles posits that small-scale solutions targeting specific problems will not be nearly enough. For a system of problems, we need a system of solutions.

Rural System is his plan for superior rural land management, computer-guided by a system of GIS and prescriptive software, informed by the latest science, and making stable profits within bounds over a planning period of 150 years. The computer software system would make precise prescriptions for management actions and business enterprises, carried out by interconnected, interdependent small businesses. Rural System, Incorporated, would be an integration of over 150 small businesses, called "Groups," meeting a diversity of needs and solving a diversity of rural problems, all guided by prescriptive software.

As a system of grand scope and scale, Rural System is new, calling for unprecedented levels of collaboration and investment in high-technology rural land management. The Groups, however, are familiar in their various specializations: System Central deals with business management, Marketing handles marketing for all Groups, The Fence Group handles boundaries, The Pasture and Range Group specializes in livestock management, and The Biking Group rents or sells bicycles and offers memberships for people to bike on lands under Rural System management. (Dr. Giles lists all of his imagined Groups in Appendix 1 of *Rural Future,* with brief descriptions for each.)

Having spent much of his life learning and teaching others about rural lands and natural resources, he stood back and realized that, while he had been focused on his research, most people in rural America had moved to the cities. Young people did not want to stay and farm, but older people were growing too old to manage the land. Increasingly, private lands not held by corporations are held by absentee individuals, who are unable or unwilling to continue to steward the land.

Meanwhile, growing urban populations still need nutritious food and clean water, and industrial farming will not be able to provide it once supplies of fossil fuels and phosphorous run low. Someone needs to do something to meet growing human needs with vital natural resources, without *exhausting* those natural resources.

Rural areas in America have long been prone to boom-and-bust economies, whether farming-, industry-, or mining-based. If natural systems are exploited completely in the present, such as clear-cutting an entire property, the "boom" of production will be followed by a "bust," where nothing much can be gotten from the land for a period of time. Rural communities in Western Virginia (the first target area of Rural System) are already suffering from extreme poverty and economic instability following the collapse of the mining and tobacco industries. People there need stable income in order to continue to live.

Rural System's large diversity of Groups, sharing resources for economies of scale, are likely to be able to provide the stability needed for communities to survive, and even prosper. Working with Rural System, small rural communities will be able to achieve greater marketing reach for their small businesses and non-profits, the people will be able to earn living wages, a

tax base will be built as property values increase, education will improve with tax revenues, and natural resource systems will improve in value, health, and resilience even as the human communities do.

The five Rural System objectives are:

> **Objective 1. Esthetic and Historical –** Achieve and enhance the history, beauty, and future estimates and interpretations of the rural region.
>
> **Objective 2. Salaries –** Provide meaningful work and related salaries for our local workers within our interrelated businesses.
>
> **Objective 3. Communities –** Provide funds and strategies for stabilizing small rural communities, with adequate related educational, protection, and social services.
>
> **Objective 4. Land Health –** Restore, enhance, manage, and stabilize high natural resource production of human benefits over a very long period. Achieve and stabilize, on Rural System lands and waters, high Rural Environment Health Syndrome indices.
>
> **Objective 5. Studies –** Conduct practical, profit-potential-increasing studies.

Given the power of modern technology (particularly GIS software) and the extensive scientific knowledge available on almost every aspect of rural land management (and some ecosystems), we can create a system that will benefit both humans and their environment.

In *Rural Future,* Dr. Giles introduces the philosophy and basic structure of Rural System, providing many examples of the Groups and of Rural System's planned action on the land. His work is addressed to a global audience of motivated people, who are ready to try something new to meet the coming crises.

I have been working for four years with Dr. Giles to communicate the messages of Rural System. Fundamentally, the child in me—taught to recycle in the fourth grade, aware from my earliest age that our planet requires thoughtful tending—is profoundly grateful to Dr. Giles for caring enough about future generations to dedicate his retirement to solving global problems. As an adult devoted to assisting future generations, I am proud to have been able to assist in offering what is, in fact, a beginner's manual for a new paradigm of natural resource management, one that is equitable, humanitarian, environmentally responsible, and consistent with the economic values of a proud, capitalist society.

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Foreword

Let me tell you about your book and what it may mean to you and your family and friends. I prefer starting by telling you about current conditions and problems, as an introduction to the book's content, and as a rationale for what I write. Extremes are taboo for my presentation; exaggerations simply duplicate recent scare tactics of movies and damp the fires of meaningful action. Few now can spell "apocalypse" (or need to) while preparing for cataclysmic events and conditions. I'm genuinely concerned about the predictions that I make, and so I request that you concentrate on the information shared in the context provided, and ask that you reason from my observations and experiences and "bet" with me on a desirable, planned, well-implemented future, rather than a highly possible and disastrous alternative.

I'll tell you what I know and hope that you'll join me and act based on what you know about me, my former students, my writing, and my planned corporation, Rural System. I recommend using only a little knowledge perceived to be needed from history. Too much has changed and now changes. I don't recommend taking advice from singular experts or limited academic fields, those without diverse rural experiences, or from spiritual sources (tanks now empty). I share knowledge to influence behaviors beneficial to you and our colleagues… people of Earth.

I am 83 now. I met 50 citizens and the head of a park in Uganda in 2014; staff there explored potentials for further earth slides triggered by a rare hail storm, it having wiped out gardens, killing one child. I explored the feasibility of implementing Rural System in diverse ways in that country. I retired from Virginia Tech in 1998, where I had taught systems ecology, integrated pest damage management, wildlife management, and environmental dimensions of architectural design.

Work with graduate students often involved intensive computer applications (including GIS) in wildlife law enforcement, airport and power line placement, and routing impacts on the environment. I had been a state wildlife biologist for 5 years before starting a PhD program at Ohio State University. In Ohio, I explored effects of radio-isotope-labeled Malathion insecticide spray on the ecology of a hardwood forested watershed. My major professor was Dr. Tony Peterle. After graduating from Ohio State, I taught techniques of wildlife management and big-game management at the University of Idaho, and then I returned to Virginia Tech where I had gained a BS in forestry and an MS in biology. I taught at Virginia Tech for 40 years. I edited *Wildlife Management Techniques*[1] for The Wildlife Society, and authored *Wildlife Management*.[2] I've gained experience from professional visits in the USA, India, China, Nigeria, Uganda, and Senegal. I earned a teaching award and published *The Didactron*,[3] a book about modern teaching methods. Retired and well, I now work out of Blacksburg, Virginia, with two writing coaches and two helpful daughters nearby.

Experience can be useful. I write from those experiences and continued study as I describe thoughts and plans for Rural System (which I remain eager to implement, and see its

[1] Giles Jr RH, editor. Wildlife management techniques. Washington, DC: The Wildlife Society.
[2] Giles Jr RH. Wildlife Management (A Series of Books in Animal Science). 1978. W.H. Freeman & Co.
[3] Giles Jr RH. The Didactron. 2012. Blacksburg, VA: Handshake Media, Inc.

effects felt). I was told (as I discussed funding for getting Rural System started) to ignore "age discrimination," but no one will support massive work and investment led by an 83-year-old person! I share concepts for the common good, those that I believe are essential for future human populations (as in no time past, ever). I estimate having 13 years of functional, helpful life to share the ideas and concepts herein.

I'm rabid, especially about the ideas in Chapter 2!

I've had my rabies shots. I studied rabies for years with students, poorly funded because not enough people are killed by this virus to justify allocating funds for more study of the disease. No one wants to study it; it's too dangerous, personally risky for investigators and associates. One graduate student, however, bravely worked on the hypothesis that rabies is "stored" in the wild and then becomes a regional outbreak after abundant rabid animal-to-animal contacts. A contacted specimen sent to a health department required my student to take preventative inoculation shots… into her abdomen! Later I took preventative shots in the arm. I still work in the wilds and feel only a little safer. Some have had adverse reactions to the inoculation. I know that rabies can and has been transmitted by air (as once in a New Mexico lab among caged animals). It's transferred in the wild by sick animals biting others and, probably just as in curious pet dogs, nose to anus among infected animals living together within the dens of marmots.

The other way for its occurrence is probably through crowding stress, large populations (skunks, foxes, etc.) in season, excessively abundant in some years and, as in lab rats, undergoing adreno-pituitary stress. Thus, with the virus present, they develop rabies symptoms… but it is too dangerous to prove! How do you know? That base question, that line of epistemology (Chapter 5) is blocked. No, you can't learn, know everything from a teacher, dad, or lab. Watch out! There are alternative ways to learn… or not—give up!

I am stressed in every fiber of my "teacher core" by such words… I am rabid about the concept that we must work toward preventing the long-claimed convergence of an excessive human population with insufficient Earth-resources to support all people with diverse needs in diverse spaces.

Rabid is my feeling; I "know" —but probably don't—but must *act* as if I do in the face of the likely future. I risk little if in error. I share with you the constraints on my conclusion and recommendation, "the fences of the ball-field" where the rules are at work. I have to work with probabilities, things "known" within limits, constraints— "gained knowledge," available reports, or recent messages.

There are now many and major differences. I don't promote *the Rural System solution* herein for large family profit; the proposed work is not designed or in any way intended to be competitive with large, existing private farms and ranches, nor land owners, nor with natural resource agencies. There is rapidly-changing, useful technology now available. It was not available before in related periods of international crisis. Time available is critical and yet speed will be resisted, though warnings and stated-needs have been available since before 2000.

Perhaps, with you, I may risk violating every field of expertise in its separateness and uniqueness, but the payoff for the risk is probably high for creating at least an essential, functional, lasting system of sub-systems to serve Earth-around, one that balances, very soon, the water and food quality and quantity needs of human populations within their now-distinct areas, in over 196 countries, with available but still questionable supplies.

I gained encouragement from the guest editorial of the March, 2016 issue of *Frontiers in Ecology and the Environment*,[4] where I learned the UN Sustainable Development Goals, "represent a major potential turning point in the future of humanity. For the first time in recorded history we have a set of goals and targets agreed upon by all UN countries, which include the full range of factors that contribute to equitable and sustainable well-being," for nearly all of us… with a working concept and modern technology. New initiatives, new enterprises, and new Collaboratives must be planned and developed.

[4] Costanza R, Fioramonti L, Kubiszewski I. 2016. The UN Sustainable Development Goals and the dynamics of well-being. Front Ecol Environ. 14(2):59.

Preface

"Just tell readers what you want them to do," said my writing coach.

"I've spent a whole book trying!" I said.

"Try again, differently," she said. "The readers will realize you are serious; work only for them, your daughters, and Earth-payoffs. Readers know that neither you (nor anyone) wholly know what to do in the next few years before 2050 AD. They'll see the problems racing toward us and pick out tasks most suitable for them… one or a few that perhaps only they know now, and that can be used in new ways, new groups to act to meet the conditions and problems ahead.

"Write it again! Fewer specifics! Count on rapid advances occurring in science before 2050 AD. We'll all have to live now with hope and work together."

Alright: I want you to read, study, and learn together what's in *Rural Future*. It's a book about "rural Earth" and most of the rest of it, all linked together, inseparable. I want you to scan the premises that I offer (Appendix 2) for later thought and action, then to face the challenges with me in your own special ways.

1. Become aware that we're working together for lands and resources of Earth, where people are emigrating from rural areas to cities. (A twin problem, sums *left* in one place and *received* in another.)
2. Today, estimate your functional years (healthy, active ones) between now and 2050 AD. Carry with you the knowledge of the years ahead for effective work to reduce Earth crises.
3. Begin to study and apply the general systems approach presented throughout *Rural Future*, starting with clarified objectives for you and your habitat.
4. Help children and others move beyond learning about "ecology" as *the study of* plants and animals and their relations to *managing* resources and ecological systems.
5. Begin deep thought and planning for the unthinkable, that is, over 190 countries of Earth reaching inadequate essential resources—inadequate water in 2030 AD, and inadequate food in 2050 AD.
6. Create diverse local programs for regulated production of nutritious, energy-efficient foods for people on restored or newly-created food production sites (e.g., mountain-contour-slopes and fish-production waters).
7. Exploit existing databases and software to provide a unified computer system to aid countries and their neighbors to have equal inputs in international decision making.
8. Call for and act to renew and revitalize the UN, as well as relevant non-profits, to address the Earth-around shortages and healthy population needs in each country. At minimum, evaluate and begin action on reducing the extents of the wicked problem (Chapter 1):
    - Air pollution
    - GMO conflict
    - Climate instability

- Ocean level rise and water quality decline
- Ground water quantity and quality depletion
- Soil quantity and quality depletion
- Floral and faunal losses and invasions
- Pest floral and faunal effects, costs and losses (e.g., insect-related pathogens)

9. But, controlling or reducing action will not be sufficient. Implement ideas and activities sketched herein as elements of a working corporation—a Conglomerate—starting on abandoned rural lands.

"Get busy!" commands for readers will not work; very different, adjacent, country-scale action will promote war among competitors. Only a UN-like concept will work, for we are *all* now linked together, liked or not, by knowledge of threats: climate, energy, and nuclear-source potentials and limits, among other challenges. Together we can create Rural System or an improved version. It is possible! It is the first step toward hopefulness.

Introduction

A View from Here

"Hi Mary, where's Bob?"

"Upstairs, where he always is, saving the world."

Laughing, "I should have known. I'll just run on up."

"Hi Bob. Nice view from up here… among your books and all of this other… mess. What's all of this stuff?"

"Leave me alone," I demanded, smiling. "I'm saving the world… as she always says. Look at that autumn sunset!"

As on most days, I was living in my "literary nest," in piles of journals, files of cards (bc, before computers), collected papers on single topics, government publications, a not-very-neat-pile of notes and photos, and several drafts. Beside the computer and its accessories was a chair for my disrespectful, rarely humorous friend. We saw the need, the Earth-peril, clearly now… and we probably met for encouragement (never admitted).

"Beautiful view from up here… the evening light's mix of sunset, conifers, and autumn leaves."

I had been led by a regional expert to concentrate on the rural lands of "absentee farmers," after my retirement. These were lands within the state left behind by the hidden exodus of farm families in the past 20 years to the cities. I could hardly believe the numbers of migrants. I had concentrated on land use planning and specific natural resource issues. I had lost "the whole" view for "a part" ... a shift of scale. In my life, within "my" Virginia, the human population had shifted, transformed. I've learned, integrated, and I now see a pathway, though it's difficult and costly, to overcome conditions now and those emerging in my children's lifetimes within the region and the world.

People of Earth now head toward 60 percent living in cities. My grandfather used to discuss at the dinner table his amazement at the great technological and rural changes *he* had seen. I now had a feeling, one that must have been identical to his. I learned that the population of Virginia was (and is) 80 percent urban. While I wasn't watching, people had traded places from 80 percent rural to 20 percent! Virginia and other areas now have abundant "absentee land-owners," and as the population ages, more and more people are leaving farms, entering assisted-living facilities, and remembering the "good times."

All "times" were not good, for farming is difficult, economically risky, and dangerous. Farmers are now well-educated… and many have moved from the family farm to very diverse jobs throughout society. The farm is now the summer place or the hunters' lodge for the returning family members, or the tax burden and the place for some share-cropping, handled by a former local friend. It is also the speculator's realm where home-site landscape beauty is abundant, children few, regulations lax, electronic communication replaces traffic congestion, and remaining residents reluctantly pay for water and other extensions of county services.

More than the percentages have changed. School systems suffer because student numbers decline, affecting several budgetary and educational scoring procedures (bussing costs, staffing,

and salaries as well as safety are affected). Large stores move into some areas, changing the stability of small rural communities, numbers, taxes, and services. The Appalachian Regional Commission remains. Coal mining hesitates under transportation, regulations, safety, mining techniques, treatment, costs, natural gas competition, and doubts about climate change, its effects, causes, and its timely, cost-effective control.

With such great change, there are opportunities for action that may be profitable. With such change, there come near-demands for action, for major change, for state and even national governmental action. The scope of change is much beyond anyone's personal control, best wishes, or influence. The enormous perceived changes require new work of equivalent size and scope. It just does not seem available! No one seems to notice.

In this book, I tell a little of the changes that have been made, the needs, and the new abilities that are now "on the shelf" and being formed to meet these changes and their associated problems. That he or she was "right rural" may have been a comment from the past, now changed with education, the mixing of populations, transportation, and widespread travel. It's not changed enough to meet the number of pressing needs within multi-county rural regions of the Eastern US, very similar western and southern regions… and international areas that I have visited. (I write herein, for brevity and as a model, of western Virginia.)

You may want a little help in making your way through the many topics within this book. I'll try to help your reading, and I hope you'll notice:

1. the connections among the means to our objectives;
2. that we emphasize a systems approach, and "practice what we preach";
3. that we expect the opinion, "you're including too many topics" … but that's a point of emphasis: a world of topics, all interrelated and scrambled together;
4. each chapter is about a named subsystem, and intended (when in operation) to help achieve the objectives (Chapter 2);
5. that some chapters are intended to convince readers of relatively new insights into problems and good prospects ahead;
6. that we suggest we have a really big set of problems, too big for a quick list or analysis of each… all linked, all dynamic, and all within reach of solutions now, sooner than generally known possible;
7. that the concepts in Rural Future are not in my imagination, are possibly within current technology, with real danger ahead, requiring a complex response to the world catastrophe clearly ahead, and that I suggest "a way out" with readers' great effort; and
8. that I'll attempt responses to your questions on my blog at www.ruralsystem.com/category/blog.

Rural Future is just a snappy title for: "What to do with over hundreds of thousands of acres of mid-Eastern USA land and water when the people have left, community services are few and declining, agricultural land is worn-out or ruined, water is polluted and unstable, mining-income continues to decline, diverse jobs are absent, pastures are returning to brush-fields, and people, financially strapped, still love their lands and waters?"

I'm "right rural," meaning what Dad was as a child, and what many people were who I knew as I worked for a country veterinarian, gained a degree as a forester (Virginia

Tech), studied forest ecology at Ohio State University toward a PhD, owned a rural 20-acres, and visited farms in several distant countries. Farmers today, in Virginia, are college grads. “Rural” has many connotations, far from those of the past. I’m probably not rural enough; nevertheless, I want to share in this book the full awareness that “rural-as-now” won’t work, and that the messages herein—Rural System, as described—*will* work. Thousands of well-managed rural acres under the recommendations of Rural System are essential for us all.

I arrived at the need for a rurally-related corporation, after months of work. Millions of dollars of federal and various matching funds and contributions had done little to help citizens in rural Central Appalachia. Coal mines of international owners moved money as well as coal out of the region, leaving pitiful, small-community "camps" through the region. Mine reclamation addressed some surface areas, and performed some land reshaping. Thousands of acres were un-reclaimed, abandoned. The land, unrestored, is largely forested; the site quality for growing trees is poor. Nutrients have been leached from the soil... flooding is common.

Over-generalizing as I have just done is like an elevator speech about a business or a day-long drive through a section of a mountainous region. The speech will always be inadequate, i.e., neither enough of the old or the new. Unseen are problems of health, mining and agricultural injuries, inadequate diets, inadequate directed education, and instability in federal and state funding practices and procedures related to families in poverty, in a region with ever-changing forests, mines, agriculture, highway-related gains and losses, and big-box stores, all distant from urban centers.

With help, I’ve designed a corporation, Rural System, to meet the needs that I saw (remaining skeptical), aware that exceptions (well-known) are much easier to describe than a totally new response, unknown to land owners and thus risky. Federal efforts over many years need not be repeated. The needs are too diverse, players too many, stability missing, and fundamental personal and family independence have been lost in decades of well-meant financial support.

The view of rural lands and their people from here is hopeful, but I am convinced that past actions are unlikely to succeed. The view is the same Earth-around, and the successes locally will enliven those who suffer. I am motivated by the perils that I see and the children who suffer, and my daughters. Rural System will work; it is needed now.

I've had trouble explaining Rural System to too many people already over the last 12 years. I'll try again because it is important, but Rural System is new, complex, and counter-intuitive. There is no *best place* to start, so I must ask you to join me as I connect the parts, tend to the nodes, elaborate the processes, and assume common knowledge. I give you too little here in the introduction. The problem is large, the solution *very* large. Rural System, the topic and context of this book, is a corporation that can work in the world, with your help. I'm hoping for a diverse audience that *will* work more than a little with my message. I suspect the problems we face are bigger, more complex, changing, and contentious than human-kind has ever faced.

I’m not exaggerating; I think we have to join in some work together for a few years. I am not positive that we shall win. Not knowing how to find a way to join, or *what* to join may be *the* giant problem for people of good will, and *this* problem is what *Rural Future* addresses.

People have moved and continue to move from rural areas to the cities of the USA and the world. 80% of the US population is now urban. People have left behind lands, waters, resources and stressful conditions within small communities. Now we see collective loss of essential resources on an Earth-scale, below the blazes and clouds of war. Enough!

Rural residents may intend to escape very hard work, variable or low income, emigrating children, high living costs, aging land owners and workers, past poor land use, increasing production costs (e.g., crop fertilizer and big equipment), adverse legal action, counter-active messages from TV and modern technology, or decreasing voting-citizen knowledge of "modern farming"… or even all of these. *Rural Future* is about rural emigrants, especially about an imagined future for lands and waters around towns. A massively feasible alternative to "the well-known farm" is needed. The lands left need intensive care and management for an array of valuable human natural resource benefits, including those of food and abundant clean water, nationwide, soon Earth-around.

The US rural complexes, including yet-successful farms and some conventional farming, will no longer work. (There are wonderful, praiseworthy *exceptions.*) Current farming will not be adequate for the future. I contend that a new entity, Rural System, can provide the essential alternative. The world approaches 60% urban and people will be hungry and much-stressed by 2050 AD. (*Do the arithmetic: How many years are there for* you *from today's year until you will be 65 or more? This count is for years of potentially massive change.)* Consider your quality of life: past, now, and later! Change is needed *now* to improve conditions, using the sophisticated, comprehensive, modern management approach suggested in this book.

Carry with you the problem of understanding the relations and effects of implementing Rural System now, for the future. See my elevator speech, a brief talk planned to be made to a friend while on the way to the next floor of a building:

> "Hi, Bob, what are you doing nowadays?"
>
> "Hi Sarah. I'm developing Rural System, a new US corporation to meet the diverse needs of rural regions with many absentee landowners, people having emigrated from rural areas to cities. Not yet developed, it "rents" their lands and waters left behind, uses computer-aided precision agriculture, uses GIS and GPS, and integrates many diverse small businesses, aided by social media. It works for local people, schools, and small communities, and improves natural resource management. I'll see you later!"

Rural System, Inc. is a proposed Conglomerate business and foundation that unifies over 150 small, natural-resource-related businesses. It contracts with private rural landowners, most of them absentee owners, and then manages their land and water, providing new services, products, and profits. It shares profits with each owner from the total Conglomerate. It offers new employment and a community tax base by (1) gaining financial payoffs in planning, decision-making; (2) using sequenced value-adding strategies; and (3) using its computer maps and databases. Like share-cropping or a big lawn service, it develops rural land for annual landowner profits, for the long run.

Given many analyses of why small businesses fail and seeing consistent findings, I thought it reasonable that I not try to start a business with such "failure characteristics." I've noted them and made precise design decisions to eliminate them. Business systems also fail for "macro-factors," though: large ones beyond the influence of the small business founder. I try to face these in my own way, hopeful, unrealistic by some standards, improperly scaled, ignorant of the real scope of the problems, ignorant of human evil and its clandestine forces, disrespectful of natural forces (floods, tsunami, blights, epidemics, earthquakes), and of their lasting destruction. Alone I'll probably fail; with others, and with a novel design, I can and will win. That *win* must

be clear, because competing budgets and agency sales staffs' appeals to the gods or "waiting patiently" will not be sufficient for the people of future Earth.

Many farmers continue to farm, gambling in the face of unsure prices, markets, support, drought, storms, pests, disease, theft, fire, and more… now the threat of terrorists. Creating Rural System seems irrational! Let me describe my irrationality, an entity (sample size of one) believed and designed by me to be unique, thus not readily included within the categories of estate management, landscape experts, community developers, agritourism enterprises, or mega-farms.

Business success or failure is evaluated in return on investment (ROI) or related financial units. I have invested the equivalent of $500,000 in personal labor, employee time, and travel expenses on Rural System. This, like the personal investments of farmers and farm families, is not typically accounted well. There is yet no return on that investment and none expected. The expected investment return, however, is from life-saving, life-enhancing returns on vast Earth-around Conglomerates, linked, dynamic, managed systems, attentive to the quartet: adequate high-quality water, adequate high-quality food, timely energy, and adequate quality of life for humans.

Rural System is designed to provide regional employment, reasonable small community stability, and modern natural resource management, all indexed by profit. Return on investment is a secondary but real part. Other parts are those of history, scenic beauty, regional stability, protection of state tax funds, and the gains of social networks. When I began, the view may have seemed small, very narrow, but it was from a solid and recommended useful (now essential) modern general systems approach. It was clear that Rural System would need profit as grounds for accountability, and a pseudo-test would be needed to engage the hypothesis of this book: *that a sufficiently large first investment will be needed for a convincing scale to be achieved*.

"We the people" now get our food from many places. We depend upon these places, their people, and production systems. In 1972-73, surprisingly a series of events led to a sharp increase in the cost of food production and thus food supplies. Since then, much more information and its pathways have increased, and now we love the technology of an Earth-wide potential food inventory… but hate the result: we recognize there are too many people on the same food production pathway… calamity in 2050 AD! We are likely to be very short of fuel, feeds, fertilizer, and other "f" words of fine farm land. Committees saw the problem in '73, some of the data needs, and some solutions. Most of those who saw were "right poor," and the alternatives they saw were "right costly" and "right political," so they did little while speeding along to a "right bad" Earth-around situation (like our 1973 national one): very low food supply with very high demand.

The situation sounds like an agricultural problem, never discussed in public in 2016 by urban people. I'll die before 2050 AD but I write personally for my daughters and former students, Earth-around… *and* dear readers. Time's up!

My assumptions are as real as my pessimism; inaction for me is *not* real, as I act for my children. I assume this is much too personal-sounding, but I also assume you will be encouraging and aware of my genuine concern for humanity. I have other assumptions and they are fundamental to Rural System starting and becoming influential.

Based on the numbers, I have until 2026 as functional life during which to get Rural System started (beyond corporate formation). I assume that world populations will be enormous and need food, but that people and food supplies are not well-matched. For people in over 190 countries, we currently have a far greater problem in marketing and transporting nutritious food to people in need than we do in growing it.

I assume the population numbers are correct, or accurate enough to aid and influence policy. But quibbling over numerical accuracy when no one can describe the meaningful difference between 250,000 people now and later is a waste of time.

I assume "food" will be translated anew as packaged nutrients per energy unit needed for production. Right now, it costs too much energy to gather and process different crops (foods) for the nutrient content derived from each item. Rural System can help in this social evolution to "gain the good" from each item grown and purchased at explicit energy costs.

I assume that crop and property thefts and destruction will increase on Rural System tracts, thus crime prevention and related action will increase, as will related costs. Quality of life will decrease (including the general feeling of safety). Threats of addiction, labor uprisings, and extreme political differences will be deadly, exceeding "erosive." Rural System areas may not be as inviting as they once were or were planned. Terrorism will remain a topic as we address crime and potentials for equipment damage, forest fires, water pollution, and crop, food, or process poisoning by disloyal Earth-citizens.

I assume there will be large taxes on real estate, as well as personal property and corporate taxes. Land value will shift, increasing the need for Rural System services. We shall have to keep costs low to maintain visits and pleasant youth contacts for years later, when economic conditions may again change and they will return to rural areas.

I assume phosphorus will be available for growing crops. The supplies will decline,[5] prices will increase, transportation costs (energy dependent) will increase, and either new geo-strata will be found or oceanic-processed supplies of phosphorus will be created. Rural System will champion the use, recovery, and hoarding of phosphorus, and crop-rotation. Nevertheless, I assume excessive use of phosphorus fertilizers and its losses will continue. Some recovery will be made in water bodies and some applied to forests, but my assumption is one of disbelief and social apathy and the beginning of anomie. (There may be costly, contested extractive procedures ahead.)

I assume coal will become costlier as upper-level mines close, deep mine costs increase, safety problems increase, transportation costs increase, and expert demand increases. Regulated or not, there is little more coal of the right quality and amount that we can extract *and* deliver cost effectively.

I assume, based on a half-century of evidence, that a national energy policy will not be developed due to powerful competition, thus the energy crisis that is real and lasting at the regional- and community-level will necessitate personal strategies for gaining stable heating, cooling, and cooking. Rural System will participate actively in meeting these regional, community, and personal needs, including those for people moving back from cities to rural areas. People will move because their energy needs cannot be met in current urban settings.

I assume that people will move into communities or housing headquarters of Rural System's clusters to achieve improved quality of life and the many other gains as the current population ages. Changing needs for personal travel and small item delivery will move products and tourists from urban centers to community centers, some under Rural System management.

I assume gaining adequate human labor will remain a problem and that Rural System will experience continuing personal challenges to "invent" the new, intensive crop-producing areas or volumes needed on small ownerships (e.g., demonstrated in Western Virginia). I assume that

[5] "The exceptions—important resources which are not in inexhaustible supply—are fossil fuels (oil, natural gas, and coal), phosphorus, and a few elements which are essential in trace amounts for agricultural production, such as copper, zinc, and cobalt." The Population Bulletin. 1979. Population Reference Bureau. 34(3).

secondary benefits (other than salary and language education) will enable Rural System to employ adequate workers.

I assume that the rural emigration will continue with brief pulses of immigration by those who remember, who care, or who will find purposeful employment in enterprises within Rural System.

I assume that we have now gotten all that we can from farmers practicing traditional agriculture, being average, and eking out a family existence with rural yields as a second income. I assume that I can now make more than 10% greater annual income for them just by applying a set of recommended practices from the Cooperative Extension Service.

I assume that a 10% improvement in annual income will sound good to many people, but without knowing how, it is meaningless.

Rural System responds to the emerging world where being a break-even corporation is a desired condition, not one ripe for take-over or sale, but a stable one working well within society. We, the society, are endangered… and I assume that the government cannot/will not respond well or adequately within the time available before the convergence of two or more of the assumed forces. I write in *Rural Future* about what we must understand as *related*, and do together toward Rural System objectives.

A Rural County Tale

Bob Giles walked into a dark shed and stepped on the end of a garden rake. When the sparkles cleared, the following was what he saw.

Once upon a time, there was a county in western Virginia that got "down" on itself. It was like 50 other counties in the region sometimes called "Appalachia." People there said, "things have changed," but that was what Adam said to Eve. The mines closed, and the railroads lost their soul, addicted to gasoline fumes. Farmers were whip-sawed by subsidies, and farms were bought up and "developed." A little greed greased the reasoning that concluded that every acre should be worth the same as the top price of where any bunch of buildings was put.

People loved each other and more people had more children. Some families left, but others replaced them, and the population grew to about 5,000 people. That's not many people in a county of 330 square miles (about 21,000 acres). Take out all of the really old and really young, and there are only about 3,000 people that pay a bunch of taxes. Most of that money has to go to the schools. Half of three thousand votes is not enough to cause a state politician to even notice the county. It is really easy to "get down" on the collective "us all."

Folks complained about the county. There was poor soil (but some really good stuff and good climate). There were only two major roads, no airports, and no big industries. There was hardly a tax base… except the people. On top of all of this, 64% of the county was in the National Forest. The National Forest Service pays some money to the county to the school fund when they sell timber, but they don't do much of that anymore, and the small sum seems smaller now that the student body is larger—along with the conspicuous, new county courthouse mortgage.

As if in a fairy tale, people were moaning. A few were wringing their hands. "Oh, if we only had an industry!" Others said, "Oh, if we only had tourists!" Some said ecotourists could be good for them, and others said, "What's one of those?" Others just said, "Humbug," for they had land, saw no future for them personally, and cared little for the future of others. Babies could not spell "future," knew the world revolved around them, and hoped that someone cared a little.

"We can't ask people to fund the entire work of the county—the schools, roads, water, waste, welfare, emergency, sheriff, and courts." But we need them all, and someone has to do it!"

"Oh no they don't!" said a few of them in unison, and frightened, they moved out of the county. The risk of staying was just too great to bear. "We can't ask our neighbors to fund our needs!" said someone else, and everyone smirked because they were already doing a lot of that through state and federal taxes.

"Let's get a grant!" someone said. "Stand in line," said someone from far away at the end of the line. "We might get lucky, but I doubt it, and someone might put a coin in our tin cup, but then tomorrow we will just be in the same place we are today."

"We need industry!" said someone else, and there was rumbling agreement, like noise from a bear den. They had tried to do that. The effort had failed, mercifully, for the offers they had to make to the outsiders were high, current residents would be treated unfairly, the extra costs for services would have mounted, more children would enter the school system (which was already known to be one of the cost problems), and pollution (another of the cost problems) would invariably increase. The more people, the more houses, students, and runoff and erosion into Broad Run and Sinking Creek, the less beautiful the scenery, the higher the land prices, the

higher the personal taxes, and … "Hey! We better watch out what we wish for!" Sounds like a fairy tale we once heard.

Then someone said, "No fairy tale. We want industry. We already have a big industry… if we just saw it." All were puzzled. The National Forest was all around them, and it had always been that way, it seemed. The Forest was up on the mountains… all around. It was the Forest, and that meant trees, and, oh, yes, some hunting and fishing and forest fires. It was just "there," but had no clear image.

They listened for a long time as they were told of how a company had entered the county, hired some people, and began using the National Forest. The old ways, good "back then," hadn't worked. Something bold had to be done for the county and its people. Small changes and simple adjustments were inadequate. A new organization had formed—a for-profit company.

The company rented parts of the County and all lands of willing owners. Every citizen resident could become a member of the Craig County Collaborative, the Craig CoCo. It worked like the landlord of the citizen renters. Many became employees in the diverse activities of the Collaborative. Profits grew from 50 small, modern rural resource enterprises that made heavy, careful use of the National Forest within the County. It was as if the Forest was an invisible, giant industrial "shell-building," already right there in the county, already open and free for the taking and using. They had not noticed. It was so big! The agency did not mind, and even encouraged such use, as long as a small set of rules was obeyed.

For the new rural land Collaborative to be successful, the lands and waters would need to be tended very, very well. Years ago, that was called "conservation," but that got perfumed and made silly with too many interpretations. The point: profit can be made from the land if it is used while it is restored, managed, and well-maintained. Profit can be sustained and increased.

Combinations of other businesses formed, both existing and new ones. People invested in the CoCo and received proportionate dividends. Besides income and reduced taxes, the big payoffs for each of them was the ability to live in beautiful Craig, to proudly pay off County debts, and to improve the environment and to hold it—not to be sacrificed to a costly or polluting industry, or to be gathered in as bankruptcy leavings by adjacent counties.

The Collaborative had a new, but very old, idea. It was that the county—all of it, especially the National Forest—must produce goods, services, and relations for a long time—at least 150 years, the lifespan of old trees. In the same way that stable profits come from very diverse stock portfolios, stable profits can come from diverse, well-managed activities within the Forest and elsewhere in the county. These activities were well-known, but they had never been put together as they were in the new Collaborative. They had never been managed with the high technology and managerial abilities now available. The company did these things, and survived, later forming region-wide franchises.

The story continued. The County flourished. The population stabilized; the forests, watersheds, and streams improved; employment increased substantially; new educational strategies became nationally known; a public-health index went sky high, indicating better citizen health; wildlife was abundant, and management systems for wildlife became nationally prominent, as did a regional fishery. Bed and breakfast groups, rather than cookie-cut motels, developed to serve visitors. The county became known as "that ranging place," the major alternative to ecotourism. At the center of a dozen new organizations working via the Internet, New Castle was abuzz with business. Seeing the potentials on the Forest, private landowners asked for help on their lands, got decision power from the computer, and thus began

experiencing the nationally prominent slogan from the County: “annual personal financial gains from modern, sophisticated, rural resource management.”

Then the sparkles disappeared.

Chapter One

Change: The Nature of Things

I looked at the blood spot on my shirt sleeve. *When did I bump my arm?* I thought, *it must have just happened.*

I had a similar feeling about human population changes in Virginia. Many people have left and are leaving rural areas. When did that happen? Was I asleep? The population here has changed from 80% rural to 20% almost overnight! The rural population has aged, the children have grown up, gone to college, traveled the world, become electronically "connected" in several media, and have seen the salaries that non-farm-workers can gain.

Many rural areas are being left un-managed, with theft present. Superior farms and diverse populations persist, but hundreds of thousands of acres of once-productive land are now left by the urban emigration, in the hands of "absentee owners."

Rural emigration produces a buzzing hive of problems and herein I share solutions for the future. I'd like for you to engage in topics on which you might take some action in the future. I'm stuck, for I believe I have unwanted bad news for some readers, but I also have solutions to address that bad news. I face unwanted certainty (shared with me by international colleagues) of dangerous imbalances between global human population numbers and their basic needs, to be reached by about 2050 AD… just a few years ahead.

I've modeled population dynamics in my work with animal populations. I've studied and lectured about the needs for widespread human population limits among populations of over 190 countries.

In this chapter, readers can see a list of problems with which I am concerned; I believe all informed citizens may know about them, and already work in many ways to solve them. Many of the best solutions are beyond personal scale for any successes, but are targets for public, community, and other group work; some don't require much action, just STOP!

I have committed my time to **Rural System**, and I feel very insecure about giving an answer to what Rural System is. I fear the explanation will not be clear, and the book will be rejected because I may sound grandiose, ashamed at my inadequacy, fearful of omission, neglect, or pauperizing key concepts. Against recommendations of sounding far too negative, I must address the problems ahead, for those collectively are the justification for my suggestions, the context of what I share with you.

I urge you, the reader, to comprehend the beauty, magnitude, and complexity of the rural areas of Earth for all people, and to learn what's needed for managing these lands and waters for distributed human "good." I'd like for you to begin (and continue) work on food and water management subsystems for people for the future, to prepare *now* for the unbelievable threats *now* in sight… believable:

- inadequate quality and quantities of water for people in 2030 AD, when significant limits are reached, and
- imbalance in human nutrition supplies to meet world population needs by 2050 AD.

After *knowing that*, I'd like for you to pioneer a start of Rural System as described herein, or work toward creating key components of Rural System with a clear plan for union into the full system. The topic and concepts presented for you and your colleagues are numerous, inter-related, dynamic, and profoundly important. They are Earth-around, enmeshed within the E's of economics, enforcement, esthetics, energetics, ethos, and ecology. We must work with several, if not all, for the near future.

With notable exceptions, the history of conservation, even "the environmental movement," has not gone very well. We are still surrounded by soil, water, forest, wildlife, fish, ocean, air, and waste problems. That's the good news. Energy limitations and climatic uncertainties leap to the front of the line along with genetic alterations of the food we eat. Though great advances *have* been made, many by large contributions of funds and land, and by government programs, we must now face our climate chaos.

However, I've realized after teaching and doing research for 45 years that we cannot sustain a corrective program, much less a planned environmental-scale project. Now we have to provide *significant, evident incentives* to achieve the desired changes and lasting production of essential diverse benefits, even for survival, or preferably a high quality of life.

I depend upon readers to understand the scope and limits to uses of human population numbers, estimates of numbers in over 190 countries, numbers that are difficult to get, and all dynamic or changing in inconsistent patterns and rates over years. The US may continue a birthrate of 2.1 births per woman. 100 countries have birth rates exceeding death rates. A mix of other countries have a rapidly increasing birth rates, others decline… and nations worry about housing, food supplies, economics (markets), and other essential supplies.

The math of countries, populations, ages, death rates, births, health, and available food and medical resources… is together so complex that expert advice needs to be taken. Country leadership must decide for themselves, fully aware of the context… and that's Earth. The numbers are convincing and need action; we do not need to continue to increase the human population now, or soon. There are now more people than Earth can support, in the basics—food and water—without including needs for food quality, reducing waste, and improving health and the quality of human life.

Suggested for first-development in an eastern U.S. region, Rural System seeks to sustain long-term profits and quality of life for rural citizens remaining, and to contribute to diverse national needs. With financial gains from outdoor recreation, specialized tourism, and rural development, Rural System will benefit from innovative wild fauna and fishery management. Rural System will preserve selected areas, and practice modern agriculture and forestry to restore, enhance, and gain lasting, profitable production and marketing from the total rural resource base under lease from land owners under contract.

The proposed umbrella entity described herein does not now seek use of publicly-supported national and state lands and waters, but provides opportunities for the absentee owners of private lands and waters to experience profits related to superior land and water management.

While managing the assets of private lands under contract, Rural System provides related services and products from many unified business enterprises. A central managerial unit provides incubator-like services, and allows the corporation to harvest public research investments to achieve economies of scale and division of labor, to gain synergism, and to stabilize employment (and thus, local tax bases).

The Rural System enterprise proposes long-term, computer-aided, year-around private land management. It links citizens as well as visitors to the land and its long-term potentials for

profits. It provides an alternative regional identity, one of a place for modern, high-tech rural resource development and management for the future.

Successes are achieved via diligent work with personal incentives, diverse enterprises and products, and computer optimization of a total system. Rural System affiliates with and potentiates existing enterprises. It overcomes the old failures of natural resource management, i.e., diseconomies of small-scale operations, mixed objectives, lack of diversity, seasonal work and special events, lack of area-wide annual income, failure to market well, and reluctance to add value to products and efforts. It capitalizes on innovative uses of the Internet, global satellites, and computer mapping that can provide precision in site-specific work on ownerships throughout the region.

Similar influences can be transferred, years later, throughout Virginia and neighboring states, then internationally. The work will be recognized as the product of a special paradigm in comprehensive, diverse, dynamic rural resource management, including a profitable **Conglomerate** operating well past this century, given its **150-year planning horizon**, sliding forward annually.

More about Rural System?

It's a planned, startup company taking a systems approach to solving Virginia's rural problems (then expanding nationally, and internationally). It is like a business ecosystem for rural ecosystems. Rural System provides profit-oriented, lasting, comprehensive environmental management. It is a new use for some old, proven ideas. It's like a lawn-care service (but for many farms), and the lawns include 30 or more shops or businesses (selected from over 150) on or around them, all under one management.

Others have called it "a special kind of cooperative," "odd new share-cropping," and "factory management applied to lands and waters." There's more, and I once told the stories about it and described it in an e-book called *Rural System… Just Dreaming*.[6]

In a "nutshell," how would Rural System work to produce profits?

1. It will lease the lands and waters of absentee owners. Owners will receive a percentage of the annual profits of the entire Conglomerate. Their land and their region will increase in value.
2. Conveniently-spaced lands will be managed under contract in "**clusters**," achieving economies of scale and major efficiencies.
3. Lands will be analyzed by staff using a computer system called **VNodal**, with inputs from an extensive satellite and GIS database and our prescriptive system, **RRx** (Chapter 4).
4. Sequenced RRx reports will be provided that will prescribe—with GIS maps—startup work within each 10m x 10m square (**Alpha Unit**) of each property. The reports will be owner-specific, dynamically changing with seasons, land use changes, markets, and prices. It may be accessible from the Internet in the field, but will usually be produced by the corporate computer system to field receivers with an app. Backup information via

[6] Available at http://www.ruralsystemguide.com/A_Rural/TitlePage.html

hypertext will be provided for each **prescription**, so the full "document" may typically exceed the equivalent of 50 printed pages.

5. The prescription will be developed from conventional and ever-changing "expert system" processes, addressing what-to-do-where. Stage 2 referrals will be made to software that is specific for crop, livestock, forest, fishery, recreation, or other categories. Details from such computer runs will be added to the RRx report.
6. With owner approval, the **Land Force** (the major new employment unit being planned) will implement the prescriptions—preserving, restoring, cultivating, harvesting, monitoring, and adjusting.
7. Marketing will be one function within **System Central**, where personnel, accounting, and related text and data will also be handled, with results presented for the 150+ enterprises that are like "corporate divisions" within the planned Rural System (listed in Appendix 1).
8. These enterprises, called **Groups**, when active, will change each "farm" into "**enterprise environments**." The land, re-developed, will become available for use by people with memberships to Rural System Groups (such as those with interests in gardening, turkey, quail, bird-watching, deer, bear, bobcats, nature study, owls, etc.). There will be other Groups not "of the soil," but will be for general memberships and services (e.g., poems, music, photography, and laboratory)—income from many sources.
9. Rural System will be hyper-attentive to reducing losses and risks, providing financial incentives for all, and employing advanced social media marketing technology. It will benefit from low structural capital investments required for each Group.

What is Rural System's target market?

"Markets" are seen within Rural System as human populations of buyers, users, and waste sources and energy loss. The goodness of many ideas must be seen as being evaluated by the number of interested buyers and what they are likely to spend. Marketing or using markets includes:

1. analyzing individual and group wants and needs,
2. advertising with new options and alternatives that are now or may become wants and needs,
3. increasing desire for needed things for the near future,
4. finding innovative ways for Groups to satisfy these wants and needs,
5. stabilizing purchases, and
6. harvesting and reducing losses of crops, energy, and market access and brand.

We have two main markets: first the *land owners*, then the *buyers* of the goods and services of the lands being managed. About 40% of US agricultural land is in absentee ownership.[7] Some of this is rented out to farmers, other land is owned by corporations. Owners, often living far from their land, seek visitation, recreational use, pride-of-ownership, speculative

[7] Bigelow D. Land Use, Land Value & Tenure [Web]. USDA Economic Research Service. United States Department of Agriculture. Available from: https://www.ers.usda.gov/topics/farm-economy/land-use-land-value-tenure/.

objectives, and modest income. Rural System plans to offer these benefits, plus financial gains made annually. It also provides a public relations opportunity, and potential long-term social contributions of energy, water, food, and quality-of-life spaces for people of the region. Rural System's first proposed customer base is composed of the people of the Roanoke and New River Valleys of Virginia, using the lands brought under management. It will expand to meet other regions' needs and opportunities. We shall seek a volunteered demonstration farm.

Rural System will target the people of the Roanoke and New River Valleys of Virginia, and later expand to meet other regions' needs and opportunities. Within a 30-mile radius of Blacksburg, VA there are about 800,000 acres within private absentee rural land ownership. Our goal is to manage over 1/3 of these (260,000 acres, 370 owners, 40 clusters). Many are abandoned, abused, and victim to theft and vandalism. We may preserve parts, but we intend to manage forests and develop other lands for a variety of Groups (e.g., floral products, tourism, music, memberships, events, sports, a modern fishery, pest control, certification services, and wood). We plant new forests, crops, and tree seedlings. Significant income is expected from the non-field enterprises (see the list of proposed Groups in Appendix 1).

The owners market is expected to increase; the owners are continuing to leave the lands for the cities; few people now have enough expertise or youthfulness to farm.

Once Rural System begins to produce goods and services (and other benefits) using resources from enterprise environments, we shall target the buyers of these goods and services. This second market is composed of urbanites and local people. They are the potential clients of many of the Groups. Some guests will buy memberships, others will use the land (e.g., hiking, nature experiences), or purchase products.

How will Rural System make money?

We shall create and operate a Conglomerate of Groups, and a new Collaborative among our Groups, clusters, and affiliate-private-enterprises. We shall bring solutions—system processes—to rural problems, including incentives at all levels, new economies of scale within clusters, synergism among Groups, a new scope of operations including blogs and related media, a sequenced value-added strategy, diversification, and arranged synergism. In addition, we shall pay special attention to losses and inefficiencies, computer aids and optimization, enormous data banks, and access to research results. We shall build on today's platform of agricultural, forestry, fisheries, and computer expertise for the future.

We have to stabilize significant, observable profits for people from the lands and waters of rural regions. "We" now symbolizes "all of us," and all of us now see "all of us." From seen-inequity I believe billow the clouds of war.

The proposed Rural System is a for-profit corporation of over 150 diverse, small, natural-resource-related enterprises and subsystems, some of which are new, and some, such as classical agriculture, very old. The corporation, often a Collaborative in some areas, will provide modern, sophisticated, computer-aided management of the lands and waters of clusters of private farm lands and waters.

We seek a $7 million line-of-credit for progressive use and repayment within 7 years, to invest in leases of land, staff, and productivity from a growing number of self-motivated, computer-backed Groups working for future Earth-around franchises.

Creating Resources

There's not enough room within a first chapter to get a running start at a very big idea: that readers' very existence depends on the lasting production of benefits.

Rural System has a twist on natural resource management that may enliven it, the enterprise, and its influences. It *creates resources*. Resources are, perhaps narrowly, defined as, "reserves of commodities that have an appreciable money value to people."[8] Endangered species are not resources by such a definition. We accept the definition of a resource being something capable of producing *benefits.* A non-resource may seem to have no value, but some economists assign monetary values to benefits of many kinds.

We find ready examples of each benefit within rural areas. We influence value by education, marketing, and field experiences. We produce potting substance from managed forest litter, waste food, and native earthworms; garden mats from pond algae; household items from diseased tree tissue; buttons from dropped deer antlers; toys from several items; crime prevention from solar-electricity; and decorations from hunters' deer hides. We enhance the value of local paintings, the significance of local songs and dances, the meanings of some wood carvings, and the value of special working-hours toward measured, purposeful accomplishment.

Appreciating fundamental resources, within Rural System we *create new resources,* give them a brand, and attach and increase value to them in our conservation, protection, and marketing. We change the time required to perform select activities, improving efficiency, thus providing an item or service at a reduced price with exceptional reliability and resilience. For every yet unknown songbird, mammal, wildflower, community or composite, each safe cavern, each basic soil type, we offer a "discovery sport," like that of BirdGolf (Chapter 10). We accept, appreciate, and attempt to produce abundant pure water and clean foodstuffs (still highly valued and to become more so) on managed lands.

When asked about Rural System and what it is and might do, the list of components and actions becomes tediously long. Parts, some life-giving, are neglected for the larger ones, such as automated soil mapping for each subscribed private ownership. We have procedures now for organizing knowledge of each 10m x 10m Alpha Unit, or map-cell, of every farm in a Virginia region. Each Alpha Unit is known by GPS location … and so, as if a medical doctor for each patient, we can prescribe for *each* such space: fertilization, best plants, planting timing, likely harvest time … and many more such agronomic factors. Almost impossible to imagine, we examined one 200-acre farm, and discovered there were over 8,000 Alpha Units…and Alpha Units are the basis for a knowledge base for the future, and for developing models for other private ownerships as each is gained. The uses for the future are unlimited!

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The mathematical concept of "combinations" once seemed to need refreshing, to use in deciding something for modern crop agriculture. I needed to know how to determine how many combinations of crops I could put into major garden-land left by an owner who had migrated to the cities. I started slowly, but the list of possibilities among plants, animals, and environmental factors ballooned.

If a list of 6 crops is computer-selected for a site, how many combinations are possible? I need to know and then to select some to be profitable to achieve the Rural System objective. I need to know and to move that to: *what to produce of x amount and y value of crop z expectation*. The combinations of 6 come from the ancient equation for them. The results are

[8] Ehrenfeld DW. 1976. The conservation of non-resources. American Scientist. 64:648-656.

always surprising to me, but more importantly, I am always perplexed. How can I pick the *one* right combination from so many? I take courage, knowing of computer power.

Then I faced *permutations*, hardly remembering that those are a class of combinations that relate to the number of *sequences* of things. How many sequences, not just combinations, are possible for 6 units? .... The number, to me, is impressive, because that is the real number, the *ancient factor* with which the modern ecologist and environmental manager must deal (beyond classical statistics in which A, such as a factor of soil studied, is then related to water, then wind, then trees, and they are put into an analysis hoping for an equation for explanation or prediction such as: X = A + B + C).

The hidden, oft-forgotten or prayerfully-considered irrelevant part of rural land analysis and management is the *sequence* of the factors, *the permutations*. The permutations of a dozen ecological/environmental factors taken 2 at a time are 132! Imagine the costs of gaining adequate, statistical control where there are more factors than 12 sequenced units! Yet, they lead to robust decision making.

Every farmer knows the difference that results afield if rain comes before or after planting. Throughout ecosystem studies, these paired differences (also triplets and others) in sequences are just as evident. In Rural System, we propose work with computer power to bring the *ancient factor*, permutations, back into play for producing realistic, lasting profits from *all* of the main relations in the rural communities. We work to bring deserted once-farmlands under superior, long-term management … for the good of us all.

The Wicked Problem

Stating objectives is a major part of taking a systems approach to anything. Understanding a system usually includes "As compared to what?" questions. As I write *Rural Future*, I feel compelled to share with you my interests, concerns, and orientation for your reading ahead. I'm not presenting a draft for a multi-color, TV-Bombing, fear-monger conjecture on the "falling sky."

I am not alone, and do not understand why others, however few, do not see or understand the threatening world conditions that jeopardize regional, national, and international human lives of the future.

Problems seen! Avoid them! Seems reasonable? *How to do that* is more difficult to see, and to decide upon which problems to address solutions. Worse, we need adequate, timely responses to their *combinations* and *permutations.* The problems are so numerous that listing them seems necessary to justify the enormous, extreme-sounding, perhaps unique solutions I have devised as a response.

There just have to be one or more superior solution-options to each of the following "problems" (within a set, *the* problem):

1. Multi-factored global food shortages
2. Continuing agricultural soil erosion
3. Spreading air pollution effects
4. Growing noise pollution
5. Disappearing wild plant and animal species
6. Increasing invasion of harmful plants and animals
7. Increasing negative results of genetically modified organisms

8. Increasing shoreline erosion
9. Declining quantity and quality of groundwater
10. Coastal cities in danger from storm surges and salt intrusion into groundwater
11. Approaching economic limits for coal removal and land restoration
12. Increasing harmful fracking effects on surface waters
13. Increasing numbers of badly impaired streams
14. Expanding broad-scale range and acreage of forest fire
15. Diminishing natural and agricultural scenery
16. Spreading limits to fossil fuel discovery and availability
17. Inadequate land and water restoration
18. Increasing ocean pollution
19. Increased heavy-metals pollution (widespread)
20. Increasing imbalances in marine fish populations
21. Notably increasing urban sprawl over productive, prime farm land
22. Continuing misuses of toxic substances
23. Declining supplies of essential crop fertilizer, e.g., phosphate
24. Increasing need for waste disposal sites, especially nuclear waste
25. Overuse of designated wilderness and wild areas
26. Lack of proper outdoor behaviors (dangers, harmful acts, care of followers, defacements)
27. Restoration required for hundreds of acres of lands and waters, related to energy-resource removals
28. Competition for limited resources between natural resource management project leaders, with limited objectives
29. Predicted climate change (affecting over 7.4 billion people) related to increasing carbon dioxide
30. Inadequate time to address, solve, and distribute the solutions to most all of the above

Dr. Philip Handler, when President of the National Academy of Sciences, said:

> Just as ecology is too immature to cope with our vast environmental problems, the social sciences are too young to cope with our most pressing national and international problems—terminating the war in Southeast Asia, establishing a stable permanent peace, learning to deal with political terrorism and the challenge to the legitimacy of government, achieving a successful progressive modus vivendi in our racial problems, coping with violence and crime, reconstruction and management of large cities, curbing the drug culture, developing an adequate system for the delivery of health care, abolishing poverty, illiteracy, and ignorance the world over—capture for us now, and soon Earth around, our wicked problem.
>
> Ignored, it cannot be denied. It is not at all obvious that we have the understanding or the social and political institutions to deal with these furious

> challenges—but seek them we must. Meanwhile, the long upward struggle of people from animal origins affords little more than cause for hope.[9]

I believe Rural System is a feasible "place" from which to move rapidly toward a general massive challenge… face it we must; gaining awareness of the immediate threats ahead is necessary, instead of believing that other people or agencies can and will solve them within sufficient time and available resources.

The wicked problem: informed rational management of Earth and its people, forever... now knowing it is possible, and the incomprehensible scope and depth of likely sadness in knowing it was not attempted.

We have to gain awareness of the immediate threats, then confidence or risk-taking energy to face those threats. We must then invest personal time or other resources and believe that other people and agencies are willing to do the same to solve these problems within sufficient time and available resources.

Desperate Hope

For most of my career as a natural resource specialist and university professor, I was involved with the pieces and parts of lands and natural resources. I taught systems ecology for 25 years. Over a period of 50 years I worked on understanding the content of this book, a practical union of the 6-Es of professional life today: energetics, economics, esthetics, ecological, enforcement, and ethos topics for people living in, investing in, and visiting rural areas. I now see clearly a singular working system that I think is essential for people, and I am eager to share it… for in my life I did not even notice… 80% of the people of the US, once rural, have now become urban! Amazingly, 20% of the nation's people are rural, many absentee. World populations head toward 60% urban! How can it not be noticed? Rural is urban-essential!

I started dedicated work on these ideas at age 70, but I began to realize that I did not have the energy to see through the creation of the enterprise that I called Rural System. I decided to write my dream. Perhaps the limitations can be corrected and the next workers can get the job done.

I woke up from a deep sleep about rural areas and their people. My task is to answer a growing set of related questions. What do owners do with a lot of land that they bought years ago in order to mine coal, now that coal is running out? What do you do when you live in an area, work there, and love the place, but the *work* runs out and salary potentials are cut in half? What do you do as a rancher when the meat prices plummet… or as an administrator when your park budget is cut? What do you do with "family land" when you move to the city or into the "home"?

Simple statements are often given as answers to these questions. You can tally the land as a loss like a piece of depreciated equipment, get all that's left, survive "as best you can," or move out. Of course, you can pray that something better happens, but, with The Reformation's Martin Luther, I suggest praying as though God can do everything, and work as though He or She can do nothing.

People are all linked together, but it is rare that we think of how closely. We all need each other—firemen, paramedics, teachers, journalists and reporters, grocers, painters, janitors,

[9] Handler P. Can Man Shape His Future? 1970. W.O. Atwater Memorial Lecture. Washington, DC. http://files.eric.ed.gov/fulltext/ED050955.pdf

snowplow crews, and doctors and hospital support staff. Hard to admit, we even need a friend or two. We need them all as part of a reasonably healthful life together. We need to talk together, to listen and encourage. Things easily fall apart when one or more friends move away (a much-shared observation).

When it's time to move, when the resource runs out, perhaps land can be sold to someone else. But who would buy it, and for what uses? If you knew, you'd stay and develop it for the same purposes and uses! You could sell it to the government if they were buying (that is now rare, and as if “they” were not "us"), and they could add it to the National Forests, the Bureau of Land Management, under-budgeted National Parks, or even military areas. Such action is not part of the free-market or of the American capitalist message. It may be all that seems to be left, but this book is about alternatives for people who love these areas and want desperately to live on or experience them. It is about alternatives for urban people who badly need vital, working rural areas with their wonderful human component… and essential resources.

We, a large part of society, have lived city life so long that we forget the rural sources of so much food and water, so much useful energy. Around the world there are rural problem areas. Mining areas are commonly affected. The manufacturing plants have shut in some areas. Lumber mills have shut in many small communities; most of the large and so-called virgin trees for wide clear lumber are gone. North American Indians continue to wrestle with life on some lands. Prize crops throughout the world (tea, coffee, tobacco, and bananas) change in price, use, or acceptability, and the people that planted, grew, harvested, and shipped them are stressed by the changes.

In a few areas, the land has been eroded and so improperly used that any future use seems hopeless. As a particular example, drastic changes have taken place in the Virginia coalfields. The changes coincided with the fall of the Berlin wall, NAFTA, the European Monetary Union, GATT, the Collapse of Communism, new wars, gasoline shortages, the loss of many travel and trade barriers, the passage of many environmental laws and regulations, the emergence of knowledge about "green gold," and the rise of the Internet and e-commerce. Not just jobs in mining but jobs everywhere are being rapidly transformed, downsized, streamlined, or made obsolete by technology, shifts in buying power, and high costs of life-sustaining medicine (*and* the perceived needs for medical treatment vs. problem prevention). The questions are the same. What do we do? Where do we go? Some people answer while plunging into poverty; some people climb into comfort and apathy. What can be our future?

For thoughtful people, since no one can believe the expected and foreseen horrors of the now-developing future condition, the question is, “tired as we are, how do we get ready for the next big change?” For example, what do we do now just *before* the profitable coal runs out entirely? What can we do? On the horizon, like two skipping children, water *quantity* and *quality* around the world head toward crisis shortage conditions in 2030 AD. Earth-around food shortages are foreseen for 2050 AD. I write to share my best knowledge and advice fearfully, and seek your advice… other than that termed “spiritual.”

Coal has already run out in many areas. People have exploited the resources (fish, oil, gas, trees, and soil fertility) and the land is left behind. Natural gas may be costlier than expected. Some people never got ahead, so they didn't notice that they were behind. The rural population still increases with the total, but they are far behind urban population growth. The nation is now about 80% urban, and so about 20% of the children of the US are in rural areas. Fourteen million of them are in need of education, protection, relief from hours in school buses, and their accidents prevented. They bother me and my family-inspired senses of fairness, being

"kind," and grade-school pledges of "justice for all." The land and the people that remain are in trouble; the people that see their struggle are in pain. Averting my gaze from little children who suffer causes me pain. Everyone suffers.

It would seem that government should be able to help. Yet members of local boards are stressed; their time is poorly allocated. People that are on the move in troubled areas rarely produce many votes for regional legislators. Loyalty to “place” shrinks when families move out, urban-enticed. Agency staffs are now reduced in size, inadequate to address the complexities of most sites. They are totally unable to visit the thousands of private and public sites throughout regions needing specific, prolonged, thoughtful attention. People in trouble have no resources to help themselves. They are in trouble! They need help from outside!

Agency interest or delivery of services, influenced by leadership, funds, and political pressure, seems to become fickler each day. The university professor, expected to "do science," now lives with no funds to develop a research program in an era of unplanned and unstable grants and contracts. There has to be a better way than begging or waiting for nearly random gifts to solve pieces of noted problems.

There are no easy answers, certainly no acceptable ones for the people who know and love a place, have family and roots, and have advanced age in a discriminating, youth-loving society. There is no clear place to move to. Everything seems "full-up," pricey, too new, and very uncertain. “What to do?” is the question repeated in despair... Not profane, they ask, “what in hell are we to do?!”

The answers are especially critical in the rural environment. There are about 1.3 billion acres of privately owned rural land. Currently, more than 1.9 million acres of land are converted to residential development each year. There are a mere 2 million family farms left. Forty-four percent of farm land is now owned by non-farmers. That suggests that there has to be a major shift in knowledge of the land, but it also obscures concerns and potential investments for the land and its productivity.

In Virginia, for example, 60% of the 25.4 million acres of the state are in commercial timberland. Of that, 80% is privately owned (not federal, not industrial). The state has a $3.3 billion tourism and travel expenditures enterprise… and 15% of the entire work force of the state (248,000 people) depends on the forests… yet most forests remain unmanaged with harvests unsupervised. The highly-valued tobacco crop has lost its value, and farmers of those special lands and traditions now seek an alternative crop… just anything to stay on the land of their parents.

The rural lands and the people who feel responsible for them in some way are under intense pressures. These pressures include uses for residential development, new services, changes in the beauty of the landscape, shrinking tract size, loss of a sense of place for many, conflicts between energy and water uses, continuing soil erosion and its consequences, and changing wild animal populations, some threatened, others becoming so abundant as to become pests and potential disease vectors.

I have answers for many of these questions and problems, unified and presented in the following chapters of *Rural Future*. I have to be confident (even if it sounds arrogant) for if I am not, the solution, the answer, will float away in the vapors of ten “devil’s advocates,” a hundred committee meetings, a thousand “buts,” and ten-thousand bright graduates, not yet mastering a university library, saying or thinking, "my opinion is as good as yours."

Industrial agriculture, claimed by some to be the rural future, will not grow tall enough from deep in its recent past failures of massive soil erosion and degradation, pollution by

chemicals, atomic waste, animal-factory wastes, depleted aquifers, spread of pests and animal diseases, cruelty to animals, and exploitation of laborers. It quakes before genetically modified organisms, as does the adequacy of the national food supply system before the threat of acts of biological terrorism.

There's a need for a departure from conventional ideas about the future of Virginia's mined-out southwestern corner, North Carolina's textile and tobacco areas, the forest communities of the Pacific Northwest, and the desert lands of the Southwest. A "departure" does not mean that people must physically leave the land. The need is to move into a new realm of thought and action. The move will not be easy, but it is very clear that doing nothing, which is pretty easy, will not solve the problems or reduce the sharpness of the pain that some of us now experience or see on the near horizon.

We need a different way of doing things, a different way of thinking about ourselves and our future, a way to work together. We need a new way of seeing ourselves as the center of a vast, important activity: Rural System.

The departure does not have to be radical to be good… It so happens that the only good one on the horizon *is* radically different. I've spent 40 years wrestling with graduate students and their rich imaginations as they spent time reading and studying. My past, my loyalties, and my knowledge trapped me. I was dedicated to improved natural resource management for people. I was called one of the "environmentalists," but I've seen some of these limits, errors, and destructive behavior. I saw my specialty as being wildlife management, but that quickly blurred as I realized that everything else in the world, everyone else, was in control of "my animal populations." I was not managing them. I was far too small for that, much too narrow. Wounded, I've escaped over the professional barricades.

When I was a small child, my great uncle, a railroad man in Lynchburg, Virginia, would encourage me to eat as he spoon-fed me and would say, "fire the boiler!" I think he would like a railroad analogy of the present situation. Imagine that in the rural area there is a great rail yard, full of quiet and still rail cars holding ideas, information, research results, theories, and assumptions. It is time to pull out the needed cars, inspect and hook them up, and move them off to a destination where their cargo is badly needed. The railcar difficulties are evident, but railroad people make such moves daily. It's time to fire the boiler.

A Few Stories

Rural System, said to be cold and difficult to understand, may be warmed by a few brief stories for the many ideas ahead.

Good Morning

The crew of 8 men and women appear under the roof of the office shed at 8am. They all wear similar shirts; their hats seem the same (but are all worn differently). A 3-minute safety lesson gets their interest with a demonstration and a YouTube video, shown on a large screen. Two crew chiefs are handed instructions, prepared by the computer "brain," VNodal. Likely work, feasible for the day, includes trail maintenance, timber thinning, sign replacement, and entrance-gate repair. (The area is open to vehicles only on announced dates.) The thinning is specified by Alpha Units, the unique 10m x 10m map squares, and located by GPS. After questions and equipment collection, the small vehicles are boarded and the staff go to their tasks. One discusses a new way to thin on the site, another contributes discussions of alternative uses of the downed wood.

Jane's Place

Jane had just inherited her parents' 70-acre farm land. She had loved the place as a child, but now she had a family, lived 200 miles away from the tract, knew nothing of farming or forestry, and her finances were tight. She took the advice of a friend, called Rural System, and after discussing her preferences and completing forms, leased her land to Rural System. She was given a book and special website access, describing the land and providing monthly reports of the changes and gains being made toward comprehensive management.

She read that forest growth was carefully marked to balance harvest with growth, carbon capture, and wild fauna benefits. A new hexagonal pattern of trees emerged; trails were built for many different visiting groups and winter-snow activity for visitors; a small, cove-shaped area was smoothed and decorated for visiting groups. Signs near the stream told of a music and poetry group related to the property. A pond was built to complement other nearby contracted ponds; a trail was constructed to ease the trip to a small platform from which the staff regularly analyzed the pond for maximum fish production; a blueberry patch on the ridge matched the site-selection criteria for optimum production of quantity and quality of blueberries; four different types of gardens for VitaLife wine grapes were created, one next to a re-built house for visitors.

At the end of the year there was visible production, much activity, work for local people, funds added for the nearby town, and, throughout the area, principles of energy conservation, soil improvement, erosion control, and profitable marketing were evident. Jane was delivered a substantial check, and local workers gained salaries for year-around work; the town business owners seemed happy. Rural System continued slow growth from some of the financial gains.

Joe and Lenoir's Place

Not far away, two people who loved each other and loved their land faced their age and illnesses and applied for assisted living. They contacted Rural System to gain comprehensive

management of their land while they were gone; they expected to visit often. They set many limits and stipulations on what could and could not be done on their place. A computer simulation would later show them the consequences of each decision on their profitability.

Under Rural System management, the land was beautified, bare places healed, erosion controlled, riparian vegetation developed for stream quality trade-offs, and the murky pond revitalized. Websites and social media proclaimed the advantages of the angler resources within the 5 closely-clustered ponds on the property.

Rural System Land Force created gardens along the pond edges. Rain gardens, storm-water controls, and groundwater addition units became evident throughout the area. Squirrel populations were favored in trees over steep slopes; mushroom booms were cultivated at trail edges to secure soil, and provide access to the crop; the trails provided access for the hunters and visitors who came to see the property.

Joe and Lenoir harvested a percentage of the money made by the total System. They retained complete control of their land after joining the Collaborative. They frequently visited their land, and participated in some activities, such as fishing. They joined a meeting of RuraLives, a Rural System Group dedicated to preserving rural life memories, and attended a Challenge event one year, a fair-like competition showing feats of strength and endurance with rural objects. They watched gardens of vegetables emerge, soil organic matter enhanced by legumes, crops of nuts thrive, and pesky road problems quickly disappear. The increase of their land's value far exceeded first year produce returns. Delighted with progress, they donated their land, with family-name signs and publications, to the Rural System Foundation (a nonprofit) for continued use to the same good ends.

Chapter Two

The Objectives and Approach of Rural System

Central Appalachia, part of the Appalachian Regional Commission area (a project financed for years by the government), is home to hundreds of rural families, reeling under mine closures, with inadequate medical care, required to travel miles to limited urban jobs, offered limited educational opportunities, and having sparse social services such as piped clean water to residences.

People of the region are in need. Those around them know they are in need and suffer with the knowledge, powerless to help. Large numbers exhibit addiction (over 16,500 in the New River Valley region[10]), victims of helplessness and/or hopelessness. Rural residents are aged, rural youth have moved to cities, lands and forests are often overused, advanced medical care is limited, and wellness is affected by poverty… or the anxieties and instability of available employment, such as mining.

Enough analysis and identifying motives for action! Analyses already go unappreciated. The people of the mountainous region close-by need jobs; job access; education for next-stage job access; general socially- and economically-relevant education; access to medical instruction, advice, and care; abundant clean water; release from poverty; and a positive view of the future. Remaining farmers, now elderly, need financial system improvements, stability, and access to assisted living. Land and water ownerships need significant, low-cost help for the future of the owners around them, their families, and the region.

These people and the citizens of the US and Earth need modern, planned, adequate food production, and new services to improve water quality as well as quantities in the significantly changed mined areas and residual oil, gas, rock, and earth volumes.

In 2014, I found an appropriate preamble for Rural System. Egerstrom, in his book, *Make No Small Plans*[11], said, "The time has come to find new structures for the ownership of production facilities and to build job security through employee equity stakes in plants, urban and rural." Later in the book he wrote a fresh call "... for cooperative action in rural America at the start of the new century." I agree. He wrote, "Rural communities, townspeople, workers, farmers, foresters, and tourists are people together for whom we must explore starting a new generation of cooperatives and new cooperative ventures."

We said it independently! The need is for a comprehensive system to address the wicked-problem discussed in Chapter 1, and that requires a precise objective or *set of objectives*.

Though similar, the differences between objectives, outputs, and goals are all-important within systems—more than just a matter of perspective. In some rural areas, there is high corn output—bushels of it. The farm family may be very happy if this volume of corn is high, the

[10] New River Valley Community Services. 2016. Annual Return on Investment Report. 2(1). Available from: http://www.nrvcs.org/wp-content/uploads/2016/01/nrvcs4x-2016-january.pdf

[11] Egerstrom L. Make No Small Plans: A Cooperative Revival for Rural America. 1994. Rochester, MN: Lone Oak.

equipment running, and the workers easily collected. System *output*, corn, is good if conditions are right. The right condition desired is decided—probably a high final sale price for the corn.

The difference between output and objectives is whether there is a clear objective—clear values and benefits, desired outcomes, or simply expected activity. The difference between efficiency and effectiveness is that the latter relates to how well a set outcome has been achieved. A person can become very efficient at some task, but if it is not achieving an objective, or *desired* outputs and profit, it is probably not in the best interest of an employer (no matter how pleasant the work is for the employee).

The scientist using a systems approach typically looks at things in nature without objectives, just to learn about what's present, how it works, and how it differs from something similar. *Description* is of high interest at this stage. The system manager usually has an objective and then compares results of a project or operations to the objective, or some desired condition or outcome. Of course, a thoughtful person, scientist or not, will be seeking "purpose" —a mission, target, or named fundamental base—and the words can and should be adjusted to ease communications. The basic difference:

An **objective** is a desired state based on analysis or design.

An **output** is not necessarily a desired state, just an outcome. (Some outputs of a system may be very unwanted!)

Goals are used synonymously with *objectives* in other fields of study and work. I believe there are seven types of objectives, and that these have caused the lasting discussions about the proper word usage. I avoid using "goal," for it seems too often to bring unnecessary discussions into the work of Rural System.

I hold that clarifying objectives is fundamental to taking a systems approach to anything, especially the environment or the natural resource complex. Those working within Rural System assume this is necessary, because *only by chance* might natural processes and conditions achieve an optimum condition in one year, much less remaining optimum over an extended period. Nature is dynamic—even more so than human objectives—so a perfect match between conditions and perceived needs, extremely rare, is likely to be for only a short time. *Management* means controlling a system to achieve human objectives in a timely manner, or within other limits or "constraints," indicated here.

Objectives can easily be expressed in the favorite terms of some economists as "goods and services." That pairing may have been a good way to think of human needs and markets in the past, but now we are *now*, and the alternative concept of ***benefits,*** within Rural System, will serve well now and for the future.

I have identified 11 classes of benefits:

1. Products
2. Services
3. Opportunities
4. Views
5. Information
6. Ideas
7. Inspiration
8. Events
9. Memberships
10. Memories

11. Time

We know about ecological services, argue with the scope and definitions assigned to those services by various authors, and work to achieve and enhance those properly named. We know how to protect ecosystem services, restore those lost, and safely exploit them.

"Services" may be an improper or inadequate analytical category. Services are probably like animals breathing; without breath, there is nothing—no life. Not the action, but the final structure or function is the measure; work, life, the animal itself is what has importance. Services of ecosystems are similar. There are many concepts that can be used to describe parts of ecosystems, but the valuation must be of the entire thing... not services *within* ecosystems but the work and function of the entire thing.

Services prescribed by Rural System have often been provided by state and federal agencies. Many of these services have been delayed, insufficient, and inadequate in the past. Some have been very expensive relative to perceived benefits. Some have led to high productivity in falling markets and thus financial ruin. Many essential services, formerly performed by government agencies, have been removed in changing administrations, regulations, laws, and policies. The best forms of American entrepreneurship and capitalism step in to fill these voids.

Services need to be expanded to opportunities; or at least, opportunities must be included within services. Managers can provide (or restrict) opportunities to *experience* a resource. They can influence opportunity to *possess* an entity or a resource or its part. There are changed opportunities (perhaps options that can be bought and sold, and preserved for the future) to visit, observe, share, or learn from natural areas. The coins of the transactions—the animal, the board foot, Christmas wreath, or visitor-hour—seem small and quite unlike those benefits in the above list, but these opportunities can usually be used over and over and with care, without depletion.

"Products" or "goods" are well-known and easy to list. However, Rural System exists to perform services that improve employment, community stability, and improved long-term natural resource benefits, especially those from research results that can utilize the power of the computer, the Internet, and other high technology. In the context of an operational Rural System, we find most of the classes of benefits listed above.

Most classes of benefits are dynamic. All classes can be discussed, perhaps programmed as being "constrained," i.e., having actual or prescribed conditions of "equal-to," "less than," or "greater than." We can demonstrate the advantages of simulation and optimization, moving us all to the positive side of the economic "margin" as we seek constrained, multiple benefits. Time is rarely treated as a resource or *benefit*. It might be *time* to start.

There are five objectives for Rural System action, limited toward achieving benefits, of the classes listed, within the typical rural region.

Objective 1. Esthetic and Historical – Achieve and enhance the history, beauty, and future estimates and interpretations of the rural region.

Objective 2. Salaries – Provide meaningful work and related salaries for our local workers within our interrelated businesses.

Objective 3. Communities – Provide funds and strategies for stabilizing small rural communities, with adequate related educational, protection, and social services. Aware of the risks of hopelessness (i.e., addiction), we add to our communities:

1. Hope for the future beyond the urban borders—hope for understanding, and an adequate rationale for re-creating and tending the future rural systems for minimum quality and quantities of managed water and basic food within a sharing society, within each nation.

2. Hope for benevolent parents, bringing their every child to fullest humanity within well-managed environments of wisely-allocated food and water—from intensely-managed, lasting, and fairly-allocated essential resources of Earth.

Objective 4. Land Health – Restore, enhance, manage, and stabilize high natural resource production of human benefits over a very long period. Achieve and stabilize, on Rural System lands and waters, high Rural Environment Health Syndrome indices.

Objective 5. Studies – Conduct practical, profit-potential-increasing studies.

This is a multi-objective set, *unified by an index of annual profit*; that profit index is bounded, or constrained, by pre-determined high and low levels, over a period of about 150 years.

For any enterprise to publish objectives is work in treacherous territory, but work gets even more dangerous the less precisely stated the objectives. We offer these five objectives to our potential clients, land owners who have moved to the cities. These are the owners of lands where all of us hope for—and some find—scenery, historical attachment, wind abatement, pollution diluted by clean air, groundwater recharged, wild flora and fauna preserved, and hunting and trapping that is well-regulated for the future. These are the lands growing fruits and vegetables for a low-energy-transportation-cost future—managed land, whereon erosion is subdued, water purification increased at low costs, and the carbon of the atmosphere captured and restored to standing trees and their soils. For each land ownership, together, we share the same objectives. We know where we're going and we'll know when we're there, holding fast, with *objectives* our basis for stopping and for making adjustments.

Diverse resources of Earth are well-known and acknowledged. Within Rural System's software system, VNodal, we shall quantify all resources and daily compute the profit index, compare it to our objectives, and express net gains within high and low bounds. VNodal's working estimates of natural resources will be provided for Group leaders. Board members, advisors, and landowner participants (stakeholders) are also sent timely, approximate estimates of probable costs and benefits for management actions. These estimates include a fairness index, a political-necessity index, and a set of risk assessments relating to:

1. financial losses,
2. human deaths,
3. diverse or abnormal disease abundance,
4. documented threats, and
5. reduced distributional gains within the region, i.e., negative effects on the poor.

We emphasize our objectives as we study and discuss maps of a western Virginia region, learning of the context for the 7 coal-field counties now undergoing radical change. We shall start in Blacksburg, Virginia, anticipating a shift within a few years to the pine forest areas of south-central Virginia.

Using available maps, databases, and addresses, we plan to contact land owners throughout the east-central areas. We shall work for cost-effective data collection on natural and

built features, early system development, and extensions for intensive use as we move westward within the state (and eventually beyond state borders). Owners will be contacted via mail, social media, local advertisements, in-person meetings, and local radio. A growing, owner/family/corporation database will be built by the Lands Group in cooperation with other Groups, and the results will be fed to VNodal. Data on the location of each ownership and relative site factors will be collected from many general sources.

We shall develop and map border zones for all ownerships, inner and outer lands and waters that affect land values, dynamics, fire controls, and fence phenomena over time. Rarely-mapped characteristics will be included (e.g., natural or mined-area high-walls and ponds, cemeteries, springs, forest seeps, noteworthy viewing sites, large animal dens, and conceivably "unreachable" areas). A first-cut inventory of evident resources will be made and valued for inclusion in estimates of the natural productivity of lands. A score of assessed potential long-term value will be assigned for each property.

This score is a temporary, first-day-visit score later to be enhanced by staff with the aid of VNodal. The temporary score helps identify any dangerous or totally unusable area(s) on the ownership. The work of Rural System, in part, is to illuminate all of the existing potentials of a property, and to enhance them cautiously, over time, to stabilize profits and human wellness in the region.

Owners will be consulted about their preferences and constraints on named developments or changes. For example, one owner may choose to prevent hunting of wild turkey populations on his/her ownership. The owner's preferences will be respected, but profits and wellness factors will be displayed later, annually, with the constraint imposed by the decision, and will be easily compared to likely progress with the constraint removed.

Under contract, all areas will be developed for operation and use by over 150 of our planned Groups (small businesses or departments within Rural System, listed in Appendix 1). These Groups are planned to be guided by System Central, and to work with many other Groups, all with anticipated growth together. The financial gains of joint work will be distributed to employees, who will gain stability by working together and sharing expertise.

We anticipate a bee-hive of activity of bright people working on their topic of interest, perhaps expertise, aided by colleagues, all enjoying the year-around farm experiences, no longer troubled by the pains, solitude, and limitations of the aging farm family. We envision people working together for timely, diverse produce and experiences, and for planned profits for the good of the region and its people, demonstrating how it could work for people of other regions for the common good. In Rural System, we shall respond to local needs first, plan for expansion later, and imagine franchising our services for people Earth-around.

The Modern General System and Systems Approach

Through the windows of the city we see the distant new rural world across the urban border. We see things as little systems, sub-systems, all linked together in evident (and sometimes mysterious) ways. Even though very different in size, shape and some functions, they may have identical, named *forms* and other *functions,* and thus isomorphism (being of the same structure). We find value emerging within Rural System in assuming things are more alike than different, and since the system structure has proven useful to so many for so long, we tend to use it for our own needs. By starting with such a premise of relatedness and similarity, especially within nature, we are heading for some economies.

Many books have been written on systems, systems theory, general systems, systems approaches, systems analyses, and other combinations such as "ecosystems"—more than a person can read in a lifetime. Some texts are very specific, such as about a particular heating/cooling system. Others are general, and some are only tangential to anything that I can perceive. I work with a slightly revised version of General Systems Theory, *a la* von Bertanlanffy.[12] The approach may be "general"—as in widely useful or relevant, maybe universal. It's been good to and for me and others, and so I want to share, convinced by over 20 years of teaching "General Systems Ecology." General Systems Theory can be useful for many people, but I am saddened that it seems totally meaningless to some. I remain ready to try to make the right connection, timing, emphasis, or example.

There's probably no best place to start with systems work, for each may depend upon funding, known past work, and future demands. (Learning often takes place within the design process.) Herein, I present the basis for our work toward Rural System. *You will note parallels throughout the book with the system parts to which we are committed.*

We find great benefit in doing an elementary systems-analysis, meaning we seek to answer the question: "Have you included all of the elements of the modern general systems approach in your analysis or design?" And if not, we shall study, adding the remaining components and their linkages and likely actions (and gain efficiency by laying aside the non-system, extra elements).

On guard! My experience has been that systems most often fail from omitted elements and inadequate attention to objectives or feedback (which is dependent upon objectives being present). We have recently added to our systems thought and actions (after 10 years of applications) Standback and Context, seen below, and we now discuss, plan, and test throughout Rural System whether we have included all parts of a modern general system. We shall see how they all work together, and test concepts for similar efficient uses in other general systems (i.e., their equipotential).

General Systems Theory has been around a long time, even before Ludwig von Bertalanffy's book by that title in 1968.[13] With other systems-oriented people in the past 20 years I have advocated starting systems design work, and for taking a systems approach, with its requisite *objectives.* I've changed, and now start with "Standback," which means writing or sharing in-depth observations and ideas of a proposed or developing system. There are improvements, reduced surprises, reduced risks, fewer losses, innovative sparkles, and powerful synergism ahead with Standback as a mere refinement.

Standback is the practicing Rural System concept of attempting, singly or with others, to move mentally to places in history and to attempt to see a named concept, project or development… a project in its fullness, from multiple perspectives, many periods, non-linear dynamics, victimized by catastrophe and enhanced by unknown benefactors, celebrated in success and lamented in great defeat. It is a whole wholeness before we get started.

Many people have wrestled with diverse rural problems, some now mentioned, and few have been solved. It seems that other problems are emerging rapidly. We have the feeling that we have *a situation,* a first-approximation to a problem operating at different scales, communicated poorly, *parts* well-known, but tools that don't seem to fit. "Whole" and "holistic" are now part of

[12] von Bertalanffy L. General System Theory: Foundations, Development, Applications. 1968. New York: Braziller.
[13] Ibid.

lunch-room conversations; computer talk merges with that of economics, student education, mine closures, investments, and new funding.

Modern general systems theory is a highly suitable form of description for a general, often-observed set of topics, agreed upon by many people as having the fundamental elements of all well-working entities. It is the best structure for description, communication, analysis, and use now known. Only using a general systems theory approach will suffice and so I start here with a picture and list of main parts, all related, all to become real in Rural System action.

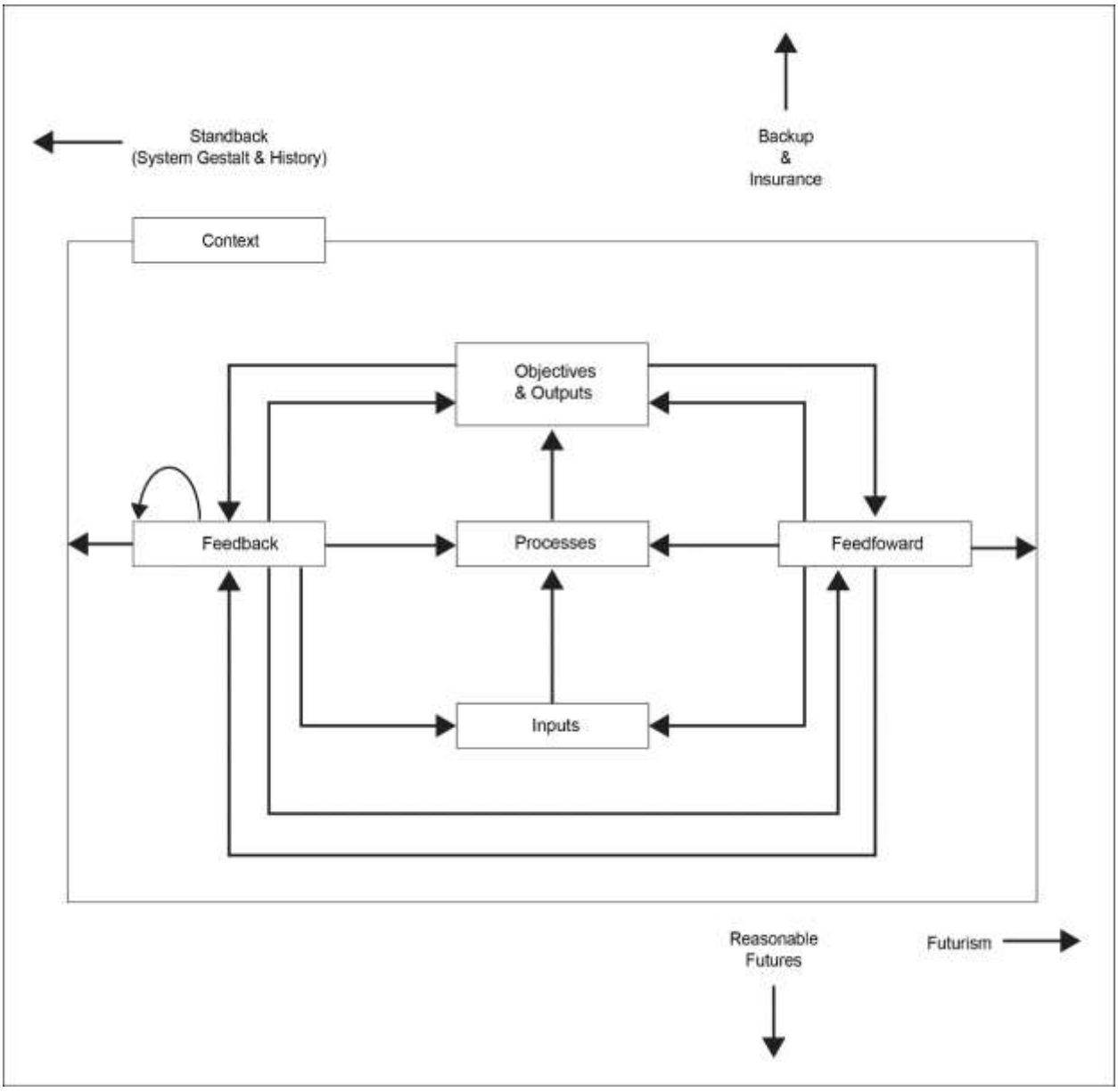

Figure 1. The modern general system, with new components.

Memorized, we can do good work ahead using the modern general system diagram. Many people understand the common, fundamental, well-connected parts of things called systems:

Standback is a look at the near past, assessment of recent trends, and a view of the potentials, even to the global and past century; the local gestalt. Standback is the action of looking at a situation, perhaps a system to be developed, before it is named, sketched, or serious analysis is begun. It is an effort to see the "thing," the "problem" being discussed or about to be attacked, from many angles, from many distances. It, unlike systems work, is broad, imprecise, and fleeting in order to get another point, an angle, for perspective. Rather than going inward and with precision in system analysis and design, standback goes outward for idea-edge description and feeling, for ambience and shadow, temperature and odor of the thing… that might be analyzed and described—even programmed—as a system.

In progress, it typically has the feel of the experienced microscopist—but working at mega-scale—dialing in and out of focus, rapidly, to see the specimen under the scope. It tracks from pre-historic time to understand people and the world then, aware of influences today, thoughtful of old evidence and that being lain now for the near future adventures. As in feedforward, part of standback is futurism—the more confident, the more short-term, the more serial the better.

Context is the broad, likely-significant, nearby surroundings. Context also includes businesses, environmental factors and past uses, and potential competition or threats—relevant constraints of all types.

Objectives, often stated as *desired* results or outputs, are not synonymous with goals.

Inputs come in many types: environmental factor sources, physical and energetic, and ideas, information, and recorded history.

Processes are flows and cycles of named sets, fundamental to very specific causes of change, including life or death itself.

Results or **Outputs** are whole-system identified, often with time, energy, and sequence considered.

Feedback is action taken to adjust system parts for improvements and to match desired results with objectives, often directed at system components as well as achieving stated objectives.

Feedforward is current action to improve likely future conditions based on estimates of change and future conditions, e.g., of equipment, buildings, staff, etc., to make them suitable for the near future.

Futurism, as used herein, is not a word for the expected farm crop, or an Italian art movement, or daily life "salted" with high-technology. It comprises collected expressions of best estimates of relatively-soon forms, functions, conditions, and methodologies. Some estimates are singular, some no more than best-guesses, and most are expressions resulting from a computer model—perhaps descriptions of future community likelihood estimates. It results from study, serious time-constrained discussions by informed, thoughtful people, prone to add many interrelated factors, constraining or freeing time-labeled, cascading conditions for tomorrow. Rarely a singular topic, "a futurism" is a best estimate for a year or a period of several years. Rare time-series analyses may yield insights. Futurism rarely, if ever, involves describing geological-scale time.

Herein we may relate to time within stories that can be told by living people or their families, those within likely old-oak-tree-age, 150-years. Futurism may consider timelines of sequoia-tree-age, 2,700 years, from described early USA conditions,[14] and to UN predictions of worldwide human population-food difficulties, 2050 AD.

[14] Mann CC. 2006. 1491: New revelations of the Americas before Columbus. New York (NY): Vintage Books.

Backup: Equipment, data storage, staff, software, protection, etc., to assure desirable (often essential) processes and system performance in a rapidly changing field, and documentation for future work and for harvesting past investments. Backup tends to prevent evident physical resource losses, malfunctions, terrorism, and spite.

We find these elements throughout Rural System, within well-functioning computer systems, and within each of the Rural System Groups.

Public lands are under management now, many by teams of well-educated and well-intended staff. Surrounded and topped by slogans about "sustainability," they know well that well-managed natural resources are sustainable, but only if there are very clear objectives, abundant use, stable funding, intensive use of scientific research results, and all well-practiced within a system run by stable, educated staff. There are few feedback examples evident, because there are few clear statements or definitions of major objectives. Systems work requires clear objectives for feedback to operate.

As I describe Rural System, I stand back and see 100 years of "conservation" effort, multi-agency, millions in taxes dedicated to nature and farming-well, and millions in land value donated by individuals and families to much-loved "nature." There have been noteworthy and appreciated gains, and useful additions in "green" knowledge and behavior, but it has been ponderous and even recent gains can be seen as slowing. I judge that the current working complex, in response to many perceived needs for the public in the very near future (before 2050 AD), is not working. Action is needed and after study, I'm convinced that along with continuing praise-worthy work, the extra, new work of Rural System is badly needed.

Rural System's Structure

Hardly a *thing*, Rural System has been difficult to describe. It's a planned corporation, though parts have been created. It does not exist now, but is amazingly real to me and many colleagues. Differences have arisen and are still discussed, because the perceived, changing entity is large and varied in scope, and needs are immense. This brief unit is intended to help imagine what we have planned for the units of the proposed corporate system.

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The land and water of absentee owners (families which have departed for urban areas) will be "leased" by Rural System for the future. An ownership under management of the system will be deemed a new "**enterprise environment**," a term used to express the great difference between the limited activities of the "farm" and Rural System's modern, diverse management. In addition to precision agriculture and computer-guided forest management, Rural System's Groups are planned to monetize many other parts of each property, such as access to trails for hunting and other recreational activities.

The company's "diagram," some suggest, is a multi-dimensional picture; others see it as a Swarm of small businesses on, over, hovering around, or within former farm houses or structures. Rural System works for profit on and around each ownership through the work of all of our interconnected Groups (small businesses). There are planned to be links among over 150 Groups, some located on or within the lands and waters of the ownerships and others diversely located, some at great distance.

Corporate Service Groups

Among the Groups mentioned, there are 11 planned **Corporate Service Groups**, serving and working with each other and the corporation to address all needs within over 150 small businesses called **Functional Groups**. Without Rural System unification and the work of Corporate Service Groups, small businesses fail for many reasons: insufficient capital, lack of legal and economic advice, inadequate advanced modern marketing, and inattention to losses. Corporate Service Groups include: System Central, Land Force, The Lands Group, The GIS/GPS Group, The Wealth Management Group, The Safety and Security Group, The Communities Group, Marketing, PowerPlace, VNodal, and The Studies Group. These Groups will work independently, but will also serve the central needs of all other Groups.

VNodal, is planned to be a unique, very large Group supplying software and database services—including cloud storage space—with many locally-developed, carefully-selected computer programs and systems, staff, and linkages throughout Rural System. VNodal, as described in Chapter 4, will be the software "brain" of the system, unifying for analysis the outputs of database management, business, statistics, GIS, simulation, heuristic convergence, and optimization software.

Programs within VNodal will produce a conspicuous, technology-aided land analysis, and then provide daily, detailed computer maps and action-prescriptions for work on lands and waters, and Group operations. These messages will be ecologically and economically sound (with time and place precision). They will arrive in the field from electronic mobile devices for the corporate work force, the Land Force. Employees within the Land Force will implement these prescriptions for stable, bounded profits from diverse-production sub-systems—the Groups throughout the working area.

RRx is a software system planned to precede Rural System and VNodal, and will become a leading part of it. It was designed for land owners of small tracts who wished to know what options are available for their lands. Owners will state conditions, limits, needs, and the RRx system will write a brief prescription for them based on the information provided. RRx was planned as a 3-step process that might fund Rural System. RRx involves:

1. **Phase 1:** A preliminary question and response with the owner.
2. **Phase 2:** A one-day, first staff visit to the owner's site to gain interviews and basic information from the ownership about objectives and the basic scale of information sought.
3. **Phase 3:** A staff field visit for several days for full-scale prescription to meet stated wild fauna needs of Eastern US rural land owners and to begin local rural System preparation.

Functional Groups

Functional Groups are interrelated, small business enterprises. (A list of many of the proposed Groups is shown in Appendix 1.) They are designed to be synergistic, profit-oriented, and to share in corporate financial success. These Groups are very diverse, and will at first be headed by an expert who will build the Group and its Rural System linkages. Functional Groups will be well-supported by **Corporate Service Groups**, and will exist on or around ownerships, or even sometimes quite distant.

The Groups (both Corporate Service and Functional) will be linked together within the corporation. Groups will be fairly independent, but supportive of each other by design (and for collective/shared profits). Most all Functional Groups will work on or with resources from the

enterprise environments, the leased ownerships. These enterprise environments will be organized into **clusters**, and are likely to be surrounded by nearby rural communities.

Rural System's Functional Groups will be successful due to the support of powerful decision-aid software and technologies, and collective computer services, education, and social engineering services. **"Swarms"** are groups of Groups or related experts, on or nearby Rural System Central offices. *Swarm* implies our Groups' work over and *around* a central office; for example, under to *over* farm ponds, and drone images from over many regions of work not-yet specific on Earth.

We have a procedure that will emphasize Group identity (for branding), then coalesce, all supported or aided by the Corporate Service Groups, working for the others in a dynamic *Swarm*. Rural System, as planned, can offer and deliver what many small businesses stumble over: associated branding, marketing, insurance, minor loans, accounting, space, secretarial booking, advisories, linkages, library services, equipment-backups and professional "hints." Rural System can also offer to Groups what is probably unaccountable: reliability and resilience—relief gained from an addressed list of the usual causes of business failure.

Clusters

Rural clusters are 2 to 5 enterprise environments in close proximity, grouped together by VNodal as if they are within only one boundary, and then managed together with common objectives, shared profits, and many interacting Groups. By relating these tracts in several ways, a cluster can gain advantages of scale, scope, reliability, community building, sequencing, and resilience.

Rural System will provide ideas and benefits for improvements and increased land profits and conveniences for the owners working together. Based on staff availability and experiences, gains may be caught, for example, in fencing changes and useful changes in roads and trails. The independence of owners will be recognized, but options will be suggested for meeting places for food preparation, afternoon visits, children and youth activities, centralized water sources, lighting for general evening benefits, optional use for available barn space, scheduled equipment use, and scheduled short-trip conveniences.

In essence, the cluster—with no extra cost—can make economic gains by very small Group work together, reduced costs, saved time, increased Group resilience, and utilized gains from fixed resources. While Rural System is planned to work on the large scale of clusters, communities, and Collaboratives, much of its work will happen at a very fine scale—conducting precision management within Alpha Units.

Alpha Units

The land and water within the survey boundary (and a buffer zone) of each enterprise environment will be mapped with Geographic Information Systems (GIS) software. Each ownership will be seen and computer-mapped as completely covered by 10m x 10m map cells, called Alpha Units. Data will be amassed for each cell and its select proximity (all adjacent cells). One test area of about 200 acres had about 8,000 Alpha Units. Within our databases, we assume each Alpha Unit is unique. The Alpha Unit extends a kilometer upward and downward—hundreds of Earth columns.

The Alpha Unit and its related concepts are not theoretical or academic, but a practical way to do precise, competitive, profitable rural land management and to escape the tight hold

that "community," "ecosystem," "watershed," and "stand" frameworks now exercise on planning and field work. It does not replace them, but allows practical analyses and prescriptions at an unprecedentedly precise level.

Managers can use differently-sized frameworks to meet other objectives. The phenomena within every Unit may be modeled as a function of phenomena of the surrounding Units, and those influences may be from any direction or distance. The Alpha Unit functions much more than in produced maps, or cartographic excellence. Its role is key to making money from rural lands, forever—probably more than is now made.

The Alpha Unit is a valued volume that is changing. The mapped Alpha Unit shows the top of an imagined earth-volume—a column 1 km above the land surface and 1 km beneath the land surface. (The legal dimension of this is recognized, i.e. Justice Douglas in the Causby opinion, 1946, that the landowner has control upward only as far as is necessary for reasonable use and enjoyment of the surface as adjudged on a case-by-case basis.) While most work and analyses will be done at the surface, the volume may include the air, weather, and *climate*—above the surface and beneath it—mining, solution channels and caves, groundwater, and the so-called "parent-material" of the soil layer, the site for precision agriculture.

We must include, as soon as possible, the tropospheric aerosols affecting solar radiation at the surface. These are composed of soot, sulfate, carbon, biomass, burning, and soil dust. The oligotrophic environment deep below the terrestrial Alpha Unit surface, with high hydrostatic pressure and often high temperatures, hosts a variety of microorganisms in this apparently inhospitable place. Many have not had communication with Earth's surface for tens to hundreds of millions of years.

Using the Global Positioning System (GPS), the exact location of an Alpha Unit can be known. GPS data, when plugged into GIS software, allows the sighting of a bird or plant to be related to all of the information available at that place. Similarly, known locations can be found when afield. Unexploited, the role of *each adjacent unit* can be estimated or changed.

The concept of a *valued volume* includes many factors:

1. the probability of not encountering destruction or failure to achieve an objective, i.e., 1.0 minus the probability of flood, fire, storm, land subsidence, poaching, theft, trespass, etc.;
2. (2a) a planning horizon for a specific project and
   (2b) also the 150-year Rural System planning horizon (an observation requirement within the Alpha Unit analyses);
3. time since last major disturbance or time zero in primary succession;
4. 1.0 minus the probability of a suitable or better substitute being available locally for the resource within the planning horizon (2a); and
5. three estimated likely local or nearby interest rates for the studied resource. The Alpha Unit is not simply an ecological or timber-oriented unit, but a map space for a resource unit. It is used to create conditions for unifying ecology and economics so that the results can be mapped, numbers processed, and visualized by decision makers.

Of course, Alpha Units are only possible with a dedicated and trained work force. Rural System's Land Force will execute VNodal's Alpha-Unit-specific prescriptions on the enterprise environments.

Land Force

The Land Force will work within enterprise environments and clusters. It is planned to be a mixed working team, typically composed of local people who are expert instructors in fencing, cultivation, animal care, etc. They will collect data, implement the plans from RRx, and do feedback operations. They will achieve economies of major equipment purchases (e.g., a tractor), optimum use, minimum down-time, and use all enterprise units in a timely fashion with diverse expert knowledge and abilities.

The Land Force will use the combined expertise of its members, and this diversity of experience will provide an exciting environment for all members, opportunities for advancement, and year-around employment. Described later, Rural System's PowerPlace will become the site for educating workers of the Land Force, and documenting their expertise.

So, Overall, How Does Rural System Work?

It's easy to get lost in the parts when describing Rural System. The system is so large, describing it is like trying to introduce someone to the anatomy of an elephant, struggling to provide enough detail to help the person understand while not losing the whole structure. This list places Rural System terms and structures in order of how they would operate in action:

1. Upon request, **Rural System** leases the land of absentee owners. Land valuation is made as part of that leasing process. **Productivity Capacity Index, PCI,** is included in the valuation, and is estimated by **VNodal** to give a first, gross estimate of the likely financial annual gain from crop and forest lands. The PCI expresses integrated useful area, general agricultural potentials of slope, aspect, elevation, access, current vegetation, forests, water resources, market access, and hazards. The PCI is used to determine the percentage the owner gets of annual profits from the entire Conglomerate. Their lands tend to increase in value.
2. Lands under contract—individual ownerships termed **"enterprise environments"**—are often managed in **clusters,** or groups of properties in a local area, to achieve economies of scale and major efficiencies.
3. Lands are intensively analyzed by the **Land Force**—the major new employment unit being planned—using VNodal, including our extensive satellite and GIS databases, and **RRx,** the prescriptive software system within VNodal.
4. Owners or buyers may obtain a general "prescription" for their land—an expert system responding with management directions based on the owner's information. An RRx report is provided, a prescription with GIS maps for what to do within each **Alpha Unit** of each property. This report is owner-specific and dynamically changing with seasons, land use changes, markets, and prices. It will be downloaded in the field by mobile devices. The prescription is developed from conventional and ever-changing "expert system" processes addressing what to do where.
5. Owners may purchase **Phase 2**, a low-cost site visit by a staff member to collect much information for giving preliminary analysis of lasting details on suggested preference-weighted actions for the owner. Details from extensive computer runs are within the **Phase 3** reports, also produced at cost by VNodal.

6. With owner approval, the Land Force implements the prescription, preserving, restoring, cultivating, harvesting, monitoring, and adjusting.
7. **System Central** provides business support services for all Groups working on the enterprise environments.
8. These **Functional Groups** operate on enterprise environments. There are over 150 designed Groups (listed in Appendix 1) with which we may experiment with new field data for contributing to Rural System profitability.
9. Annual profits are assigned to land owners, investors, and reinvestment in the land, in proportions assigned within the initial contract, based on acreage and a PCI.

VNext, the Group

Rural System, by design, is optimistic and termed "futuristic." A noted system function is feedforward, in which the VNodal system projects likely outcomes, or adjusts to prescribed actions. Though all Rural System Groups continually assess needs within the System, this process is not the concentration of **VNext**.

Not feedforward, VNext will describe and promote the Rural System corporation for its near future. It is planned to be a special marketing, advertising, and promotion Group, selling not the Group itself, or any other particular Group, but developing the Rural System concept as a whole, its uses and utility, with stable, professional backing. Rather than touting only the greatness of special Groups, VNext will present the greatness of Rural System—its parts as a system now and for the future, with abundant benefits for the individual components as well as Earth-society. Related to the Marketing Group and to feedforward action, the emphasis in VNext action will be on the likely future of Rural System and its function or role in the future.

One or more Rural System ownerships will be specially developed for superior public visits, show-places for Rural System today … with an extra dimension showing visitors what's happening *now* and *what may come next.*

VNext will *inform* other Groups of interior successes, *educate* people about Rural System, and *promote* it for the good it is likely to do for people tomorrow.

The Rural System Esthetic

One of the fundamental "E" words of Rural System analysis and prescription is *esthetics*. Easy to generalize, equally easy to unify with economics, energetics, ethos, ecology, and enforcement, we see esthetics to be a major dimension of our work. Esthetic dynamics are likely to arise in our changing landscapes, practices, land and water allocation decisions, and in the human pleasures that are different, those that change even in the well-known and new-appearing rural lands, climate, and waters.

The visual environment, the realm of work of **The Viewscape Group**, is part of rural space for the future. Esthetic dimensions of decisions are present, heavily importance-weighted, and sensitive to owners' past and to neighbors' futures. We shall work toward a *new esthetic ideal,* spiritual, naturalistic, and cultivated, set by colorful grazing animals—a **Rural System Esthetic**.

We believe there are temporal and seasonal esthetics (perhaps dated, e.g., a 1900 esthetic, as captured and displayed in images). We reflect on "ideal formation" over time, see the urbanization of society, scant ecological knowledge transfer, limited college education of the

general public, and the uni-dimensional influences of TV, and now suspect there is no rural, classical, or forested land ideal for a "land esthetic."

We include viewscapes as part of our GIS analyses of land, minimally mapping and describing what parts of each tract can be seen from main roads. Recognizing highly-weighted ones and including them as a weighted constraint on clearly "destructive" actions, we phase in visual features that *contribute* to perceived future beauty spots, areas, and heights.

Viewscapes are described as land areas seen from a point (e.g., fire lookout towers), and the areas from which it can be seen (given various details of distance, equipment, abilities, and climate). A building or major land use change may be claimed to ruin or lower the value of a viewscape. Viewscapes are often parts of landscapes but are notable near buildings and statues, as views *from* and *to* come into notice in decision-making before or after planned land use changes. Certified before-and-after images may be useful in conflicts.

Aware that viewscape value or appeal differs greatly among individuals and groups, we concentrate on knowing these groups, understanding their reported preferences, and exploring the dynamics of viewscape perception. The Viewscape Group is designed for many roles, including providing education about future needs for viewscapes and analysis likely conditions and human populations influencing viewscapes (e.g., economics, protections, and comparisons of natural effects (wind, etc.) with human effects).

There are many other "scapes," *landscapes* being well known. The evident others are soundscapes and odorscapes.

The Landscape Group of Rural System links well with **The Gardens Group**, and concentrates on the broad field of the home or office garden, yards, and vegetation… but also the vast landscapes of the rural areas under management and nearby national and state-owned public lands. We move off from the advanced work of Dr. Margaret Trani (1996)[15] and explore the extreme diversity now found under *landscape ecology*, employed by some others but now included within this scape topic: nearest-neighbor phenomena, edges, corridors, forest land coverage, watersheds, population densities, land-use sector, allocations, and wildfire effects.

Few people seem to have heard of *soundscapes.* They become more important each day as people try to find a quiet place to work, think, meditate, or live a stress-reduced life. Each becomes more difficult. The soundscape Group of Rural System, **Earshot**, may assist and direct others into reliable, cost-effective uses of recordings and their quantification. The Soundscape Group will assist the GIS Group in improving soundscape GIS maps—pictures of more or less *sounds,* emitted from select sites (e.g., poacher shot-gun sounds, morning and evening, from selected points within a roaded, heavily-used watershed).

I once tried to capture the sounds of a forest to see if a difference could be detected before and after a pesticide application. I could not, with the instrumentation available to me at the time. I perceived that all bird calls and notes ceased for 10 minutes or more after the aerial application of malathion insecticide to the forest research area where I stood in a protective suit.

GIS can be used to analyze gun shots (source-relations) to assist in wild fauna and other law violation detection. The hunted zone and its gun noises (randomly distributed gunners) might be mapped for general interest. Locating houses and recreational sites can be done with noise

[15] Trani MK. 1996. Landscape pattern analysis related to forest wildlife resources. PhD Dissertation. Virginia Polytechnic Institute and State University. Blacksburg (VA).

sources in mind, and measures (or topography) can be selected to reduce effects of noise on people.[16]

Other work may be on notations of natural effects on sound attenuation or clearing. We shall find or develop soundscape aids for property structures, training areas, and major recreational areas. We may collect, for use, computations and maps of the sound patterns of aircraft and vehicles, as affected by vegetation and soil barriers (as at Blacksburg Airport).

Earshot will provide workers with hearing aids and protection, and use these for learning and for employment within the region. We seek expert understanding of sound design, sound healing, and listening consciously.

Summary findings and general topics, now believed to be of interest and value for future uses, include human voice sounds (50 decibels in a library), which, for example, reduce bird sightings by more than 30%. Most conversations occur between 40 and 60 decibels. Any sound higher than 85 decibels puts a person's hearing at risk. iPods, music players, or speakers may emit 105 decibels. Over 26.7 million Americans, age 50 or more, have trouble hearing. We shall work with **PowerPlace**, one of the education centers of Rural System, to assure all students can hear their lessons well.

Under growing pressure from citizen's groups, some cities regulate train whistles, roosters, hawking peddlers, auctions, fireworks, and night-time music, and create quiet zones around hospitals, schools, assisted living, and other places. (Thomas Edison once predicted all American city dwellers would be deaf.)

Earshot is planned to include work with **Nature Folks** (Chapter 10) in trying to listen for the sounds of nature, such as the calls of birds and particularly the night sounds of amphibians. It will require a paying membership, issue a newsletter, sell equipment and tours, and provide services for industries, certifying certain noise levels and changes resulting from management. Earshot will aid private groups in promoting a quieter space, and sell of services for quieting situations (such as buildings, dogs, individuals, and equipment).

Odorscape**s** emerge with air pollution and sewage, manufacturing, and human, and livestock wastes, and need relations to human sensitivity as well as wind patterns. Dog sensitivity to ambush potentials may be investigated. Services may be offered profitably, particularly in border areas (Chapter 11).

The Odorscape Group specializes in odors and how they affect humans. Its actions and products, listed here, are intended to suggest to the reader the potentials for the future. The Odorscape Group is developed for:

- Providing detection enhancement for rural law enforcement, defense, and security patrol dogs and other animals;
- Responding wisely to conifer tree insect attacks;
- Evaluating tracking, security, and cadaver dogs;
- Assisting in hazardous material detection and cleanup;
- Separating pleasant odors (e.g., those of bakery yeast) from harmful emissions from the same source(s);
- Presenting regional floral odorscapes (computer-mapped) and quantifying the seasonally changing fragrance of gardens;

[16] Treasure J. 2010. Shh! Sound Health in 8 Steps [Lecture}. TEDGlobal. Available from: http://www.ted.com/talks/julian_treasure_shh_sound_health_in_8_steps.html

- Relating meadow and other natural odors to allergens and to peak seasons for outdoor enjoyment by most people;
- Developing an Alpha Unit odor classification within an existing or developed classification system (as for wines, perfumes, etc.);
- Expressing pollution controls related to waste pond odors and change rates;
- Determining plant disease presence or changes caused;
- Detecting wild animal disease;
- Determining crop ripeness;
- Determining molds and food spoilage or freshness;
- Understanding the role of Blarina (shrew) populations (a distinctive odor) in forests and relating soil odors to time-to-plant conditions;
- Detecting fired gun odors (hunters present);
- Measuring presence and impacts of industrial or commercial malodors to Appalachian Trail users or users of select campsites near an actual or proposed development;
- Measuring the odor zone of influence of operating a fossil fuel vehicle;
- Detecting ketone odor (related to cattle disease condition);
- Correlating measured odors with stated wine taste qualities and effects on dining areas; and
- Using scent-named annual flowers and their role within gardens, attracting insects, birds, and bats, and develop results into scented solutions for sale.

All of the scapes will gain profitability through marketing, redundant and related services, expanding scope, multiple uses of identical software, and by responding to diverse challenges of the changing rural conditions and perceived shortages.

What is it Really?

I'll try again for brevity: What's Rural System, really?

Rural Future is a book about Rural System, a startup private corporation with a plan (in general system structure) to improve rural conditions for people who have not emigrated, or for people who are now urbanites who own rural lands and related resources and may wish to return. Rural System attempts to respond to international needs to be encountered in 2050 AD, partially by describing a computer- and technology-aided response to state appeals for employment, and improved productivity and stability of the diverse resources of rural areas of Virginia. It presents an alternative to recent unsuccessful farming, adds jobs, and responds to intensified needs for quality waters and lasting food supplies for likely increasing human populations.

Rural System is a proposed and developing modern corporation that works within a set of premises, listed in Appendix 2. The premises, un-weighted or ranked, tell what's behind many of our thoughts and decisions.

In securing participants, we are attempting to provide "price incentives" for land owners and investors in Rural System, hoping that they will align their actions with both personal and social interests. We work with land owners who have emigrated to the cities or "away" (however described) and, under lease with them, manage their lands for multiple, mutual benefits for them, the corporation, and the people of the region. We work for our money and provide fees for a very special kind of land "use," that of increased profitability, beauty, stability, and value for the future and for nearby rural communities.

We see people emigrating rationally for mobile resources, labor, new capital, lower expenses, better services, and family cost-effectiveness. Rural System provides insights to loss of rural lands for land owners as well as people of rural regions and provides solutions for changing land and its uses and values for the future. Economist Boyd argued that "innovation thrives when private markets – and the incentives and information they provide – can be harnessed."[17] That is what Rural System attempts: innovative uses of research results brought daily to workers in the field, for applications on computer-determined optimum sites, selected by searching data banks. Rural System involves a modern, novel use of economics with energy-conservation, esthetic sensitivity, a regional ethos, and evolving knowledge of rural ecological systems.

Rural Future tells details and stories about the proposed Rural System. It is a plan for a real system to be implemented. It can be planned in greater detail, modeled, and details improved. It now has many constructive concepts, data bases, technology (computer, GIS, social media, etc.), and is needed for the very near future. It's for farmers and farms, but also for us all, to develop adequate food and water sources before 2050 AD… first in a region, then Earth around.

Really.

[17] Boyd J. 2013. The Limits to Ingenuity: Innovation as a Response to Ecological Loss. Resources Magazine [Internet]. [cited 2017 Apr 18]; 182:41-45. Available from: http://www.rff.org/research/publications/limits-ingenuity-innovation-response-ecological-loss.

Chapter Three

Human Food from the Restored Land

Rural System is a planned, working response to a world full of stress and change, of new investment and hiring practice, international relationships, rapid technological change, exploding information, and untested methods of education. Intermingled with these are the uncertainties of national and local actions, faced with a set of environmental crises.

We propose a rare market turn, for we invest in rural-related companies, within a system operated for stable, long-term profits—which results in a stable natural resource base. We plan at the forefront of market-based approaches to environmental regulation; high, specific productivity; directed waste; and even quality of life. We explore Alpha-Unit-specific management for production and reduced waste of our branded, high-nutrition produce.

We know that environmental values can never be fully translated into dollars and so we show the extent to which they are translated over time. We guarantee a long-term perspective, and change actions which simulations assert will be destructive on the lands and waters. We no longer believe, but test skeptics and major project advocates saying that "environmental values will come out on the short end of the stick" in cost/benefit analyses. We can now use market values to help achieve major social and environmental values.

Behind Rural System's plans to work for produce and profits locally is the need to set up a responsible, inter-nation system to feed a yet-increasing world population of nine billion people by 2050 AD. Keeping that from being a simple suggestion, we reluctantly concede roadblocks to it occurring, like new or newly intensified climate change storms and coastal flooding for novel, episodic human muscular challenges (against the apparent political rule on non-disclosure).

As we share in this book, we have become aware that systems are needed and can be created to link research and study results (converted into system inputs) with objectives and processes (i.e., policy formation)—strategic intent with optimization results and corrective progress, moving to respond to socio-environmental challenges of the near-future. These are mere words, as I now see them, far-removed from Tansley's concept of the ecosystem as, "the system resulting from integrating all living and non-living factors of the environment."[18] We plan to attempt such integration in special ways, to produce a lasting, working system of paramount importance to people of Earth.

We have benefitted from studying International Service for National Agricultural Research (ISNAR) briefing papers. We shall seek support to harvest progress of the International Agricultural Research Centers (IARCs), and use past efforts at "system levels" in agriculture. We intend to find pairings within soil unit, field, farm unit, farming landscape, catchment area, and agro-ecological region. We have planned uses (as others have attempted) for micro-scale **Alpha Units**, which we shall use within GIS maps to find and record agricultural and rural complex units for analysis and model-building.

[18] Tansley AG. 1935. The Use and Abuse of Vegetational Concepts and Terms. Ecology. 16:284-307. doi: 10.2307/1930070

The past has changed. Lamenting its absence and re-analyzing history seems likely to yield little. Grasses, for example—seemingly well-known to most people—are reported to be inadequately known by agronomists for their long-term persistence. Too late now! It might be classical agriculture to describe precisely the 325 biophysical regions of the US Department of Agriculture, but the funds, time, or interests are not available; the uses are not convincing—some say "regions" are too gross for meaningful analyses.

With anxiety, we generalize on "good land," "prime land," for that is the baseline for the future—lost to housing, airports, and other well-known human habitations. Worried, we study plant location, related to the fundamentals of nutritious plant growth needs (slope, aspect, growing-degree days, available moisture, and elevation, related to temperature and precipitation). We harvest the best knowledge available on generalized crop production, identify the location of the areas with such characteristics, and use GIS software to identify and map these socially invaluable lands as well as note those destroyed or no longer available. "Future value," defined!

Rural System enjoys significant advantages over farmers who have struggled to stabilize crop production (and related family income). With resources from the Virginia Cooperative Extension, and graduating students from agricultural colleges armed with GIS and GPS, Rural System now may operate from a dynamic series of combined crop-system information sites.

We plan to work through available water, ownership borders, re-define "flat" areas, use importance-weighted slope/aspect/elevation Alpha Units, and then identify border zones and "special places" (e.g., fenced areas, roadways, etc.). We shall give full attention to maximizing valued-nutrients in the likely weight of named crop production per Alpha Unit, given locally-reported price-per-pound, and likely local crop waste weight. We shall work for local market value of *nutrients* (proportional to weight) in the volume of each crop sold. There is real pleasure (compared to the past) in making rapid computation of all of the above for each of several crops, changing yearly and over many years, with adjustments for tall-tunnel greenhouse structures, new local weather patterns, unusual crop predation, and new processing of weeds, pest influences, and crop waste.

We shall seek similar, existing software now before creating new software, to combine our crop-specific data files on Alpha Units with regional spatial, solar, and climatic data sources. We shall work toward having small water costs. We shall examine harvesting, storage, and shipping tactics, mixed with local delivery-to-market techniques and related costs, as we seek feasible, high net-value human-food crops. Net-value human-food crops may have low costs for collection, storage, and drying, low-energy cost for preparation, and "servings" high in essential, measured, nutrients. We seek bountiful, locally well-adjusted, high-nutrition crops contributing to diversely-flavored, tasteful meals.

We shall work toward discovering, shaping, and describing well all the potentials of the leased ownerships, within which we may grow and market crops. As we develop, we see the sum of all of our Alpha Units, 10m x 10m spots that we will get to know intimately. We are likely to have very large data sets or report-potentials for each, as we carefully engage their best uses. We shall work to gain high production from each Alpha Unit, and because we know each well, we are not likely to exceed their limits or expect too much. We recognize looming limits on each unit: the historic threat of a water crisis in 2030 AD, a phosphorus limit over its edge, and novel consilience that there will be no leeway in which to gain maximum likely profit on its tended-depths over time.

"Costly," I can hear. I shall try to be brief. I believe I am at war now, quietly, but I prepare for human threats and their action on the deserted farm: changing markets; departing

workers; unexpected but well-known pests, diseases, storms, and misbehaving guests; changing crop values; broken fences; new taxes; changing, selfish neighbors; and wind-blown atomic-nuclide threats. Hungry urbanites are testing security at border edges while admiring the rural autumn beauty, as we wonder—without them—about the new possible sources of major nutrients for *our* food, because coal and phosphate mines are closing and sources are far way (and protected by gunners) … giving a new flavor to "foods-hard-won."

We'll give a new price to water (amount, cleanliness, shipping, sourced from protected aquifers), and add it to food cost, along with human-terrorist and intestinal threats (those of ubiquitous, drug-based, novel water-pollution).

Staff will work to enhance a computer network, a nest of now-tentative lines among vegetable species and varieties available—select planting mixture used, age components, roots, delivery successes, purchased food, and aged waste. The network will also consider a processed component, processing energy and costs, waste, and will account for food discarded or unprocessed (i.e., due to disease evidence). The coded network procedures will include assessments of assigned palatability and personal (family or population) consumption weights, following processing procedures; probable nutrition ranges and weights; reported deliveries; probable multi-human consumptions; and overall costs per human life-day. All analyses will lead purposefully to local human health and wellness, as part of **Q*, the quality of life index**, over many years (Chapter 11).

We may already concentrate on plant and food growth, but we often fail to mix with such study and work knowledge such as: more can be gained from cooking wisely than from wisely producing and buying family food. Rural System will seek to identify common sources of food waste, and identify strategies to reduce waste.

Resources for buying family food are needed, and Rural System may arrange resources for gaining money or its equivalents (e.g., hours of labor). Together we shall discuss and plan as we imagine and discuss:

- the home place,
- history and hope,
- food and the family, and
- water and wealth—the options.

The Rural System Alpha Unit will become known well, variation under control, and will likely be widely used for analyzing and prescribing, for maximum stable cost, suitable human food (nutrients emphasized) for the near future. We work to learn of companion crops, such as legume-cereal "intercropping," gaining positive relations among plants for shade and structure, nitrogen gains, and moisture conservation. We shall explore the use of high-algae moisture additions, intensive pasture foraging for soil improvement, alternative-patterned forest stands and inter-stand patterns (as seen in agro-forestry practice), and pond-proximal stand cultivation.

Only with computer assistance can we likely achieve desired annual and long-term objectives from mixed crops, annually, over large rural areas. With expert help and data stored within **VNodal**, we shall seek to gain diverse benefits and profits from local gardens, many emphasizing differences intrinsic within area **clusters**.

We shall analyze the regional maps and what now grows within the boundary of each ownership using GIS/GPS, and we shall conduct roadside surveys to train Alpha Unit use based on our findings. We shall map and build data files about each Alpha Unit on all properties,

computing “cropland production”: a summary concept for all “lands,” excluding separate analyses for ponds, forests, wilderness, and roadside areas.

We shall subtract forested lands from the cropland production analysis, for economics will cast them as less valuable than those categorized as food-crops due to the time needed for tree-crop production. Then, we shall subtract all of the occupied areas, the land with road surface, those with dams, poisoned land, and lands on which it is impossible to grow and harvest crops. Some are too steep, too wet, too rocky, known to be barren, or lately poisoned… (We shall designate roadside areas as “polluted,” crops easily damaged, human-diseases uncontrolled, and crops likely impacted by waste along roadsides.) We shall include agroforestry crop-lanes. After subtracting, the lands left will be all we have for food production before nuclear and chemical contamination, full-scale exploitation. Our analysis will progress from all crop-land Alpha Units (i.e., all within a cluster, minus all inappropriate Alpha Units).

We shall study and report on microsite structure, and related costs and benefits of differences in temperature, light, local shadow, wind, lunar force differences, slope, aspect, elevation, and subsoil. Rural System will have identified and mapped such areas and found secure means for their preservation and best uses. Restoration and improvement work will recover some lands, and sunlit spaces may be used for artificial homes for plants, the plastic-covered green-house-like places, tall-tunnel houses, where prized food plants will grow.

All areas are dependent upon soil health. We shall attempt displays of the meaning of “soil health” and how to interpret it, and shall promote our healthy soil in marketing efforts. Rural System is devoted to displaying and teaching about sub-soil development. We shall study separately, and usually in parallel, a type of soil being formulated (selected and mixed) for diverse demonstration and sales/marketing attention: “**Vital Soilife**,” a potential Rural System product. We shall evaluate and show-off, as appropriate, our very diverse soil as a standard for various simplifying comparisons.

Rural System recognizes the importance and developmental potentials of pastoralism, as a production system and way of life, with increasing economic activity in producing milk, meat, leather, wool, and other products for domestic packaging, processing and consumption. Rural System may eventually apply intensive pasture management within climate-suitable areas, and grazing for understory suppression and site-improvement within some areas. Specialized Groups related to pasture and range will require a work force, and so will move counter to emigration trends and urban emphases, and engage questions of essential human nutrition elements to be produced per feasible unit area.

Early in Rural System development there will be no large livestock Groups. Large animals require intensive management and very personal attention … and the people now continue to emigrate! Later in Rural System’s development, after structures, fencing, effective care, new pasture management and a stream of profits has been well-established, Rural System may launch livestock-related Groups for ownerships and select, small tracts that would benefit from them.

Rural System sees opportunities for producing work animals, animal wastes for plant growth, exports of live animals, and animal products (with foreign-exchange potentials). There may be novel potentials within agro-silvo-pastoral producers. New forms of fencing, handling livestock, and marketing products may alter local options and varieties of livestock handling (e.g., the valued pastoral beauty of managed grasslands in the tourism industry, and using goats to remove vegetation, thus removing extreme wildfire risks).

Only small farm animals (poultry, swine, milk-goats) will be suitable human-food animals in the future. A picture from China emerges; human success in the sculpted plateau lands is a hopeful demonstration for other lands of Earth, for there we may see future areas where conventional food supplies do not meet needed production. We may study using small herds of small, foraging goats within mobile, fenced areas to achieve plant and other desired characteristics for select, prescribed "plots" or Alpha Unit "spots." Within such mobile activities, staff engage in erosion control, trail building, and watering-device repairs.

We know well the imperative of stopping erosion, but we know we must re-shape the land—all of it; soil-surface "injury," if un-healed, spreads widely and quickly, like an infected wound. We have to find ways to restore mineral nutrients lost over the years from soil areas, with timely, well-distributed commercial fertilizers (notably of increasing cost), and "clean" wastes for our worm processing (composting) and diverse decomposition efforts.

We seek other food sources within ponds and streams, but find the costs of production, processing, and delivery of aquatic fauna to be very high. We study alternative foods, such as algae and insects, and study abandoned high-rise buildings for new food-growing surfaces (i.e., where there will be "experimental ecosystems," because some human lands now seem unlikely to be suitable for high volume, mass production of food).

The Bees Group – Managing a Different Kind of Livestock

Keeping bees is a fascinating and profitable pastime that can be practiced in most areas of the United States, with relatively little trouble and a minimum of expense. Only a few dollars invested in equipment, a suitable location for hives, and an elementary knowledge of the habits of honey bees are needed to initiate a beekeeping operation. However, expert knowledge is needed, as with other "livestock," for consistent, superior production and marketing.

Rural System's **Bees Group** is part of the "land doctor's" bag, as he or she explores the health of any rural ecosystem. Beekeeping is challenging, and successes or failures may better reflect the beekeeper than the bee population or their hives.

The honey bee (*Apis mellifera linnaeus*) is said to be humankind's most useful insect. In the United States alone, they produce $100 million worth of honey and beeswax annually, while pollinating more than $2 billion worth of valuable agricultural crops. Animal-pollinated food products have been tallied to constitute 15-30% of US diets.

Insect pollinators of crops are often assumed to be "given" as a service to people from within nature. Yet, land use changes, climate change, invasive species, and diseases may cause a decrease in pollinators, their role in ecosystems, and the pollination service they provide. There is now a known decline in insect pollinator populations, caused by a lack of food sources, and the influence of disease and pesticides on egg laying, dispersal, and other diverse interactions.[19]

There are now abundant reports of bee hive population disease. Honey prices are high, and honey can be a valuable food and rural product. There are many local experts in Southwest Virginia, and the Cooperative Extension Service often offers published and personal advice. Within Rural System we plan to guard against bee pests and diseases (viruses and mites). We recognize the need for protection of hives from wild and domestic animals, possibly with electric fences, with the aid of Rural System's **Fence Group**.

[19] Vanbergen AJ. 2013. Threats to an ecosystem service: pressures on pollinators. Front Ecol Environ. 11(5):251-259.

Warming due to climate change may be a benefit (one of few) to raise bee colonies and queen bees for their roles; insects, being exothermic, are more active in warm temperatures. With many ownerships and variable elevations and protective tactics, a diverse quality and flavor can be created for significant marketing, branding, and profit gains. Climate change also increases weather uncertainties, and a new tactic must be developed to control hive moisture, which affects temperature and the likelihood of "mold" diseases.

We plan to diversify honey taste and quality, and market nationally and then internationally to key groups. Select management units will contain flowering trees within agroforestry lanes, with visitor/guest trails to come to learn, study, and experience our bees and honey. We expect wild fauna damage, shall work against it, and shall monitor attacks and evidence (displaying it in select areas for educational opportunities for visitors).

We propose (as basic to our business) an in-depth study of local forest and range pollination, abundance, duration, and life, as affected by the biotic and abiotic factors typical of regional land ownerships—especially noting ecological roles in grass-forb forest edges, the bee as prey of forest/field birds, the phenology of pollen abundance, the role of pollen within the complex soil ecosystem, and the effectiveness of bee hives stationed within tall forest canopies.

We shall develop products from local wood, including honey "spoons" for dipping, candies, poems, songs, and recipes. We shall invite studies of the reported first-aid and healing properties of honey.

There are 4,000 total bee species. We'll be studying our local species for change and its effects on our total system success. The loss of proper, adequate pollinator interactions with crops may affect human food supplies, i.e., food security. We need habitat networks, reduced pesticide risks, and new therapies reducing disease within these pollinator populations. We need "approaches" to landscape-scale resource management, balancing the production of food and timber with pollinators, pest regulation, and water purification—among other management concerns explored herein—for resource security.

It is a peculiar logic, a dialectic, that separates the life forms of nature and discusses them not only as benefit providers (as done by economists) but as "service providers." Services are inseparable from their providers, and usually providers are inseparable from their communities… and thus who gives and receives, provides and prospers, are inseparable among those usually bent upon discrimination.

Kremen and Ostfeld[20] suggest that services may become so well-known and distinctive, that the ability to provide them may become known and managed for increase or stability. Yet, difficulties encountered in replicating or restoring wetland ecosystems is cited as evidence of the cost and near impossibility of reproducing or managing ecosystem services—poorly defined, poorly known—and that this fact is an incentive to *protect* ecosystems and their services.

Rural System's Good Garden Group

Staff of Rural System study and work toward developing a **Good Garden Group**, specializing in superior garden products for guests to purchase.

Will our garden produce be "organic"? Widely used, in Rural System that term relates only to our own classification of "organic" produce.

[20] Kremen C, Ostfeld RS. 2005. A call to ecologists: measuring, analyzing, and managing ecosystem services. Front Ecol Environ. 3(10):540-548. doi: 10.1890/1540-9295(2005)003[0540:ACTEMA]2.0.CO;2

Type #1 Organic in Rural System, means that the crops are from our tracts of exceptionally high-level organic-matter soils (>25%), those not treated with organic pesticides, and well-processed by our "herds" of native earthworms.

Type #2 Organic means plants grown in our highly-processed carbon-rich soil, with thrice-turned, GIS-selected, local vegetation mix.

Type #3 Organic means only that the produce was grown in conditions fed only with plant food bearing no pesticides, and that the final produce for sale is free of noteworthy pesticide residue.

Local means produce is grown and sold nearby, with minimum distance and fossil-energy cost of delivery to sale-place.

While USDA's "organic" certification may be a useful and respected condition, we have learned that the condition is not profitable, the produce may not be of high quality, the public response is not widespread, the nutritional and health benefits are not clear, the results on the land are not well accepted, the wastes can be large, and the paperwork and filing costs are high. That's more than enough to name a problem. The other part of the problem is that rules and regulations are not adequately monitored, and are subsequently not enforced.

From Berkeley Wellness,[21] we gain a report confirming that organic foods are not more nutritious than conventional foods. Stanford University researchers' review of over 200 studies, "found no significant overall differences in nutrients between organic and conventional fruits, vegetables, meat, poultry, eggs, milk, and grains - or in people consuming them, such as in blood vitamin levels or immune markers." However, organic produce and meats were 30 percent less likely to have detectable pesticide residues than conventional ones. (One expert observed that there is no clear evidence that low-level residues in foods are harmful for consumers.) "Organic fed/processed meats were less likely to harbor antibiotic-resistant bacteria" than animal tissue of those with conventional diets. Antibiotics will be prohibited in our organic operations, partially because these contribute to the increase in anti-biotic-resistant infections in people.

We plan to develop information about our produce for buyers to describe our procedures, reasons, and expected customer benefits from our garden produce. We know, and share with customers in our publications and guest lecturers, that foods are only one part and function affecting a human's long-term health; other functions include genetic inheritance, diet consumed over a lifetime, total activity and lasting adverse event effects, environmental exposures, and infectious agents/vectors. The Good Garden Group will work with all of these elements, and invite guests and staff to learn from us their full meanings and effects.

We hold that our species-specific crops should be produced on the right soils at the right locations (growing season, slope, aspect, irrigation as essential, pollution free, etc.). They will be grown in Alpha Units, our unique, GIS-indexed spots of Earth. The meaning of "right" soils is being defined, and for preliminary work it means grown with minimum additional water, nutrients, or remediation, for an estimated proper-length growing season; with minimum environmental stresses (primarily water stress) potentially resulting from or correlated with insect, disease attacks, wind, or related physical damage; and minimum energy costs prior to consumption (planting, transportation, and preparation of a serving).

We have begun and are continuing to describe our objectives for the desired conditions of our crops as they grow. We seek a well-agreed-upon word or phrase for improved, profitable, long-term branding of our work and its results – healthy for the land, for the crops, the resources

[21] Swartzberg J. 2012. The Right Reasons to Buy Organic. Berkeley Wellness [Internet]. [cited 2017 Apr 18]. Available from: http://www.berkeleywellness.com/healthy-eating/food/article/right-reasons-buy-organic

upon which they depend, and for the people that use them. For now, it's simply "Rural System's Good Gardens."

We believe that many of the lands with which we plan to work have been mined of their nutrients by past crops and harvests, and also by dissolution and leaching (e.g., the limestone and karst-topography), by sheet erosion and floods, and by livestock grazing and subsequent removal. We cannot expect such soils to produce for future people as they have for past people because the essential nutrients are diminished. We believe in adding the lost ones needed for superior, healthful, useful crop and tree growth. The nutrients we intend to add are documented, fundamental elemental minerals used by plants, many of which are used in the essential mineral processing systems of people. Thought costly, we will monitor the soil chemistry of our croplands and water bodies, collect food wastes from our customers, and, after processing, re-unite the nutrients with the land for the people of the future.

We well-understand that nutrients can be added and that the proper amounts are needed to achieve a desirable cost-benefit condition. Yet, excessive applications to the land can be costly, even harmful, related to an important, intricate system. Mining operations for many major fertilizers are energy-intensive, and surges in energy prices (from any cause, hurricane or not), can increase producers' cost structure. Reasonably, that pushes up price of fertilizer products, expectedly causing farmers to decrease nutrient use and delay buying for future fertilizer use. Available nutrients then become a factor in deciding what plants to plant, influencing what cultivation methods and protection will be needed, and, full-circle, begin affecting the amount of costly energy that can or will be used to achieve profitability within the Good Garden and related promoted projects of Rural System. Rural System's crop profitability is therefore likely to be strongly influenced by quantities and bid prices on international fertilizer export demand, which influence prices of fertilizer products for our applications, which affects the amount we can purchase, thus drastically influencing the vigor of our well-placed crops and residual inventory.

As well as dealing with variable prices for nutrient applications, Rural System staff are well-aware of current and increasing surface and groundwater problems. We plan to irrigate carefully, fully aware of the continuing nutrient leaching that takes place on cropland soils. We shall capture and hold water, minimally using groundwater. We shall monitor these waters carefully and use the results to adjust the water use, soil amendments, crops selected, and the rates of removal and "binding" techniques being developed.

We are particularly aware (from reported studies) of the effects of plants being stressed. Those stresses create conditions attractive and/or beneficial to insects, and bacterial and fungal disease. These tend to produce preliminary discoloration or "spots" that significantly reduce the sale appeal and value of crops… if the crop itself is not destroyed before harvest. We shall carefully use biocides as needed to produce healthy food. That use itself is complex, and involves selection, carriers, timing, sequences, combinations, amounts, equipment, washing, delays since application, and transportation time and wind, temperature, and sunlight conditions… all within a system mastered by Rural System for **Healthy Crops** in lieu of "organic."

One of the ways that we shall reduce plant stress and thus crop-value reduction *and* the need for biocide uses (for crop pest or infectious disease control) will be to build superior soils. A key process includes crop rotation, which controls erosion, maintains or improves soil organic matter content, and manages deficient or excess plant nutrients. Sod strips, cover crops, green manure crops, and various mulches will be included in the rotation to perform these functions.

"Healthy Crops" is one of our phrases, denoting crops very beneficial for humans. There are some foods sold that have little nutritional value, and others that require large amounts of energy to harvest, process, prepare, cook and serve. There are some that are just too costly, said to be "not worth the trouble." We plan to sell stable, healthful food, at lowest reasonable prices, from especially well-managed lands and waters, and with the food, we shall provide advice to make it useful to customers, i.e., to improve their health and that of their families, and to reduce wastes. We shall seek to be known for selling reasonably priced, "really good" food.

We study and work toward improving the following statement of a desired condition of hay and vegetable cropping systems. We call the desired "healthy," meaning:

- Able to grow a primary plant community within a year and move along a recognized, diverse stage of transition to the next community;
- Offering only superior rural produce to customers/clients/guests;
- Maintaining a reputation for profitable production of tasteful, sparse-blemish, nutrient-high, reasonably-priced basic foods, consistently, for a very long time; and
- Using Rural System's 150-year bounded production model, with "sustained" results sliding forward a year, each year.

"Sustained" has been and remains a smelly, wet, deep word-bog—a mire of unclear meaning. Rural System provides current understanding of the term "sustained," and how it will be used to inform our future work and its profits.

Sustained –

1. a perceived condition, at a place and point in time, typically resulting after a series of actions, as in "after the project, the species was sustained";
2. within a human-influenced system, species or functions not yet extinct, extirpated, or destroyed;
3. a perceived condition persisting over a period, possibly with unstated (but needed) periodicity, fluctuation, and contingencies and constraints;
4. not permanent, but almost, as long as all of the conditions needed persist in quantity, quality, and sequence, and when interventions, if needed, are in place;
5. a past-tense verb, to have caused the condition of the system to exist for a stated period, e.g., by the combined efforts of A, B, and C, they sustained the production index of the region for over 30 years.

To sustain – The actions and processes that cause a system to be sustained. "Sustain" for how long? The life of a tree? A human life expectancy? Ten generations? An expression of an approximate period of concern seems needed, as well as the connotation of on-going inputs and processes. "Sustain" is a verb, generally meaning that a proposed or observed action should not seriously harm, impair, or significantly change negatively (or rarely positively) a structure, condition, process, effects, or output of a system.

Sustainable – An identified system having characteristics and conditions that allow the decided or specified condition of "sustained" to be achieved (1) ever, or (2) in some specified, implied, or policy-bound period. It means "able to be sustained." Sustainable is a prospective noun, a condition, a processing state or status, e.g., the system may not now seem sustained, but it might be made or reshaped within a year to become sustainable. A system may be asserted to be sustainable at some level of operation (or implicitly "now") when some time scale, conditions, or investments are also stated.

Sustainability – Having conditions and forces that may allow, perhaps expressed with a probability greater than zero, a condition of "sustained" (as defined above) to be reached. Sustainability means the ability to maintain an effort at a given level or intensity, and an entity encounters difficulty if that "given level" is a declining rate (e.g., - 0.05 for toxicant removals or population rate of change). A word excessively and indiscriminately used since about 2002, sustainability has had use that was not sustainable. Flawed, the word or apparent concept behind it has no intrinsic lasting ability. Perhaps some systems have no sustainability; a negative is hard to prove.

Stable – Having a specific, usually limited rate of change (usually zero) over a specified period. The bounds or limits of that rate, if an estimate, need to be discussed and decided if the condition "stable" is to be asserted. A stable decline or increase matches the definition. A decline may be very stable for a period. A stable animal population of different sex, age, births, and mortality classes is a special complexity.

Static – A system in equilibrium with no net change of forces.

Having many meanings and connotations (and these are still debated), having a "sustained" system implies using practices and approaches that assure that it, the present system (or perhaps an evolved or improved one for the future), will persist. We want to know what "sustained" or "sustainable" really means in each particular situation, because we can imagine going to court and being confronted with the argument by some client that we have not sustained a resource, or that our work resulted in a condition (even if it was our intent) that was unsustainable (i.e., a very bad condition that should be reversed and made unsustainable). The subtleties can be missed by people who have not resolved the difference between words like "continuous" and "continual." (Some dictionaries suggest they are synonymous but the latter word may include recurring events, regular or not.) We have to say precisely what we mean in many situations, the more the better, because then we can build a strong conceptual structure as well as avoid the passing assaults of those who do not understand what we attempt to do.

"What has the future ever done for me?" quips a humorist. Sustaining good things into the future may be costly, and some people may not want to invest on behalf of those who will live then. Not so funny is the need to decide on a relevant time frame for any planning, and eventually to confront the issue of intergenerational justice, i.e., how can we decide on a criterion which, if met, assures us that we are behaving justly toward future generations?

It may be that assuring justice is a condition for sustainability of a social system. Without it, history is writ large about societies that have not been sustained, frequently disrupted by those believing they had been treated unjustly. Unjust or just, unfair-seeming because of the disproportional wealth of some people, organizations continue to bear the heavy burden of past decisions, wishing to avoid a sustained handicap.

A notable "handicap" condition exists… as we learn of whole human island communities endangered by sea rise related to glacier melt and rising sea water due to human-caused air pollution and climatic warming

In forestry and agriculture, it is well known that perfectly stable productivity is unlikely. Production practices change; nutrients are removed. Staff efforts in Rural System enterprises are directed to finding and being assured that they will have a desirable working system … and to keep that, even when modified to address natural, legal, and policy changes. Actions are designed to meet changing human needs without degrading the environment or the natural resource base upon which achieving the objectives depends. Achieving the abilities and eventual condition of sustainability within an organization is treated as a dynamic, somewhat mystical

activity, allowing for and meeting shifting demands in combined ways that enhance future options for effective resource utilization.

It seems unlikely that we or other practitioners can prevent the loss of all threatened species in a state or region. Conditions have changed; some species cannot be sustained. We might do research and find out precisely why they cannot be sustained. What shall we do with such knowledge? Maybe they have no innate sustainability characteristics that allow them to face successfully the changed conditions of the world. Maybe funding to help those species was insufficient, though knowledge was adequate. Maybe knowledge was static, and no one knew how to use it.

Achieving sustainability is a false god, an open door to controversy, a sandy foundation for future work so badly needed. Simplistic publicists want a single word for their work. Those words selected were well-intentioned but too loaded with meaning and diversity to be useful now.

Work within Rural System over a broad area for the future will address arresting and reversing natural resource degradation. It will also address issues of declining crop productivity, and how to double food production over 25-40 years. Solutions are unclear, but for now, they include centralizing administrative and overlapping functions, coordinating, reducing duplications, using complementary practices, reducing competition, balancing endowments (money and resources), developing synergistic Groups, expanding the scale of select operations, and joining in setting priorities for project work and waste recovery.

Temporarily, all Groups will have access to specific, required GIS maps from the GIS Group. VNodal will use such data to achieve Rural System objectives of selecting crops and crop sites, building trails, expanding gardens, locating portable toilet sites, marking timber, establishing mowing patterns, scheduling pasture, making preferred re-seeding, building outdoor presentation areas, and developing sales media.

Each Group will order specific planning services from VNodal, e.g., growing tomatoes in an expanded garden beside a former home site. In the tomato example, three programs would be accessed, and will have been modified so that site conditions are separated from care and tending and regional blight probabilities. For another example, noteworthy flowering plants found at an old home site may be transplanted to a GIS-mapped, new site with best elevation in best shade with best soil conditions.

A **Modern Yards Project** will be started by four relevant Groups (including **The Gardens Group** and **The Yards Group**), primarily to reduce storm water loss, enhance groundwater, reduce mowing noise (**Earshot**) and fossil energy use (**The Energy Group**). The Modern Yards Project will plant flower gardens near impervious areas in former grassed yards, develop a small-version “Victory Garden” and do garden cluster marketing. It will use mob grazing (for soil nitrogen gains) by goats in mobile, electric-fenced yard areas; add yard sculptures; and gain certified status as having “fine fauna” places for diverse, year-around songbird enjoyment.

The Gardens Group

Rural System tends to respond to owners of small “farms” who are leaving rural lands for the cities, but it prepares for a major additional option—one of small land parcels of vacated farms being arranged for highway-access land-sale as home sites and “Hobby Farms.” There are about 70 million households engaged in gardening activities, or doing outdoor decorating.

Landscaping can increase the resale value of a house, thus there is a clear financial justification for landscaping work, both for those leaving and for those homesick and eager to see the changes. We have soil and ecological knowledge to back a landscaping or gardening enterprise. There is, in some areas, high county-level support for general services for dispersed tracts (e.g., water, access, waste disposal, schools, and safety). We shall work with the marketing potentials of such areas.

Owners are often swamped by demands for activities for "the front-yard" lawns and gardens for their new lots. "The backyard may be developed soon" is heard. A Rural System Gardens Group will demonstrate a principle of "economy of scale," offering land owners, often who have purchased large lots, service-gardening within their backyards. Clusters of such garden areas will be studied and encouraged for their increased economy of scale.

The Gardens Group will offer owners a contract service to produce and manage beautiful fenced gardens on a portion of their home property. Much like a "lawn-service," the Group will permanently manage, on each contracted property, a designed garden with flowers and garden foods, and achieve work-free management of the garden for the family. The Gardens Group may add lawn care, fountains and ornaments, diverse wild-bird foods, nests, and bird-baths.

Existing soils will be analyzed and then, based on conditions found, adjusted to an optimum standard of texture, organic matter, and fertility. Catchments will assure moisture in water-limited periods. The Gardens Group will work with other Rural System Groups, such as **The Pest Force** and **The Fence Group**, as needed. Fencing protects gardens from vertebrate pest damage and vandals.

Each garden will be specifically located with GPS coordinates, and a database with information on each garden will be prepared. Optimum seeds will be provided for the most profitable crops that can be produced on the plots within the specified location. Garden owners will be encouraged to achieve maximum-quality production, for they will earn additional income in sales of produce.

The gardens of all willing neighbors under contract will be managed in clusters, as if from a single regional garden, with advertising, cooperative sales, and marketing for all types of garden-related services and products (with partial financial returns to the landowners). Similarly, The Garden Group may invent, maintain, and enliven existing gardens for the general benefits of guests, visitors, and owners. The well-tended gardens, when abundant throughout the region, will give a distinctive look—additional charm and beauty to the area.

We must participate in growing and marketing the world food supply. The global population (that will reach 9 billion people by 2050 AD) will need food, and that must be increased by over 70% of today's production. Rising risks, fertilizer prices, and fossil fuel are all in the way of an already difficult task. Not only on highway-side tracts of absentee owners, or those with little time for gardening, The Gardens Group, working closely with other Groups when necessary, will offer intensive-use, computer-aided garden development—area-wide management of plant "housing," soils, local compost, disease controls, theft protection, marketing, and water management.

Part of gaining human food, beyond that of estimating needed nutritional units for all healthful, non-wasting members of society, is gaining superiority over insect and related pest behaviors, and losses of plants to disease or harmful handling and storage. In addition to intensive animal behavior controls, other controls are needed for those in plant values with major alternatives gained by managing water; reducing wastes; selecting precisely-appropriate sites;

cultivating carefully; fencing; and simultaneously avoiding edges and trails, accidents, fires, theft, and terrorists' behavior.

Cropland Weed Control

Given expected, reported changes in weed elimination and control, we shall evaluate results from reported sites and study recommended treatments with site-characteristics known, including sequence differences in local applications:

1. Sequential weeding,
2. Sequential herbicide application,
3. Sequential shading (soil coverage, e.g., black plastic),
4. Heat-Rod application to early-adult plants. (Rural System's Heat-Rod is a concept to be studied for a well-heated metal rod that kills weed-plant roots.)

We shall combine other strategies for weed prevention and control:

1. Use of clean and vigorous seeds;
2. Selection of super sites for seeds (to ensure they will be strong competitors);
3. Use of space also occupied by non-weed species, and companion planting;
4. Continuing analyses of sites prone to weed growth;
5. Careful harvest and destruction of seed-bearing weed plants;
6. Two attempts at herbicide control, followed by alternative recommendations;
7. Aggressive, trained duck weed-seed foraging;
8. Broad-scale, timely moving to reduce seed dispersal;
9. Modest, timely weed removal and destruction;
10. Use of rural system wind barriers to reduce seasonal seed/weed plant dispersal; and
11. Required seasonal use of boot covers for guests entering garden areas.

Fencing In and Out

The Fence Group will provide land and watershed protection, but also a powerful managerial tool silently guiding people, animals, vehicles, and visitors' eyes to historic landscape beauty, protecting growing food supplies and providing solar-electrified protection for bee hives from bears. The Fence Group of Rural System will play a large, growing role within land management of all types, from studies to assistance in protecting crops from unplanned animal use. Crop loss prevention is a key challenge to overcome in Rural System's work toward increasing and stabilizing human food supplies for future people.

The Group will design a visually distinctive set of very suitable fence types that will contribute to the rural character of each county. It will develop an efficient procedure for installation, create horse and other pasture fences, and specialized fences for gardens, beehives, and rabbit housing protection. It is likely that signs for Rural System enterprise environments, **Dogwood Inns**, cemeteries, and various other Rural System sites will be created in this Group. Local woods will be used for fences and signs at some sites. Notable but compatible colors will be used, as well as minimum wood preservatives. Bird houses will accompany almost all Rural System fences, for wild fauna as well as functional benefits. Nested hexagonal pastures will be

used in rotating grazing to areas rested from use, and for creating unusual patterns on the landscape. Lay-down fences will allow maximum soil rest rotation and mob-grazing strategies.

Flagpoles, with locally-made colorful flags, will typically be placed at two corners of each fenced pasture. Undersized wood will be thinned from forests to supply fencing and to improve forest stand quality. Special efforts will be directed at stream and pond bank fencing to reduce erosion and to improve riparian water volume conditions. Abundant fencing will be needed throughout each property to allow for livestock management later, though livestock management is not planned for absentee-owned lands if caretakers are not present. The Land Force will likely be otherwise very busy for the early years of management. Later, livestock may enhance rural beauty and atmosphere, and aid in soil improvement through intense, fenced-grazing. Stone walls, or fence combinations of stone and wood, especially for contoured areas, may be appropriate for some livestock and trail sections.

Abundant, low-quality wood often exists on areas within the region. In this planned enterprise, a log splitter can be used to form or split small fence rails. By immersing them in a gas-, coal-, or wood-heated vat of preservatives they can then be used area-wide or bailed and moved by rail or truck to urban centers for sale, for yards, estates, and farms. The preservative properties of daffodils, Eastern cedar, Christmas ferns, common moss, black locust, Ohio buckeye, and walnut hulls (from the Walnut Vales Group) will be investigated for use with bio-preservation substances.

By careful, planned use of a unique fence style, the image of the region and the corporation can be built and enhanced. Visitors may so admire the fences they will order them for their property. Guided employment and salaries will be noteworthy.

Consistency of style and evident "fit" into the planned appearance of the total property will be necessary. An architectural review panel will be consulted for fences as well as other Rural System structures. They will have the responsibility of deciding on or approving paint, color, texture, proportions, materials used (stone, glass, wood, etc.), and otherwise assuring a high-quality visual experience for visitors and one that enhances the life quality of the residents.

Deer damage has reached unacceptable levels in some areas. Work with **The Pest Force** is one option that will likely develop, but a separate subproject of The Fence Group may develop a cost-effective, high, out-rigger fence for protecting nurseries, crops, and high-valued landscaping. Solar-energized electric fencing and repetitious use of repellents (as from a lawn mowing service) may also become part of the supplies and services provided by The Fence Group.

Significant fencing literature is available from county cooperative extension offices. There are experimental designs for outrigger fences related to gardens and select landscaping zones within cities and border areas. Fencing limits will vary, and extensive public inputs may be needed for large-area satisfactions.

Homeowners may wish to keep deer out of their property areas. Some also wish to allow dispersal of other species (e.g., turtles, bobcats, canids, etc.) across the landscape, now blocked by some highways and structures. However, if the current trend of installing deer fencing continues, a town or area may become a collection of isolated habitat islands. Instead, we shall continue to search for a “magic” fence that acts as a semi-permeable membrane, filtering out deer, while allowing other species to pass through. Extensive fencing of our landscape is undesirable but here to stay. We must find a way to minimize the impacts of fencing or to change animal behaviors, a combination, or consider a de-valuation of the animal or its effects.

The Fence Group may use fences to move animals away from (or toward) photo areas, toward hunter blinds, or to particular areas for observation and image gathering. Staff are likely to explore increasing and controlling the wild faunal values present, with blinds for wild fauna watching, animal feeding, using highly-visible electric-fencing, and select locations for organic repellents. Controlled culling of deer by expert teams now seems a reasonable solution to a now-growing problem within rural areas in the absence of native predators.

In towns or built-up areas, shooting at garden pest mammals or birds is dangerous or illegal. There are usually people or animals in the background. People usually only try trapping animals attacking a garden after damage has already occurred and been noticed. The losses may be great; large deer populations now damage crops.

Garden animal pests are a big problem and a fence may be a solution, i.e., calling a vertebrate pest damage manager such as those planned for The Fence Group and The Pest Force. Electric fences with solar power sources may offer adequate behavior control.

Integrated Pest Damage Management

The Pest Force is a planned, integrated pest damage management enterprise within Rural System. Its function is central to the sustained profits of Rural System's work with land owners.

There are poisonous snakes. Gardens or crops are eaten by deer. Woodchucks get into gardens; bears destroy bee-hives and sheep (and in some areas, signs and tree saplings), birds eat grain; raccoons get into young corn; foxes kill poultry... and bats frighten some people. Reducing real, significant loss within a total production system is an objective of modern Rural System management.

The Pest Force will exist to meet the needs of citizens, corporations, and agencies. It is planned to be a private, for-profit corporation seeking to improve comprehensive, total system management with other Groups of the Rural System.

The Pest Force will concentrate on damage, not necessarily on the animal apparently causing it. It will seek to reduce and manage that damage in legal, humane, and cost-effective ways. Their analysis of costs over time will use a combination of methods, often selected with the aid of a VNodal program, to gain an optimum strategy of damage management. The land owner may implement the selected and recommended strategy independently, or may obtain Pest Force services to do so. Fees will be paid for the visit, analysis, and implementation.

Profit need not be made exclusively from product and service sales. A *net* return is achieved in profit; reducing losses is fully as essential as improving gains. In some situations, wild fauna may become a pest. There are various definitions of "pest," but herein the emphasis is on reduced or limited benefits and costs of money, time, equipment, future tree or crop growth, and quality of recreational and outdoor experiences. The emphasis in Rural System is on the lost benefits and costs, on the damage, not the animal, but the productive system.

In some cases, the pest may be an insect species—an herbivore susceptible to chemical application. In a recent book, *Integrated Pest Management of Tropical Vegetable Crops*,[22] the author assembled the factors likely to be faced by The Pest Force and others in the complex decisions dealing with insect pest control. The number of factors is impressive, challenging and persistent, making repetitive use of computer aids necessary and worthwhile. Among available control methods, cost comparisons are needed, as well as consideration of: timeliness, land

[22] Muniappan R, Heinrichs EA, editors. 2016. Integrated pest management of tropical vegetable crops. Springer Netherlands.

treatment, crop value, labor available, local laws and changing regulations, shipping available, freshness of harvest, control substances available, targeting of control applications feasible, control substances' effectiveness, and local markets attitudes toward substances found locally suitable for chemical control of insect damage to crops. Managers must also consider ever-present, harmful climatic/weather events before or after chemical application.

The methods of control will thus depend on the pest species threatening Rural System enterprises (which are furthermore not limited to crops). Rural System will focus on preventing damage, and may not rely heavily on chemical control. VNodal prescriptions of the best sites for crops or trees and their density will likely reduce the need for chemical control in some cases. For example, trees that are not water-stressed—that are spaced adequately to reduce competition between individual trees—will not release the chemical signal that resembles the reproductive pheromone of the bark beetle. Trees that are not stressed or dying should therefore be less likely to attract and succumb to bark beetles.

In other cases, the pest may be an animal species. The Pest Force is not a group of trappers (though trapping may be the only cost-effective, legal, safe, and timely response to a disease-related or fierce animal problem). Its trained staff is willing to work in often-dangerous conditions in order to solve people's immediate, often costly problems. Many of the problems are not those of direct financial loss, but of lost quality of life, sleeplessness, fear, annoyance, and uncertainty.

Trapping is a special skill and requires site-specific and animal-specific equipment and licenses. Live trapping is often illegal. Killing and removing an animal from a live trap can be illegal and dangerous. It is illegal in most places to release the animal other than where it was trapped, for it is socially irresponsible; animals often return over great distances, and the potential crowding at the release site causes stresses and does not help the wildlife populations at the site. Very often the offending animal is not captured.

However, we see trapping as a part of the nation's history. It was a part of settling the land; protecting people, livestock, and cultivated areas; and obtaining food and clothing in early pioneer days for rural people. Today, trapping is part of a diverse international fur, meat, gland, and medicinal industry. It is an economic mainstay for some, and a source of extra income for others. It has rarely-assigned recreational value.

To operate a trap line is hard work, but it provides an opportunity to be outdoors. Given success in so many areas, "pest" control has become a necessary activity for farmers, ranchers, orchardists, and increasingly for people in cities affected by wild animals. Trapping may be the only practicable means for controlling damage to the land itself. Skills in trapping are fundamental to sampling animals and to obtaining information for decision making... or basic knowledge of animals, habitats, or behaviors. It is used in some types of disease surveillance, notably rabies control efforts.

Trapping is said to be a recreational activity for some people, but we view it as very costly of participant time, having too many probabilities for consistent, planned payoffs and meaningful successes. As it was with pioneers, it may be essential for survival for some families. We shall work to produce a high ratio of benefits to costs, with minimum personal and group displeasure. The same animals sought for trapping may often be seen by visitors and guests, adding to the diverse, pleasant, rich experiences of those visiting Rural System lands and waters.

Continual work is underway on improving traps and trapping procedures, gaining quick kills, protecting each carcass, and rapidly recovering animals taken by traps. Modern trappers control costs or losses, and use of effective traps (by many criteria), are part of modern vertebrate

animal *damage* control. Research and invention is underway on traps. Over 4,000 patents on traps or trapping devices have been issued over 100 years. There is great interest and concern for better traps, though the leg-hold and conibear remain popular and effective. Difficulties with traps are rare and usually associated with poor trapper procedures, not the trap itself.

We anticipate using trapping to influence crops directly; buildings; animal forage; game-bird-breeding experiments; perceived risks to guests; non-migratory birds affecting experimental crops; predator effects on stock and their profitability; predators on pond fish, their monthly weight removed and angling success; and birds-of-prey within special studies related to woodland-mouse production (related to bobcat, fox, raccoon, skunk, and opossum population foraging studies).

Specific recommendations within the Rural System programs and projects related to trapping are:

- to encourage superior trappers, largely through employment of certified, successful and well-trained experts;
- to continue to develop analytical techniques to relate pest-species-specific individuals', populations', and migrants' estimated effects over time on rural product profits;
- to set traps outside of areas or under conditions in which domestic animals may not be caught or harmed;
- to check traps regularly, at least once a day, and in the early morning;
- to label all traps and devices;
- to achieve balance with estimated desired effects on animal populations and desired crop production or "target" amounts;
- to engage in studies, and to improve animal behavior-control techniques by several criteria (e.g., fences, containers, repellents, crop substitutes, attractants, frightening devices);
- to continue to support improved recognition of animal damage causes, population size estimates, and detailed estimates of physical and monetary losses related to wild animal populations;
- to use effective traps as needed, some that kill targeted animals very quickly, and some that trap animals harmlessly;
- to support continual improvement in traps and trapping systems to increase their effectiveness and social acceptability;
- to dispose of animal carcasses properly, preferably for beneficial secondary uses, and at least so as not to offend other people;
- to concentrate on animals perceived to be of pest status or predators of domestic animals;
- to offer trained hunters opportunities and procedures for effective removal of vertebrate pests;
- to support strict enforcement of pest-animal-related laws and regulations;
- to support educational programs, both for trapping effectiveness and for allowing trapping as a tool to achieve many wild faunal resource objectives;
- to report promptly the presence of diseased animals to authorities; and
- to maintain records for improved faunal predator and prey resource management.

As may be sensed from the above list, there are many potential commercial activities that, working together for scale and scope, can become profitable within The Pest Force—essential in

protecting ever-increasingly valuable, high-quality, nutritious food supplies for human populations gaining the verge of 2050 AD.

Sensitive to human regard for life and treatment of animals, The Pest Force is also realistic about the threats related to animals infected with rabies, West Nile virus, tularemia, leptospirosis, encephalitis, psiticosis, and recently black plague. The interaction of the fleas of cats and dogs to those brought to them by mice and other animals is well known. Wild animals are reservoirs of insect-borne diseases.

The Pest Force will offer an effective program of town and neighborhood rat and mouse control. It will be equally responsive to select needs of people with immediate and long-term solutions, household and corporate, for problems with bats, moles, snakes, geese (e.g., golf courses and agricultural grain fields), woodpeckers (noise complaints and damage to exterior walls), feral cats and dogs, squirrels, gulls (airports), starlings, skunks, muskrats (pond dams), and garden pests. The Pest Force will offer effective deer management strategies in cooperation with **The Deer Group**. A specialized program for beaver management may be developed for **The Beaver Group**, one including beaver removal, tours, education, anti-preservationist work, publications, damage assessment, legal assistance, and integration with forestry and fisheries.

The Pest Force, backed by VNodal, will continue to build a database and report-system, and provide every customer with unusual information about each relevant species with pest activity. An effective Pest Force blog is planned, featuring pest species, young and old, and tales of the animals' ecology—food, living quarters—all for desirable marketing and Group branding, concentrating on financial loss-prevention and -reduction.

In some cases, research will be needed, but Rural System advocates a rationally robust strategy (Chapter 6), and sophisticated, commercial "expert system" software (Chapter 4). When research is needed, The Pest Force may work with students and faculty at Virginia Tech and elsewhere, providing employment and experience for students, and research and project options for graduate students and faculty. The animals involved in the work of The Pest Force will be measured and scientists will use results to learn more about the animals and effective control of their actual or perceived damages. Unique problems *do* occur, and the staff, with a taskforce, will attack such problems.

As in other aspects of Rural System, records will expand knowledge of animal distribution. The Pest Force will offer GIS analyses through System Central and The GIS/GPS Group. One recurrent theme in damage management is that the wrong crops (or other things of value) are put in the wrong places. "They could not have picked a worse place!" is often heard after loss to a foraging animal is seen. GIS can help developers avoid problems by selecting the right or "least bad" spots for crops, livestock, buildings, etc. GIS can help explain problem causes, identify trends, and project future problems as land uses change due to ecological succession or urban sprawl.

The Pest Force will offer unusual architectural design services. Major pest damage problems arise in faulty design. Simple changes in building construction can avoid costly damage reduction work year after year. A question-answer software unit will allow contractors, developers, and architects to solve some of their own animal damage design problems. Personal advice from staff will also be available, because the software will not likely address unique structures adequately.

Furbearers are a group of animals with great appeal and with unexploited financial potentials for intensive management. A rich variety of these animals lives in the Southwest Virginia region: raccoons, beavers, weasels, skunks, mink, and others. Furbearers need

management already, since they cause damage and can compromise other management objectives, but they can also be changed into parts of a profitable managerial enterprise: **The Furbearer Group**.

Much research has been done on them, but much, much more is needed and few people realize the complexity and relations of their system. The need is for some of the most intense, far-reaching research anywhere in the world. It should not only be on the biology of the animal (the past trend), but on the total profitable enterprise.

Agencies have waited for funds, but none to our knowledge have stabilized an intensive management system including standback, Context, feedback, futurism, and feedforward. The prospects are not for recreational trapping (strongly opposed by some), but for a viable, profitable enterprise utilizing some of the well-managed, non-threatened mammalian fauna, one of the natural products of the area, in ways no one else has been able to sustain in the past.

The laws that relate to controlling animals are now very complex. Trained, certified, bonded staff can avoid these issues, adding further to cost-effectiveness and increased value of services provided. Expert testimony can be provided. The Furbearers Group and The Pest Force of Rural System, as all other Groups, aspire to high business standards, leading to known standards of business excellence, of opportunity, fairness, and personal integrity.

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Rural System's approach to high-quality and quantity food production to feed growing populations, in anticipation of the 2050 AD food crisis, is an extremely complex system. In Chapter Three, we sketched the main components of Rural System food production, which includes but is not limited to:

- Alpha-Unit-specific precision management of crop placement, nutrient additions, erosion control, companion planting (i.e., permaculture), irrigation, etc.;
- Small animal livestock, such as goats and chickens;
- Bee "livestock" to provide stable pollination for Rural System crops, as well as various bee-related products (e.g., honey, honey spoons, and beeswax products);
- A new concept of "Healthy Crops" rather than USDA's Organic certification;
- Carefully defined and challenged use of the word "sustainability," and related terms;
- The Gardens Group, providing precise garden management on the properties of remaining rural residents, to supplement larger-scale production of food on Rural System's enterprise environments and to contract sales to rural border customers;
- The Fence Group's work with a variety of fencing styles, both for esthetic benefits of accentuating landscape aspects, and functional benefits of pest animal damage management;
- The Pest Force Group, working with The Fence Group to provide pest damage management, but also engaging in limited trapping activities to control pest populations; and
- The Furbearer's Group, which may sustain a novel enterprise in legally trapping furbearer animals for diverse meat- and fur-products.

When unified, the many components listed comprise a novel, holistic, and systematic approach to stabilizing rural food systems for healthy human populations. We continue to ask for reflection on our objectives, none of which is "maximum profit." We have consistently said that

Rural System is not a high-yield, high rate of return enterprise, and thus typical angel investors have not expressed interest. Rates of return seem small, and observers are invited to consider planned scale of operations… Are they less costly than to send fruits to market?

The evidence is in: traditional farmers fail and are moving from rural to urban areas. Superior and extended farm work without salary, little innovation, unavailable off-farm family workers, and land inheritance issues together destabilize farm life. The well-known "small farm" cannot likely be recreated in its traditional form now as a food base; a food-export source; a community financial base; or as a safe, healthy, well-educated, lasting-family home. Widespread, water quality and quantity are now threatened. Absentee owners have little information about agricultural agencies or their services. An estimated 63% of absentee owners (mentioned before, the new and likely emigrants) have never been farmers.

Fewer than 2 percent of Americans farm for a living today[23]; only 17 percent of Americans now live in rural areas.[24] People now leave farms in Virginia. Some are aging, infirm, and even though rural medical and assisted-living services are present, adequate transportation is lacking. Agriculture is within the topmost-dangerous occupations. Affordable, rapid access to health and medical services and centers must be stable as regional needs increase. In 2012, the average age of a principal farm operator was 58.3 years, up 1.2 years since 2007, and continuing a 30-year trend of steady increase.[25]

Farms cover 8.3 million acres, or about 32% of Virginia's total land area.[26] Much of the rest of Virginia's land is covered by buildings, highways, and airports. Absentee landowners (emigrants of all types) own an estimated 45% of agricultural acreage in Virginia.

Nearby where I write within western Virginia, there are more than 300,000 acres (variable criteria throughout) of absentee farm land, an estimated initial market for Rural System services. The current average farm size is 180 acres.[27] Small farms and ownerships in Virginia are marginal (family income below the poverty line) and "success" is tallied by some as related to international trade conditions. Eight percent of farms account for 85% of farm sales.[28]

Rural housing quality declines. Absence of broadband for high-speed internet work now limits business and education growth for the region. Threats of fossil energy shortages and local limitations abound; critical knowledge is absent—that agriculture is highly energy-dependent.

Active strategies to respond to harmful shifts in climatic temperatures and growing seasons are only slowly forming. At national and international levels, diverse, timely, large amounts of food and organic products are needed to feed an expanding human population by 2050 AD. Unbelievable! I claim grounds for action.

The 2013 United Nations Conference on Trade and Development Report Summary states that small-scale, diverse systems of food production are the only way to feed growing human

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[27] Ibid.

[28] Ibid.

populations of the future. “We need to see a move from a linear to a holistic approach in agricultural management, which recognizes that a farmer is not only a producer of agricultural goods, but also a manager of an agro-ecological system that provides quite a number of public goods and services (e.g., water, soil, landscape, energy, biodiversity, and recreation).”[29]

We may assist the region in meeting part of those needs with an alternative strategy, integrating sophisticated, diverse, computer-aided land use actions conducted by a very diverse, for-profit business corporation, i.e., Rural System. We predict success and a modest, stable, bounded profitability for the system while it achieves its other, closely-related and co-dependent objectives. The destination is much clearer than the pathway to it. I write to clarify the well-hidden paths to that challenging condition that must be reached soon.

You are now reading about the alternative to the present, rapidly-forming, very troublesome conditions. That alternative is a well-developed Rural System, existing within the same lands and waters of the present, but differing in many ways by their great diversity, emphases, productivity, resilience, reliability, and gainful linkages to other lands and waters in clusters—*all working, computer-aided, land-character computer-mapped, toward common, long-lasting financial gains.* Within Rural System, collaborating small businesses will emerge in these rural settings, using research results and high technology in novel ways to improve rural conditions … and to produce food and water for healthy, educated people, very soon.

[29] United Nations Conference on Trade and Development. Trade and Environment Review 2013. Wake up before it is too late: Make agriculture truly sustainable now for food security in a changing climate. Geneva, Switzerland. UN Symbol: UNCTAD/DITC/TED/2012/3.

Research, although I prefer for the rural future the more relaxed "studies," is said to be done to improve decision-making and also, strangely, to "support" decisions made, (as in a "decision-support system"). Let me tell you a beaver tale, one about rural decisions, their number, complexity, users, and impacts and consequences. Most rural decisions, in my experience, do not fit the textbook simplicity (or complexity) of decision-making, or of so-called "decision-support systems."

A Beaver Tale

Within the parentheses are decision or knowledge-base types, then the total count of decisions made within this tale.

A forester and a laborer drove down a dusty road in late summer. Rounding a sharp corner, they were faced with leaves and brush in the road. "Tree down across the road!" was the observation that almost anyone could make. No decision needed there!

"I wonder how that happened." They both got out of the truck and followed the tree trunk to the base. Any TV-watcher over the age of 4 could tell it had been gnawed through by a beaver.

"I didn't think we had beavers around here." (Presence or absence – 1)

"What is their local range?" (Local range – 2)

"Are we on the edge of their range? And are they expanding? I heard that they had been very widespread, but that they disappeared with settlement. (National range – 3; Continental and world range – 4; Brief history – 5)

"Do you have a saw in the truck?"

"No. It is always a problem deciding what to bring on these trips. I could fill up the truck and still wish for one more thing. I do have an axe." (Daily service equipment – 6)

"Thank goodness! Hey! It's a double-bitted one. Why did you bring that kind and not the single bit?" (Equipment type – 7)

"More versatile, I guess, but I grabbed it from several of them next to the door when I left. What safety issues do we have here?" (Safety instruction and training time allocations – 8)

"None, just stand back! I'm wearing my steel-toed boots." (Requirement to wear personal protective equipment vs. efficiencies and comfort – 9)

"What kind of tree is that?" (Species identification – 10)

"Does it always grow where it is damp?" (Silvics for 50 species of trees in a region – 11)

"Why do you think the beaver felled it into the road?" (Details of beaver life history and dam building – 12)

"It didn't have the road in mind, I assure you. It was cutting wood for a dam and using it to plug the culvert crossing the road down there."

"That's a small culvert." (Proper culvert size within a watershed – 13)

"How are we going to stop the beaver from cutting more trees?" (Should we try to stop it – 14; If yes, how – 15; If no, consequences – 16)

"We can walk away and assume it is only cutting a few trees and that they are not very valuable and that whoever finds the next tree will also have an axe or a saw. To walk is a big decision."

"The beavers are more valuable than one or 2 of these kind and quality of trees." (Local stumpage estimates – 17; Local fur prices – 18; Local attitude toward wild fauna not present but potentially recovering – 19)

"We ought to try to get help from a trapper." (List of trappers – 20; Trappers with live traps available – 21)

"I wonder what kind of bait they use." (Trapping techniques – 22)

"None. But I worry about growing sentiment against trapping." (Probability of local offense – 23; In-house policy on trapping as a serious profit-loss reduction operation – 24)

"Where would the trapper take the beaver if they caught one?" (Current range and "non-range" or places where losses would be tolerated – 25)

"Maybe we could make some money by encouraging beavers and managing them for fur, meat, photography, educational tours, and castor... and then start worrying about diseases they harbor and then contaminate stream waters."(Total net financial benefit potentials – 26; Disease public health risk analyses – 27)

"What's castor?" (Commercial uses of animal organs – 28)

"The glands at the hind legs. The oil is used as a perfume fixative." (Commercial potential and development – 29)

"There's a lot of talk recently about exporting products. Maybe there is a potential for exporting glands from a well-regulated beaver population managed for fur and other products." (Commercial development and business plan – 30)

"Could we export castor?" (CITES (endangered species, etc.) laws and export and customs laws, regulations, and tariffs – 31)

"Let's not discuss exports before we chop through this tree. How many cuts can we get by with and still roll the logs?" (Local tree weights and efficiency – 32)

"I've seen pictures of elaborate structures that prevent beavers from plugging culverts and thus protect roads from flooding or washout." (History of such efforts and best current practice – 33)

"What if we do clear the tree and trap the beavers. Won't they return? I hear that they migrate upstream. I hear that young are driven out of their homes by their parents." (Restoration ecology – 34)

"Correct. We'll continue to fight them from here on."

"Is this a new and perpetual cost of forestry?" (Forest health, invasive species, etc. – 35; Forest economics models – 36)

"Only on some areas; maybe pest work can become like forest fire accounting." (Forest tax law – 37)

"The boss might make more money from his farm and these two forest tracts with the beaver losses than he would if he spent a lot of time and money on trapping and beaver removals." (Total present net return calculations – 38)

"It will take a computer to figure that out. What about these beavers? If we trap them and release then somewhere else, will they return?" (Homing behavior – 39)

"Maybe we could just trap and remove the females." (Beaver external sex characteristics – 40)

"We do not even know how many there are here at the culvert or in the watershed." (Population estimation techniques – 41)

"Maybe we have no worries. This could be like a random event. We can watch and see what happens next. Maybe predators will wipe them out." (Predator-prey population relations – 42; Loss of former large predators such as lion, bobcat, or wolf – 43)

"They can cut only so many trees. Maybe Nature knows best."

"Trees cut are not the issue. Trees that die after an area is flooded are the problem. The potential value of the trees may be the real problem. Beavers work up the banks around their water bodies but the acreages flooded are some of the best tree-growing sites. One family of beavers can kill superior trees over many acres." (Silvics and flooding and riparian area ecology – 44)

"Beavers slow the water, it warms, and good trout water can be reduced in quality... but small-mouth bass go crazy in such waters." (Trout fishery management – 45; Trout and Bass tradeoffs – 46)

"I'd say let the trappers have at them... But maybe there are many trappers and allocating beavers among them can be a problem. In Canada there are allocations of trapping areas made by the government. Would that be necessary?" (Area allocation – 47)

After much chopping and log rolling they sat eating their lunch. (Policy: always bring lunch – 48) A man appears from the forest edge and starts walking down the road. "What are you doing cutting up my logs?" he said.

The "warm" conversation that followed included property lines, old owners, questionable corners, who owned the water rights, and whether the logs were in the road or on the right-of-way and whose property they really were.

Brought from the truck, the recent GIS map was studied by the three men. (GIS ownership and watershed boundary and stream channel – 49)

They finally departed; the old guy continued to walk down the road.

"Should we have given him a lift?" (Local etiquette – 50)

"Do we have to get these land boundary lines re-surveyed to be sure about whose log that really was?" (Survey or re-survey contract – 51)

“Who will we contact? Who did the boundary?” (Contract history – 52)

“When is it scheduled to be re-painted?” (Boundary marking scheduling – 53; Contract work or employees – 54)

“Are these 'our' beavers, and will we be sued by that guy if our beavers’ water floods some of his trees?”

"Keep chopping; I don't know! And back to the beavers, if we have 3 kinds of traps, 2 kinds of poisons, 2 systems of trapping, and a treat/not-treat decision, then we have at minimum 24 different options from which we must select. If we do about 7 separate things in various sequences, then the permutations of those 7 things gives us 5,040 options. Picking the very best option from among them is tough. It is very easy to be good but not correct. Usually ‘close-enough’ or satisfying seems to work. The land, in my opinion, has been destroyed by the relentless practice of well-meaning but poor decision-making. Hundreds of C- and D-grade decisions, all following after each other, produce a failing system."

"If we knew who should be deciding—from the boss in the big house, to me standing here chopping, or that old guy down the road—then the question remains." (The properly-designated decision-maker – 55)

"What question is that?"

"How would you know what is a good decision, one really close enough to the best one?” (The objective function, what to maximize, stabilize, or minimize... the desired net expression – 56)

“Then if we knew, we would have to face: how can we get it all together?" (The integrative model for satisfaction – 57)

“Maybe, but accountability is not yet in the decision about how well it is implemented."

* * *

In rural system management, there are decisions that range from whether to go to work on a day because of stomach cramps … to whether a decision made during such a day may threatened the existence of a form of life or close a mill for an entire region forever. There are at least 57 such decisions (those listed) related to the simple local issue of beaver trapping. Over and over, techniques for making decisions have been developed… but use has been poor or fragmented. Alternatives exist for the near future.

Chapter Four

Rural System's Computer-Aided, Precision Management

Away for years, I knew the old building on campus well and had worked in the basement, but I did not understand the "B" on room directions given to me for my first day on campus as a new faculty member. "B" turned out to be a coat room in a department office. It was now an office where once hung the dripping rain coats and hats of ROTC cadets. The empty desk was mine. The good part was that I got to meet Jack, H.K. Heikkenen, professor of forest entomology (the insect world), and to become friends over the next few years as we both moved "up" in quarters.

Jack and I shared military, Pacific Northwest, and forest interests … and the extra interests of the bark beetles (once subject-matter for foresters—now encapsulated and de-emphasized within "forest health"). Jack's lasting "speech" was about his findings that bark beetles, evident on local pines, do not kill the trees! The argument was that they are evident *on* trees … and therefore killers. Wrong! Spraying pesticides does not make it right.

His finding was that trees with beetles are already dead; the bark beetles are scavengers, like very small vultures. When pine trees and other similar coniferous and high-resin trees are stressed (fire, drought, wind damage, too much water, etc.), they give off an odor that is otherwise also the seasonal odor of beetle sex-attraction and time for reproduction. The beetles fly to the dying trees. Jack's favorite analogy (among many useful ones), was that your Christmas tree—purchased because it is very green and healthy looking—is *dead,* severed. It looks green. A forester, by analogy, observes yellowing trees out within his forest to be dying trees. They seem to be, and so he blames the bark beetle … they are there! Evident!

The beetles are there *after* the fact; something else has killed the tree. Few professionals believed their eyes or what Jack had to say. So, he sawed through the base of several large pine trees, added cables and held them in place, and slid a metal plate between the stump and the base of the tree. Each was dead! Certified! And he trapped—before and after the cuts were made—the beetles that were flying to the tree. Only when the specific alcohols of decomposition arose from within the trees did the beetles appear in large numbers, attracted by the wind-borne pheromone or sex attractant.

The control of this evident tree discoloration and "damage" has, in the past, been attempted with insecticides, sprayed in a contest against the beetle enemy—the tree-disease vector. The actual treatment, if needed and if likely profitable, is *stand management* to achieve desired stand density to reduce competition for water and other resources. If not… the action is to "do nothing" and watch the natural recycling of the standing "sequestered carbon," the tree bole, by bark beetle scavengers.

The desirable condition, probably agreed as "healthy," is that of well-managed tree stands in proper soils and sites, rarely if ever stressed because they have desirable root-soil-water-exposure conditions, bulk density, and size and stand density for the trees' ages. The health of the tree and tree value and function are of human importance, and full-scale understanding to avoid high "control" costs and undesirable, secondary impacts on diverse insect and avian fauna

of mixed-age pine forests… thus tree growth rates. The working, money-related "relations" are the topics of modern ecology and aging "land health."

I learned, from Jack, patience with a reasoned answer, expectations of rejection, appreciation for creative or "novel" approaches to old questions, persistence, and opposition to the adage: "nature knows best." (He hated that over-worked, escapist word, and insisted nature may not know but the educated, experienced scientist *does.*) I shared with him a quote from founders of the Mayo Hospital: "The scientist is not content to stop at the obvious."

We saw together that my teaching units—my Toolbox of what were then like smartphone-app-equivalents, some begun at the University of Idaho—could be used to identify the units of land where tree stress was likely … and to produce, from within our computer, practical units such as: "Don't plant there!" Or, given trees with firm knowledge of the best growth sites for each species, "Here is the GIS map of where those best sites occur…plant here!"

The message was clear: avoid the stresses; plant where best; harvest to achieve the proper tree and root distribution; recognize interconnected root structures of trees; work with the microscopic root-hairs and fungi that unify biochemistry, field observations, soil moisture, and profitable tree-growth rates; and work for the optimum … over the long run.

Within Rural System, I now attempt to avoid *average conditions*. We have computer aids to map the superior sites; average is sub-optimum, and insufficient for the future. We shall work for changes in wood over the next 150 years—healthy oak tree life expectancy. The real value in both quality and volume of wood is added in the advanced ages, and we know that for managed trees on best sites (computer-selected) … all other is wishful thinking, child-like, sub-optimum even over brief periods.

To plant a hardwood (an oak) tree or to dedicate a site to it, at least 40 feet x 40 feet for a sun-collecting canopy, is to *devote* to it, to invest in that organism the value of 0.037 of an acre, about $100, if local acreage is minimally valued at $3,000/acre. The site *has to* pay off (as it must if it were money invested in a bank over time), and it can do so if all of the profit-oriented strategies of Rural System are involved. If they are not, practices will continue to hasten the emigration to cities and increase the absentees among the rural land ownerships.

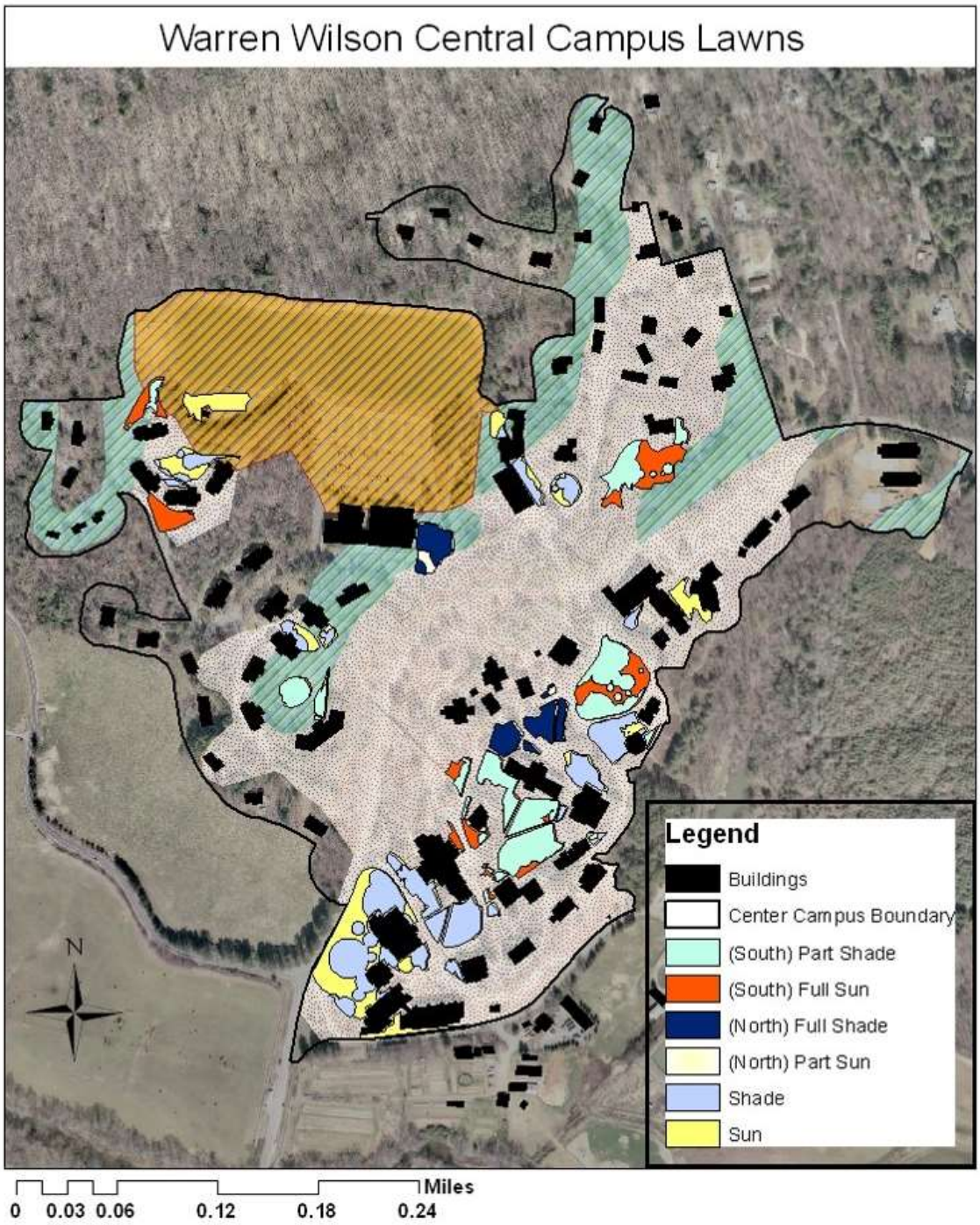


Figure 2. An example of color-coded GIS data-layers (or ecological factors) mapped together. Here, layers are for sun exposure based on tree-crown cover, soil suitability, and aspect. Great discrimination can be made among sites, allowing managers to predict where plants may be able to grow in an area. Similar maps with even greater separation and environmental detail can be made for many uses.

VNodal: The Software Center

The "V" of VNodal suggests the original, vital ***Virginia*** system underlying and controlling most of Rural System and its related software, data, and text—its staff and storage/operational spaces, and computed results of many forms. **"Nodal"** names the ***nodes*** present, the junctions of data and forces, the within-computer and online linkages. It is the named, first version of computer software, operational for various outputs from Rural System and partners, staff, and colleagues.

Agencies have created tools to systematically improve decision-making, but sometimes the agency has disappeared before the tool was distributed or marketed and benefits gotten from the investment. There have been failures. There have been simplistic systems and excessive systems. There have been educational systems that have failed in applying results. Filed systems, created for demonstrations, have been costly and were not very educational. Many systems have been designed for the wrong decision-makers. *Many* system-creators have had unclear objectives, and even more have known what that can yield. There have been many systems lost when their creators changed jobs or retired, or when data was lost. There have been a few evil people at work.

New technology now makes some decision techniques available in the field. Still, deciding on *which* decisions to be addressed is important. The funds available, the ideas, the likely uses, the agency, and the people who decide what is important … all influence the decision. Techniques for solving hundreds of trivial decisions can be created. Years can be spent in inventing the single method for "the big decision" (which may never be made in the blinding winds of globalization and accumulated carbon dioxide). Yet some difficult decisions must be made about how to improve decision-making. We need the results of an excellent system to create a system.

Maybe we need well-educated people in decision positions undergoing continual education. With encouragement and protection, integrative and precise objectives, collaborations with others, a backup team for information and review, clear applications of feedback, and a feedforward program, things could get better very fast.

While some things—like those technological—seem to be getting better, other things seem to be getting worse. The U.S. Forest Service, part of the Department of Agriculture, seems to many people to be in trouble, like other natural resource and "environmental" agencies. Once the paragon of federal agencies, The Forest Service is now under attack for many reasons, such as flawed planning, staff conflicts, failed accountability, unresolved regional differences, and failures to use the knowledge bases that they have built over the years. A book by Randal O'Toole, *Reforming the Forest Service,*[30] has been written, as if the need was real and the effort and pain of such writing was worth it. After years of spiraling delays, suits, frustrations, counterclaims, and conflict among practitioners and analysts, the difficulties of decision-making within public natural resource management (particularly the U.S. Forest Service and bureau of land management) have reached a level at which further delay seems intolerable.

We live in a time when virtually every major policy decision of any kind, if it is to be wisely achieved and intelligently carried out, requires scientific and technical input from the most knowledgeable experts in their fields. The U.S. Congress needs better information than it gets. Nobel biologist Gerald Adelman of Rockefeller University recently suggested that

[30] O'Toole R. 1988. Reforming the Forest Service. Washington, DC: Island.

congressmen might set up for themselves a science school that would offer crash courses when necessary.

All of us have difficulty "keeping up." "Behind" is no longer a very embarrassing managerial position. Staff have extreme pressures on their time. Rural issues and problems are too complex to be managed by folklore, guess, or casual observation and information on a few past observations. Often logic fails. Natural systems seem to perform illogically, due to feedbacks and jumps within sequences. Efforts at increasing the vast, wild flora or fauna management knowledge of our staff and people, with sound observations and probing questions, are paramount to continuing success in achieving our objectives.

Rural System has its own, novel response to this difficult task. A functional software package will be created as part of an overall management system, called "VNodal," with first applications to Central Appalachia. VNodal is a planned, computerized system that responds to a long-held wish to "get it all together." It contains the broad, dominant categories of Environment, Esthetics, Economics, Ecology, Enforcement, and Ethos. VNodal began when I was a professor, serving students using mini-programs as teaching aids. Many of these tools are still available for use and exploration on the Rural System website.[31]

VNodal will contain many software units or programs, some purchased "off the shelf," some small, many specialized, and some have been created with harnessed work from bright, energetic graduate students and staff. A new software package, VNodal will be built upon past computer programs wherein each program has nodes, or places where ideas and computer language connect within the system and where output from one program feeds into another as input. It will include a set of math and word models in a series of computer programs, interlinked at hundreds of nodes—a veritable "computer ecosystem" with the objective of producing precise, functional descriptions and prescriptions for near-optimum actions on the land and waters of each property over time. Its dominant function will be decision-making… based on a massive database, clear objectives, and opportunities for desired changes.

The model integrates current Geographic Information Systems (GIS) and Global Positioning System (GPS) technologies with existing databases that include hydrologic information, soil quality, erosion potential, productivity, temperature, sunlight, and other landscape factors, as well as over 150 options for profitable land-use activities. The result will be a system of optimized, profitable activities on privately-owned lands over a long period of time—150 years—achieving a high profit margin for rural land owners and managers, and leading to improved quality of life in the region.

VNodal will be operated by people aware of and facile with several programming languages and main computer functions. Many programs will be addressed and accessible on-site, others will be stored in the cloud (a new, spatially-distributed computer data storage system) and available Earth-around.

The philosophy around VNodal is rooted in the general systems approach, including changing desired production and losses in time, space, and value. Within Rural System, one objective is to stabilize, within five years, a high quality-of-life index (Chapter 11) for people remaining in rural regions, and to combine that with the objective to maximize—within all contracted areas—annual, bounded profits within all relevant Groups.

Conventional (expected) use might include entering data from actual fields of an ownership, loading data from national databases on the known topographic factors and soil qualities of such field sites, and (using a commercial statistics program, active within VNodal),

[31] Available from: http://ruralsystem.com/tools/

producing results demonstrating strong relations and general processes, or providing specific answers to questions about functions related to some forest or forage plant or condition.

As mentioned previously, the name "VNodal" simply implies the importance of and use of nodes, the linking points, places where outputs from a program are linked and provide inputs to other programs. Answers will likely often result from complex processing of vast data sets over many years (some with purchased access and others shared with us by state and federal agencies). VNodal is the planned, dynamic "brain" of Rural System.

A system of mini systems, VNodal will process instructions integrating data on deer, human foods, pond characteristics, student performance within PowerPlace (Chapter 11), landowners' information, annual reports, and many other variables. The VNodal software system will provide daily instructions to Land Force teams for their management activities on leased ownerships, which may include guiding, trail-building, and placing anti-poaching devices. VNodal will regularly provide personal safety advice afield.

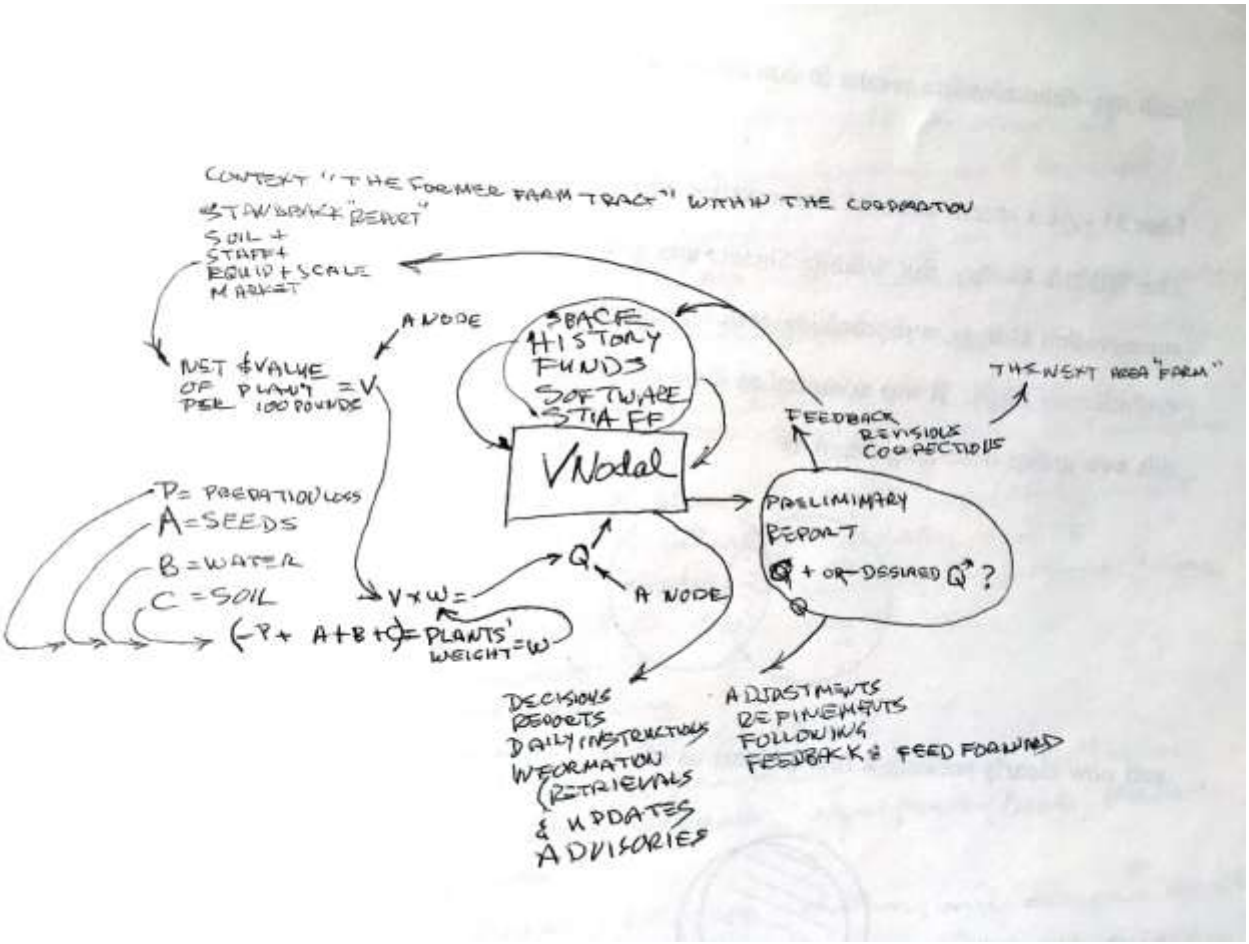


Figure 3. A sample diagram of how VNodal might work to integrate information and make prescriptions for work on rural land.

Staff working on VNodal will await ongoing development of related ideas and programs, including improving upon current technologies; using nearness-to phenomena and non-linear Alpha Unit data as GIS places of action; using an "expert system" for criteria matching and

exclusions, including analyzing species richness or biodiversity[32]; developing continual forecasting to prepare for future adversity; assigning monetary value estimates to aspects of the rural environment; and weighting values for natural resource quality.

Multiple regression analysis is a common form of statistical analysis, and will be a common type of VNodal action. Many factors will be entered at a node, code will be read and processed according to the rules of a multiple regression program, and several statistics will be reported at one or more nodes. The regression program will read in data, compute as directed, and produce outputs of a regression analysis that, with instruction, will be sent to staff. Or, results will be sent to another computer program, and different computations will be made before the results are sent to Rural System staff. VNodal is planned to provide common statistics, multiple regression, game theory, several optimization procedures, and to display results as GIS maps where possible.

At a somewhat trivial level, VNodal will provide text for some widespread correspondence; at other times, it will provide specific recommendations from incredibly complex, high-risk, dynamic computations of ecological, economic, and wild fauna law enforcement values. The planned, primary function is an elaborated, expected, stable, present-discounted cost/benefit ratio, resulting from diverse benefits associated with private rural tracts over a long period.

We see that the land and water productivity of many rural regions is now damaged and that high productivity cannot be readily gained or maintained. We now hypothesize that annual, net, family, year-end ownership gains *can* be made with computer-aided management of forests, agriculture, fisheries, and many well-marketed products, services, and opportunities. Rural System work can greatly enhance human conditions in most rural areas. We shall concentrate on yearly, annual net gains of named resources.

VNodal's database will usually be at work building local knowledge bases, perhaps toward Aldo Leopold's concept of land health, and perhaps beyond, toward creating strategies for balancing water and food for human needs, Earth-around, by 2050 AD. The important VNodal functions to that end include:

Land and Water GIS Map Images: Staff of Rural System will maintain and retrieve data, typically of the Lands Group, and of each leased private ownership and sub-units. The data is a VNodal software input.

Best Spaces: Each Alpha Unit of each ownership can be evaluated for its suitability for non-use, crop, range type, pond, stream, riparian, forest, faunal community, mountainous, and/or a list of recreational uses.

Rural Complex: Often whole-area overlayments, Groups will exist and function in relation to whole or major parts of each ownership. They may be dependent upon the presence of ponds (e.g., angler-hours spent), or on the quality of the soil, but are not counted here as direct products of the enterprise environment. They may include memberships, license fees, related sales areas, parking, books, clothing, and suitable affiliate returns.

Timing: VNodal will determine or report results of studies for the best times for planting, treatments, harvests, marketing, and liquidation based on local data, expected conditions, and plant-specific data.

Rural Goods: VNodal will determine the Groups likely to be developed and "run" on each ownership, selected from a list of over 150 (Appendix 1). The likely presence or role for products will be apportioned by ownership area.

[32] Kormondy EJ. 1969. Concepts of ecology. Engewood Cliffs (NJ): Prentice Hall.

Rural Activity: Similarly, VNodal will determine the involvement of activity-based Groups, such tourism, trail organizations, biking, several hunting and fauna Groups, and **Plant People** (Appendix 1). Owner's constraints (such as prohibiting certain types of hunting or tourism), and state or federal constraints on birds, plants, and discovered pre-settlement human sites or other historic sites, will be employed here.

Estimated Current Local Market Value: With location of the ownership and current travel costs included, a potential market value for the production of each of the VNodal processes so far listed will be made. This will be the scoped value, realistically sensitive to ever-changing land values, climates, markets, fuel costs, staffing, political shifts, inventions, social trends, etc., and often weighted by the area and ranked as likely markets.

Constrained Space Values: Much of the planned VNodal computation is that of identifying and describing within statistical ranges, known maxima and minima, real areas identified by GIS maps, with legal and other limits imposed. For example, many plants are constrained by their tolerance range of soil and moisture characteristics. Land owners may specify limits to uses and receive consequences of such decisions on computer-optimization results.

Transition Analysis: Computer-Aided Transition (CAT) software is the "secret sauce," allowing Rural System's VNodal software system to prescribe management actions on Rural System managed lands for stable profits into the future. CAT is planned to be a key process within VNodal, unifying the math models of known or estimated rural change, such as ecological succession, forest yields, and business production functions. CAT will produce graphical and tabular information on scheduled plantation, growth, treatments, and harvests. It will play a major role in assessing or monitoring utility and safety for motor-pool vehicles; quality and life expectancy of out-buildings (e.g., cabins, work centers); statewide, wild animal trapper effectiveness and life expectancy; and many other system processes.

Dynamic Space and The GIS/GPS Group

I have walked and wondered about my surroundings in the countryside from early youth and was encouraged by amazingly generous leaders of Boy Scouting. I then studied the terrain of Washington State from the windows of a "forest-fire lookout" for a summer. I now have access to Geographic Information Systems (GIS) software for Rural System, vast computer databases, and computational power. For a small rural ownership, Rural System can now gain probably more data about their land than ever before. Rural System depends on GIS—lake bottom to mountain top—and increasingly, field identification of the nearly-exact Global Positioning System (GPS) locations in the field, forest, or water for observations and data recording.

While maps for land and water that are made by computers are now well-known, the various uses of GIS software that create them are not. We have had experience with them in the past, in specifying optimum routes of high-voltage power lines and recreation trails, desirable locations for general aviation airports with reduced "environmental impact" results, and location of optimum corridors for moving water supplies from mountain sources to meet the needs of urban costal populations. On the whole, finding and mapping land spots with given descriptors is now easily done.

I use many sources, as have my students, and I look for others. I But, take delight in telling about Jerry Ziewitz's MS thesis, in which he collected data on soils from a rural Virginia county, and related factors describing each map cell or place within that county. In effect, he

taught the computer what abundant landscape factors were known to be associated with soils from a similar place in an adjacent county. There being similar counties, he trained the computer to name cells of the "blank" map to be the same as those of the known map having the same probable set of factors. He was making a probable soil map for one county based on data of nearby, already-field-mapped soil distributions.

The common-sense data were available for the readily-observed soil characteristics, but not the chemical or structural analyses of the soils—only factors like land slope, aspect, elevation, stream adjacency, and other factors. The map features of the un-mapped areas (having no field work or "digs") were labeled as if they were of the soil names and types of the adjacent area. Multiple comparisons were made of major parts of the "new map" with the official, current soil maps.

There was amazingly close statistical correlation of the predicted maps and those from field work, allowing new possibilities for the vast areas needing budgeted field work. One observer suggested the computer-derived map may be better than others, for it was based on many more site-specific observations or "spots on the land" than from the base map which originated from former years when original roadside surveys were made of selected sites. The savings in creating a needed (and much-delayed), useful, county-scale soils map may have exceeded several thousand dollars.

At a much-reduced scale, we tested the commercial services of a GIS firm for locating the best places on a mountainous farm ownership of about 200-acres for growing a variety of mushrooms for commercial harvesting. Seven desirable factors of mushroom species habitat were specified to be selected from the volunteer farm.

Our test exploration was: given 7-8 major factors as GIS-layers of information about an ownership, which of all of the more than 8,000 Alpha Units would be suitable for growing mushrooms on bundles of vertical, inoculated, low-value oak log bolts? Trivial for the computer, the order was: "color map cells with the eight characteristics for the named mushroom growth." The computer found 3 cells out of 8,000 with the desired growth characteristics present, and where logging, access, and additional features leading to profitable production might be explored.

The results suggest almost unlimited potential applications. The proposed GIS/GPS Group within Rural System will have work ahead with mapped-site factors related to adjacent sites; multi-layer map factors at work on trees, other flora, and fauna; and dynamic color change reflecting changes in the ownerships and regions, and even health and risk zones of residents who have not emigrated.

Related, valuable, some now-classic rural applications include:

- Determining the best locales for each named plant;
- Recording habitat where a species has been found, and then locating identical sites;
- Characterizing the habitats or environments of endangered species for location and protection (and evaluation of potential substitute areas or waters);
- Given an observed "forest site index," relating observed tree species sizes, numbers, and characteristics—valued tree measurements—to on-site, computer-mapped characteristics;
- Analyzing stream and riparian volumes, related to fish found, and identifying the conditions most suitable for protecting rare or desirable species;
- Creating three-dimensional images of Crescent areas (Chapter 7), the alternative watersheds;

- Mapping and tallying wild faunal and floral impacts within and beside powerline corridors to inform proposed routes and alternatives;
- Locating the best corridors for general-aviation runways, and identifying select environmental factors as more "costly" than others or having multi-factor undesirability;
- Locating best routes for hiker-trails, given their origins and destinations;
- Using three-dimensional image software for ponds and lakes, with images of informed zones of named purpose (e.g., likely pond depths to encounter particular fish species);
- Improving estimates of elk and large animal habitat suitability by including *aspect* and *elevation* information in analyzing the impact of solar radiation;
- Exploring the esthetics of viewscapes from select points to enhance area purchases (and prices), lookouts, and building location for perceived and reported public preferences; and
- Quantifying solar radiation at any point, related to structures, plant growth, diverse ecological relations, evapotranspiration, ice-thawing rates, etc.

The GIS/GPS Group, having GPS expertise, will work with the map locations of many topics (e.g., cemeteries, animals, plants, trees) to be located and unified within Rural System. Our planned work has been called "precision agriculture," that precise group of actions prescribed by computer to be conducted in very precise areas. We plan to produce such work in multi-dimensional space, deep into the soil layers and within atmospheric conditions, well-selected within local and regional data, all changing with staff and funding and treatments. Variance (statistical) will be reduced by the specificity of observation and sample sites made by staff. Site-specific, the quest for related, correlated phenomena can be enhanced by the effective use of the GPS. With such location aid, we can engage in precise ecological study for field, forest, or riparian areas.

Computer-Aided Transition (CAT) Software

Computer-Aided Transition (CAT) software emerged from study of forest and rangeland succession analyses by Dr. Jack Lyon, and was later enhanced by Giles and Snyder (US Forest Service). An image by Dr. Lyon diagrammed curves of forests, shrubs, and grasslands (or "range"), showing their related sizes and scales, largely related to solar radiation effects received over time, with the biomass of shrubs and grasses declining in conspicuous volume over time on a plot of land.

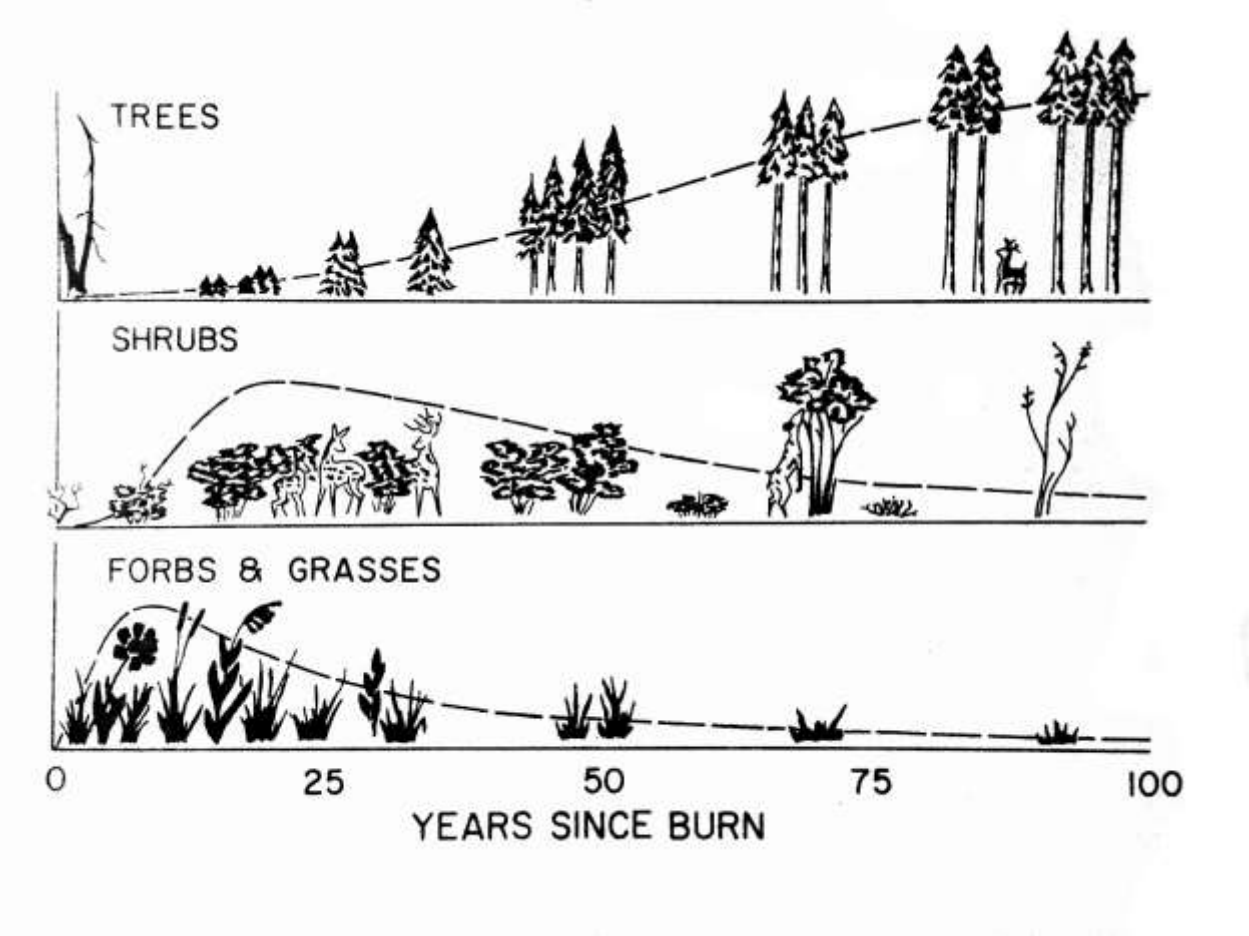


Figure 4. Ecological succession curve diagram, originally created by Dr. Jack Lyon.

The ecological succession curves pictured here describe the growth of plants over time. Soil and moisture factors can change the curve shapes. We saw each as curves expressing known ecological change over time. They were fortuitously presented on the same illustration; only curve 2 and 3, as depicted, were influenced by the shape and location of curve 1 (the well-known forester's potential "yield curve"). The ecological succession curves are similar to the Habitat Suitability Index (HSI) models created by the U.S. Fish and Wildlife Service.[33] (Many HSI models have now been created and we plan to use many of them within our vegetation and faunal modeling.)

Yet transition curves are, of course, not limited to describing plant biomass or height over time. Many other single-factor curves—one often highly influencing the other variable—are seen with topics such as species richness, individual organism lifespan, building stability, and human productivity (industry). Each of these can be described by transition curves of expected life or function over time. Mr. Nathan Snyder and I soon realized that **transition curves**, beyond features of wild faunal systems, have the potential to revolutionize what people call "sustainable" farming.

[33] Schamberger M, Farmer AH, Terrell JW. 1982. Habitat suitability index models: introduction. Fish and Wildlife Service. FWS/OBS-82/10 [Internet]. [cited 2017 Apr 19]. Available from: http://www.nwrc.usgs.gov/wdb/pub/hsi/hsi-000.pdf

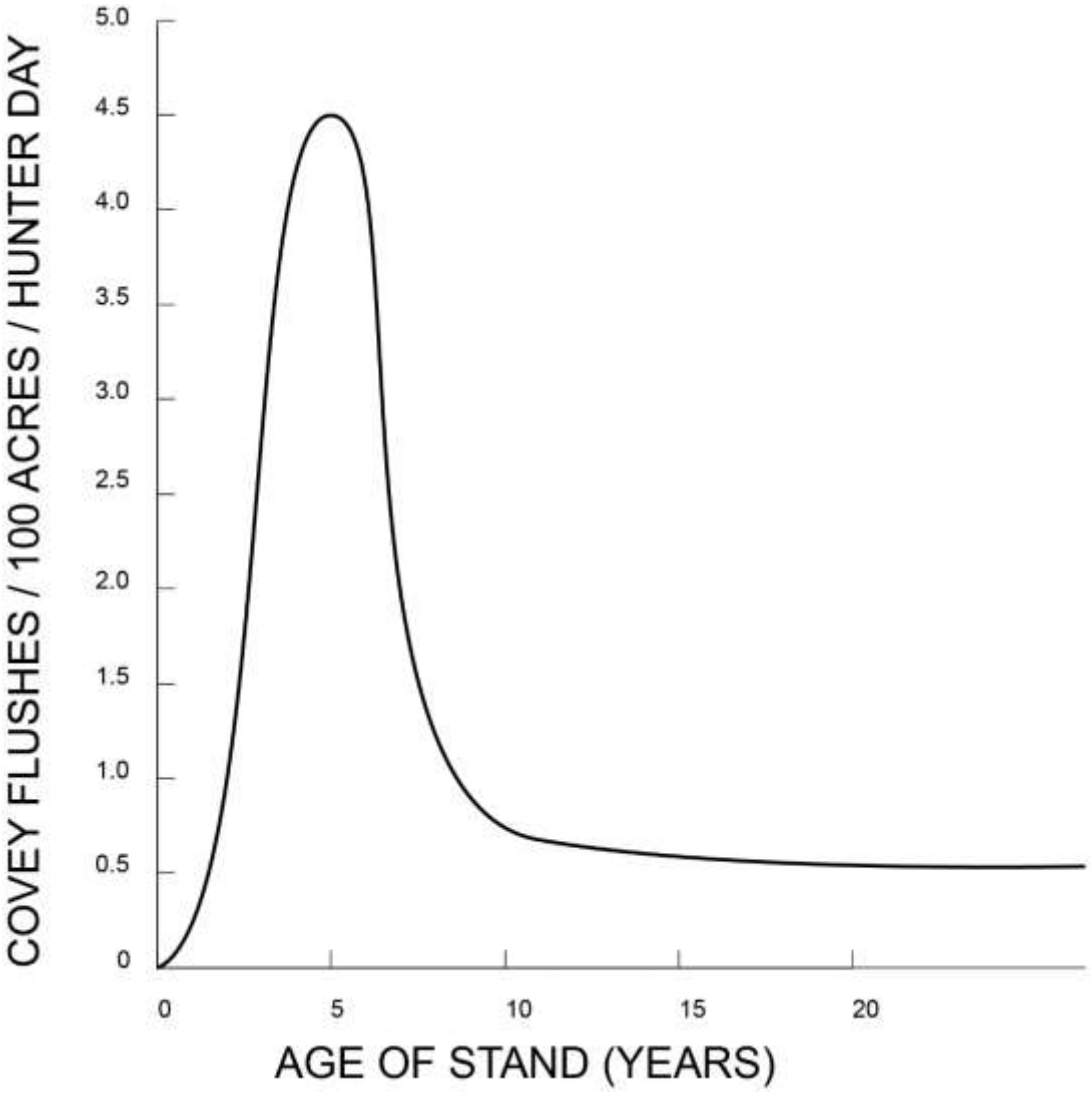


Figure 5. An example of a production function. Here, the production of bobwhite quail covey "rises" or flushes is expressed as a function of the age of a planted southeastern pine forest. Quail are abundant in the early field stages of pine growth, but disappear as the trees become dense and understory vegetation is shaded out.

More food is needed for larger human populations by 2050 AD! The traditional farm model fails from boom and bust economic patterns! Scientists struggle to prioritize environmental management actions because they are all interconnected—it's all important! Small businesses fail!

All of these problems may be addressed with our planned CAT software, demonstrated in Microsoft Excel by Risa Pesapane.

The *sustainability movement* recognizes that maximum profits cannot be the goal when working with natural systems. If an entire forest is cut down, profit opportunities for the forester will disappear until the forest grows back and is again harvested. The forester will not be able to benefit from other opportunities, such as recreational hunting and hiking, forest products such as mushrooms, or soil stability and erosion control. Typically, maximizing profits in the short term leads to tough decision consequences in the long term. A manager concerned with sustainability

asks whether some profits and benefits may be had over the long term, and often decides that long-term benefits outweigh short-term profits… When managed *together,* with measured yields, profits can be stabilized, and many other forest advantages can be gained from the same operations (or a planned sequence of them) on a single area.

Rural System does not follow the sustainability movement, however, because the goal is not to sustain current or historical conditions into the endless future or at a single level or amount. Actually, Rural System goes further than sustainability can, by seeking to *improve* conditions; stability may not be in an owner's or society's best interest. Profits will not be sustained (equal annually), nor will they be maximized. Profits will be allowed, even expected, to fluctuate over time… as long as the fluctuations remain within constraints, and as long as total yields are advantageous with managerial feedback, directed toward achieving precise goals on time.

Risa Pesapane, former executive director of Rural System, used Microsoft Excel to digitally model ecological succession curves (equivalent to the curves within Figure 4). The resulting curves represented rural factors, such as grass weight per unit area after grazing, fire, etc. (i.e., complex, additive change over time). Typical curves of weight or volume or counts over time can be combined, and total production can be displayed, then selected summation values may be used in decisions. The curves, converted to math functions for crops, forests, fisheries, wildlife, erosion, pest influences, and other changes, can be obtained from research papers and from expert estimates, undergoing continual revision (system feedback).

We shall look at the shape of each curve for each animal species, and as we add them we shall designate where we start and stop management actions for each (e.g., the beginning and end of hunting seasons or plantings).

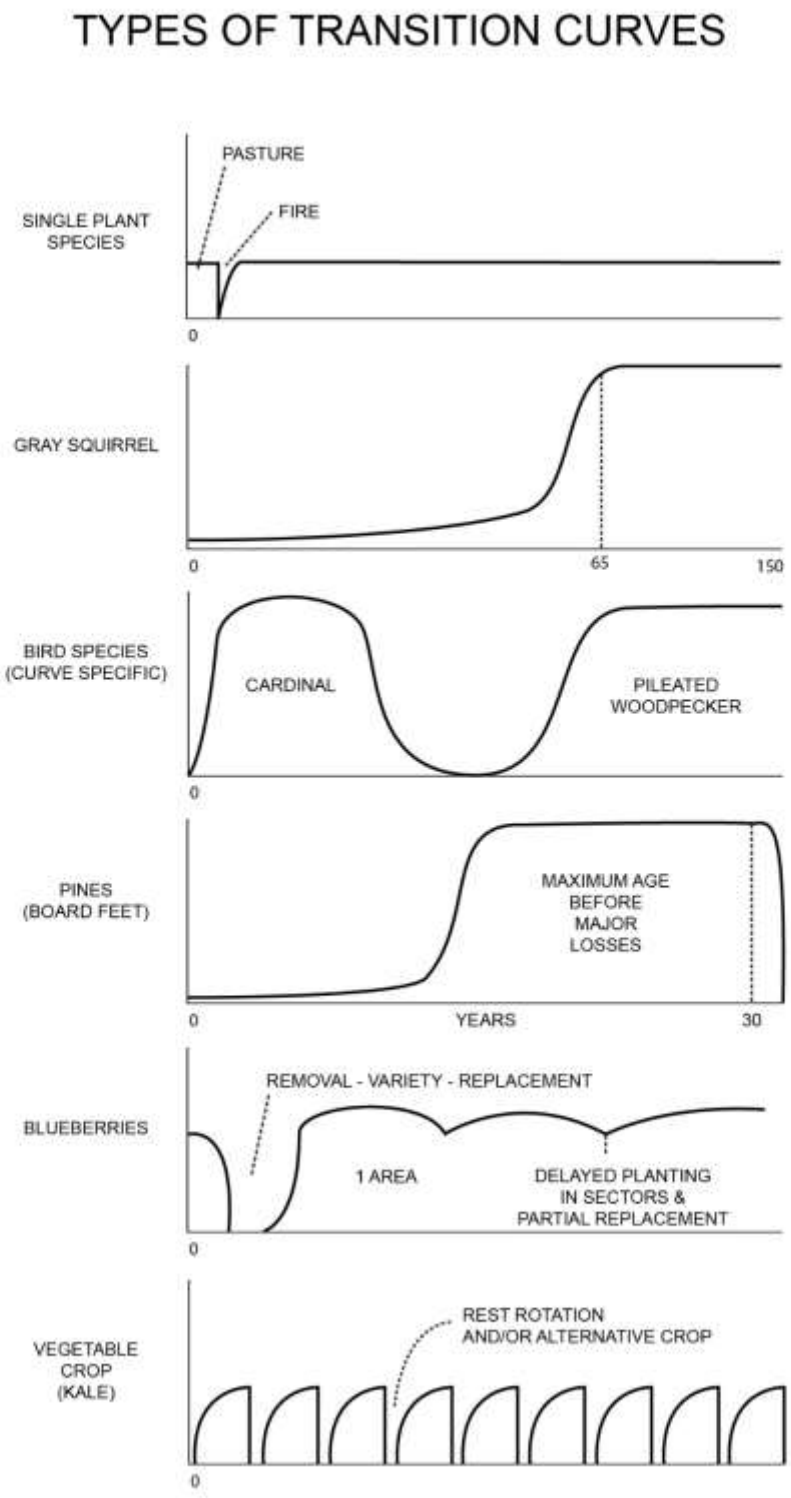


Figure 6. Different species of plants and animals have different life history, productivity or succession (abundance is related to vegetation community age), shown as phenological curves that may quantify their usefulness as a resource.

We graph an x-axis representing time, from start to finish… or some specified time, such as the 150-year planning period used within Rural System. Then, we graph an approximate or representative common space of parallel trees or topics of interest. Buildings are first used for clarity—they can be seen as straight-line features and, like animals, have a life expectancy well-studied by realtors.

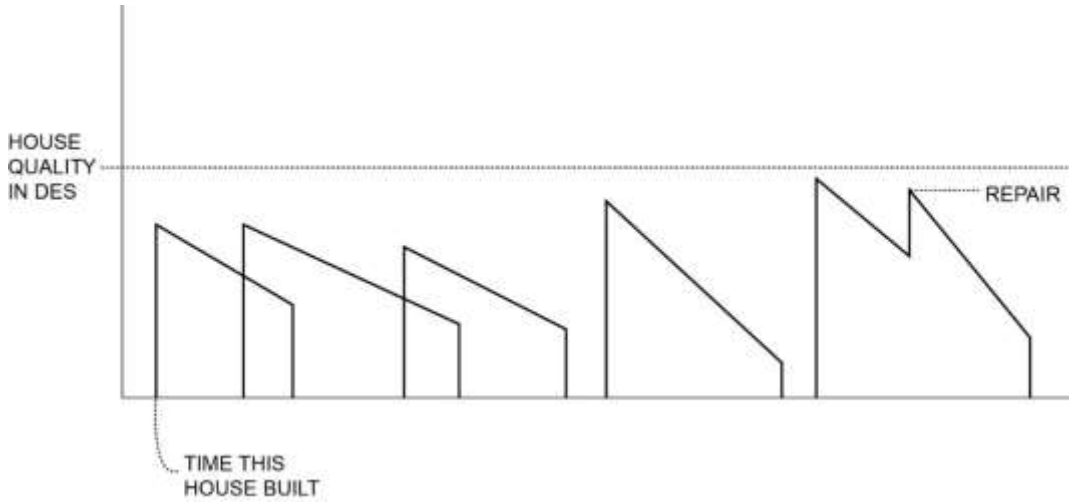


Figure 7. Buildings also have "curves" describing their quality and life expectancy.

The "ecological succession" function, also called a "production" or "transition" function, uses site-specific, weighted production estimates over time and integrates values over the ownership space and many years. By having the computer select the starting time of such curves, a relative flat-line production for a product (housing quality) can be achieved for an ownership. That "flat line" will be matched by the manager to desired annual production (within bounds, since an exactly flat line is very unlikely to occur).

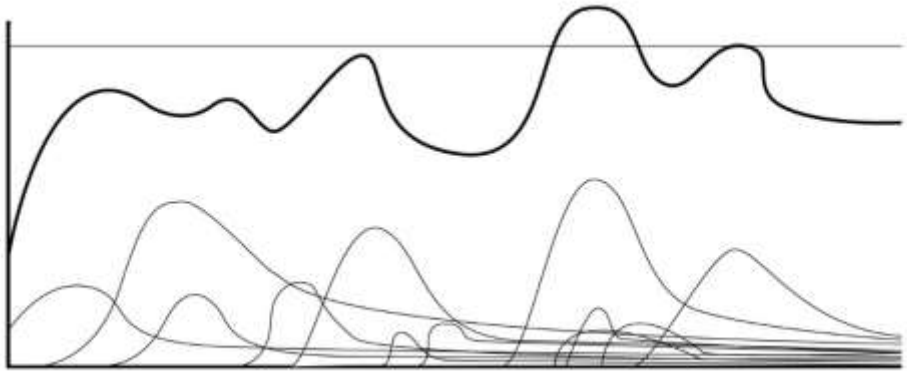


Figure 8. Many curves can be added to create one overall production curve. Within CAT software, curves will be adjusted in order to forecast the desired "flat-line" or summation production, within bounds. Based on the curve adjustments, VNodal will make prescriptions for management actions.

Decision-makers may establish bounds (as done within investment firms): allowed or desired limits to peak productivity. “Too much” within a year (as suggested by a graph of boom and bust economies) may result in destabilization later, and a curve suggesting losses or dips in the future may call for changed behaviors within the rural forest ownership. A lower bound suggests the lower limit of productivity to be reached or tolerated.

The system, advised by the procedures above, often with major decision makers setting the upper and lower bounds, will allow a creative environment—freedom for diverse and informed management within the recommended or specified bounds. For example, if endangered species seem threatened, fire risks too high, pond yields too low, then features programmable for display over time will help to inform managers in advance and assure the stated, bounded local objectives—success on display!

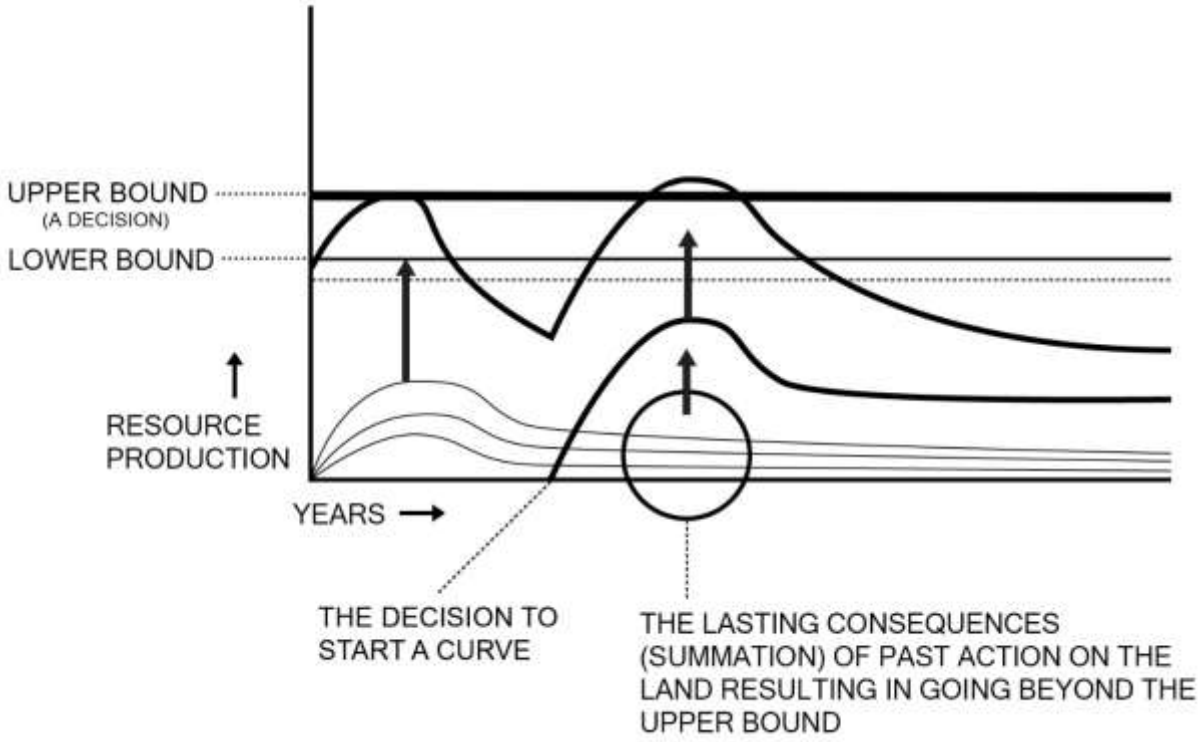


Figure 9. Resource production curves can be adjusted, and new curves can be started, to increase production within upper and lower bounds. Arrows indicate curve summation.

The top constraint or bound may be determined by known or reported local ecological limits, beyond which the manager risks a major bust (perhaps caused by erosion, loss of nutrients, pollution, or habitat loss). The lower constraint may be personal, but is suggested by the financial requirements of the director or owner, who requires profits at least above some intolerable level or recognized limit on costs of time and operation. As long as these two constraints are respected, the manager is “in the clear,” within current and reasonable levels.

In the case of a forest manager, a forest with varied ages and species may mean that different trees may be harvested in different years, spreading profits from logging into the future. The peak time for wild turkey hunting may differ from deer, boar, or fishing. Meanwhile, hikers and birders may be willing to pay for parking year-around. Each tree species has a curve; market values for wood follow variable curves, and deer populations fluctuate in areas and over times

for which curves may be developed. Each Group, or combined Groups or "tetrads," will have different profit curves over time. CAT software will add these curves and determine which ones, when, and in what sequence will create stable profits over time. By maintaining a variety of enterprises year-around and over many years, the Rural System manager may ensure relatively stable (bounded) profits for many decades.

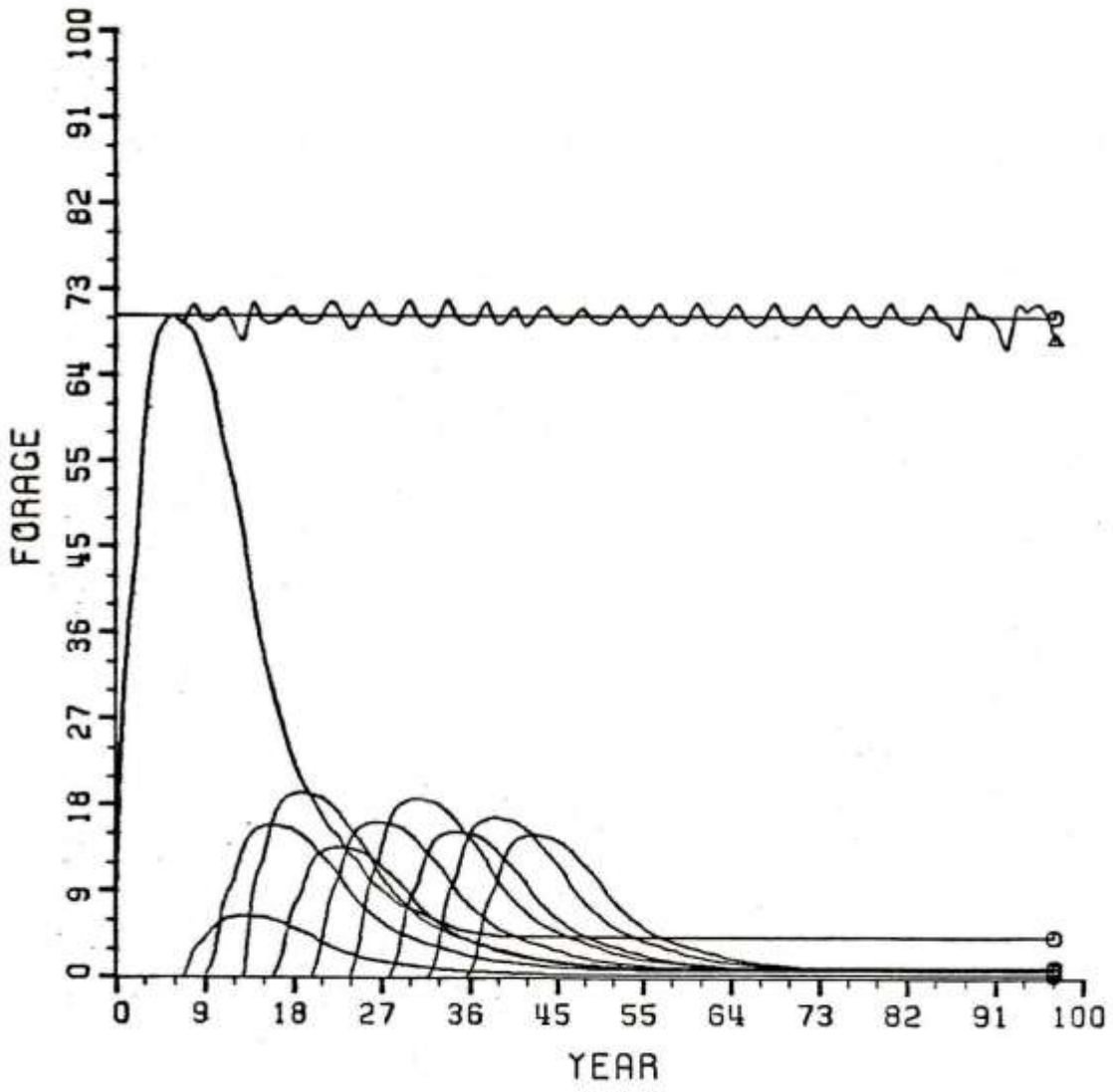


Figure 10. Ten production curves (functions) such as may be available for deer after a forest is harvested are shown. Many others are actually in the program but only 10 are shown. The upper straight line is an objective (the objective function). The curves are added to produce the undulating upper line. This line is the total area production. The program solves the problem of (1) what year to harvest and (2) what total area to harvest (the height of each curve) to produce forage for the deer. Areas to be cut must be 30 or more hectares. Depending on the shape of the curves, Fibonnaci or least-square search procedures are used to determine the start time and forage production of each curve.

Over 150 Groups are proposed, ultimately, to operate within Rural System. Rural System was designed to have this diversity in order to enjoy the benefits of many rural, ecological, and enterprise curves, adding up to stable profits for the entire System. Adding to this advantage, Rural System Groups will share resources, and gain efficiency from shared insurance, legal support, and administrative staff within the System.

"You're comparing apples to oranges!" is the imagined objection. "How can the size of a deer be compared to the yield of a crop or the age of a tree?"

The problem of adding different substances (the apples and oranges problem) is breeched, often by converting production function values to "proportion of the maximum value," stabilizing the curve of probable change over time and allowing each such curve to be assigned a relative weight: the market value of each named unit. The ecologically- and biologically-driven curves of relative product production are thus assigned probable annual or seasonal monetary market value.

Basically, the curve concept we introduce is a histogram derivative. The Y axis of the curve is converted from original units, such as units of biomass, to percent of the likely maximum over time. By standardizing the units, curves for very different phenomenon can be compared, apples to apples.

In general, Rural System will work to get maximum area under the curves, as close to the objective and within the general bounds, as soon as possible. Delays "waste" the functional area under the curve, if a curve is placed late within the 150-year planning period. Rural System will try to get early optimization, if possible, leaving later periods for invention and adaptations. Optimum strategies need to be explored and the system used as an advanced simulation. What is best? Best average? Solutions will depend strongly on the curve types, and thus different strategies are likely depending on the types encountered.

Management using transition curves would be mathematically- and data-intensive, requiring computer aid to make sense out of the complexity. CAT software would analyze and add all of these curves in different ways, allowing the CAT software subsystem within the VNodal software and data system to determine which enterprises and management actions would most likely produce stable profits and/or food supply over the long term. With the help of CAT within VNodal, boom-and-bust economics can be avoided, stabilizing the future of rural land management. VNodal-guided management may be our best shot at providing stable food supplies for humans of 2050 AD and beyond.

How VNodal Would Operate Within Rural System

VNodal is planned to be a complex, diverse, computer-oriented Group within Rural System. It will work with GIS maps of spatial data—the places for all things rural, where experiences and long-term research findings come to life.

The needs of many Groups will be met within VNodal, such as knowledge of climate, precipitation, staff and efficiencies, and simulations. VNodal staff will combine conventional statistical analyses, optimization, and decision-support… facing the realities of the ever-changing rural area production, markets, and recognized "objectives," responding to excessively deep problems.

VNodal may be useful in planned sub-systems of the Cumulative Group on International Agricultural Research (CGIAR), that has recognized the values of combining GIS with other

system-dependent methods in research, leading to improved food production.[34] Also included in VNodal plans will be in-house accounting; employee data; PowerPlace teacher-student dynamics; ponds, streams, and Crescent dynamics; floral and faunal dynamics; whole-system energetics; avian systems; educational graphics; Computer-Aided Transition (CAT) subsystems; GIS-supervised soil analyses; agro-forestry dynamics; human safety metrics; avian systems; regional spatial graphics; rural databases; and legal behavior (database; education, courts).

We propose to purchase, trade, and plead for access to available rural software, and continue to implement software already begun by former students and willing colleagues. We continue to find useful combinations of simulation, expert systems, and isomorphic software, with similar translations.

VNodal will process the annual productivity from each active Group of Rural System, gain data for modifying any of the elements, then modify the system and continue the process so that each element of each Group is influenced by other Groups present on the ownership. It is at the many nodes where each subsystem of VNodal will potentiate, limit, or even destroy the starting Group products being evaluated. Once modifications are made, production will be established, and then system production will be converted to a monetary estimate. At another node, the system will "move" among relevant Groups and collect the net gains from all Groups.

The software of VNodal will include attributes such as Internet links, databases, and descriptive texts. One set of programs within VNodal, called **RRx**, is designed to work in unison to produce rural prescriptions ("Rural Rx" or "RRx") within a developing system. The RRx outputs will be electronic text documents (with figures, maps, and images) made available to land owners or managers, indicating which land management activities to employ at certain locations and times for optimal land use. Optimal land use is defined as achieving lasting, bounded, sustained profits while meeting other objectives.

Our Rural System prescription, RRx, is intended to be a guide for landowners, not an order. It will be the best report for analysis and design that we can prepare, given information on private land we have collected briefly from landowners. RRx will be a "learning system," capable of being revised and improved with new data as it produces land-use prescriptions.

Our emphasis is on a total system of involvement, and needs at least minor clarification. Privately-owned rural lands, with their forests, ponds, and streams, can produce many benefits. In addition to money, recreation, and beauty, rural lands can yield products of value to people. In RRx, we jump out of the mental bounds of forestry, lumber, pastures, and cropland. We shall work toward a rural ownership base that is a *total* production system, one that is cost-effective, long-lasting, well-planned, and grounded in the best current knowledge. It may, but not necessarily, include wood or crop production.

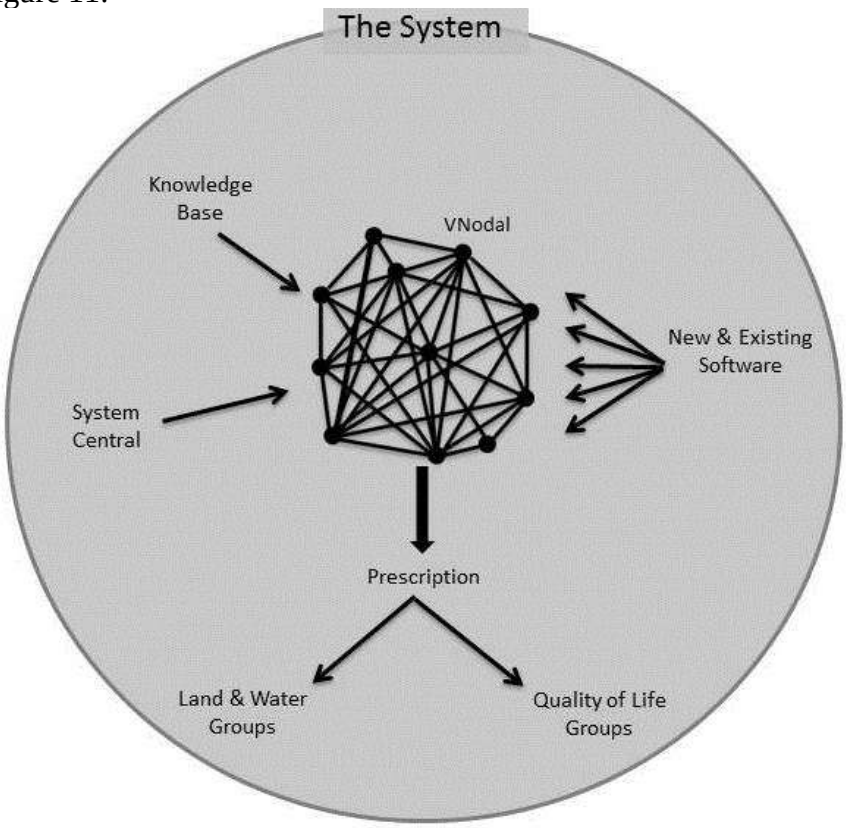
RRx will be available for the site- and time-specific needs of the property and its surroundings. When mature, VNodal will include RRx, and will be overseen by directors that link resources within the community, the nation, and the world in its network. The application of the system is not limited to agricultural business opportunities, but those of art and culture as well, ultimately affecting quality of life for rural communities based on preliminary programs developed for a rural town.

What's so new?" has been asked. The perceived newness of this program is not its individual parts, but the integration of all of the aspects of a diverse rural area into a singular

[34] Goldsworthy P, de Vries FP, van Dongen J. 1994. The use of systems methods in international agricultural research centers. International Service for National Agricultural Research [Internet]. [cited 2017 Apr 19]. Briefing Paper No. 17. Available from: http://ebrary.ifpri.org/cdm/ref/collection/p15738coll11/id/247

system and its ability to constantly self-modify and adapt. Only a highly integrated, technological, business-like approach with social payoffs, utilizing local resources, and accounting for common causes of business failure can begin to meet Rural System objectives. Figure 11 depicts many elements of such a proposed system. It is central to Rural System's success.

Figure 11:



In the diagram, Knowledge Base represents the vast math and text datasets that will be stored and analyzed. This research-based knowledge, gathered from state and federal agencies, land owners, and local people of Central Appalachia, will serve as the foundation for decision-making.

System Central is the planned administrative unit of Rural System, providing essential, non-field and non-forest expertise on markets, accounting, and legal dimensions. It ultimately delivers prescriptions from VNodal to the staff to be implemented at the best time and precise place on an individual ownership or cluster.

The system has, by design, over 150 enterprises, or Groups, that can be selected and matched by VNodal to the property and ultimately contributing to the profitability of the whole system. Land and Water Groups are the small interconnected, interdependent, year-round companies that will implement their business specialties directly related to land and water (e.g., growing corn, managing habitat for bear, outdoor recreation activities, etc.).

The Quality of Life Groups are complimentary to Land and Water Groups, and are comprised of small companies related to socio-cultural aspects in the community (e.g., art, landscapes, music, poetry, crafts, etc.), maintaining a local quality-of-life index, QOL*.

The Land Force is the internal team of workers who, using modern corporate strategies and latest technology, will implement the computer-produced, site-specific prescriptions on individual ownerships or clusters of properties.

An ownership under management of the system is deemed a new "enterprise environment," a broader definition and expression of the great difference between the limited activities of the "farm" to more appropriately describe the essential modern diversity of precision agricultural in combination with the non-agricultural actions prescribed, performed, and made profitable over the long run on the diverse land ownership. Often, several enterprise environments will be managed together in a cluster, as described in Chapter 2.

Feedback and feedforward are built-in system improvement attributes. Once initial prescription actions are performed on the land, the short-term results will act as corrective and adaptive feedback within the system for the knowledge base, programs, and practices on the land. As the knowledge base is strengthened from feedback data, the system will have the ability to make more accurate decisions on those best estimates for the future, a process termed "feedforward."

VNodal is a major part of a modern systems approach that addresses the condition of multiple objectives of differing importance, extreme variance in events over time, lack of sufficient data, and dynamic and counteracting forces. Modified systems theory can work for large, diverse, complex ecological and sociological problems in a rapidly-changing climate—the real poverty complex of Central Appalachia and other rural areas.

The proposed software is an improvement upon current technologies in several ways, including but not limited to using nearness-to phenomena and non-linear Alpha Unit data as GIS places of action; using an "expert system" for criteria matching and exclusions, including analysis of species richness or biodiversity; developing continual forecasting to prepare for future adversity; assigning monetary value to aspects of the rural environment; weighting values for natural resource quality; using a heuristic-convergence approach to reach reasonable conclusions; and emphasizing farm- and natural-system transition processes, influenced by ecological succession mathematics, to readily estimate changing trends.

Conventional systems theory alone cannot work for a large, complex set of ecological and sociological problems in a rapidly-changing climate, with limited water supply and quality, energy, and food supplies. We cannot "prove" Rural System will be useful. We know the difficulties within Central Appalachia and shall address some of the major ones, counting deliverables from the proposed VNodal and comparing approximate before-and-after status in achieving objectives.

Assuring a useful future is a founding principle of the described Rural System and an integral component of VNodal. In creating a systems approach to management, there must be elements of achieving lasting success. The proposed system will require recurring land analyses using an updated knowledge base, relevant to current trends and possible entrepreneurial activities, to accurately prescribe precise management practices over a period of 150 years. Hence, there will be an ongoing relationship between the system and the landowner.

Central Appalachian communities will guide and promote growth of the system, which will be constantly evaluated and adapted through feedback and feedforward over time. VNodal's ability to prescribe precise management actions is expected to be a vital resource in community work, and therefore widely supported.

An Agro-Economical Note: Waste Not

Rural System was designed to avoid the consequences of the 4-5-year periodic "Farm Bill" of the federal government, known to have negative impacts in agro-ecological functioning. More and better-informed rational decisions can be made by using *available data* and operating decision models.

Unused, aids have data gaps, heterogeneous subsystems, and excessively challenging political and related budgetary realities. An advisory group argues that farmers should deal with risks connected to their businesses just like other owners. Agriculture is not a singular activity, and is not of singular importance or value to people. It is also highly seasonal, often of critical importance … or of great waste—local as well as international—in its markets, uses, and scales, and it is usually under the threat of "total annual loss." We see real social value in gains, unlikely made, or valued-losses surely avoided … as well as risks very-reluctantly taken… because their private-owner effects rapidly become quite social.

Information and systems are not being used, partially because of information gaps. Economist Sandra Batie identified, "critical gaps in our understanding of how to structure science-based, producer-relevant policy."[35]

We now know that US farms and ranches are managed by less than 2% of the population.

Within Rural System, we shall attempt advances but suspect (and act upon) our perceived need to be self-funding to achieve the long periods of time needed for study and trials in forestry, rates of shrub growth, productive soil development, herd development, and changing climate. For stability for the future, we plan educational growth units within PowerPlace in health and nutrition, as well as advanced marketing for the rural clusters and the modern rural cooperatives.

So much of agriculture has negative impacts on ecological processes. With widespread and off-farm effects, effects on available human food supplies in some situations suggest risks *not* like those encountered by other business owners. As we study factors affecting the productivity of our managed lands, we concentrate on strategies derived from four terms defined by Batie, 2009[36]:

1. Gaining new or positive "scale effects" – economies of products and services per unit of high-valued computed output;
2. Gaining from "mix effects" – economies from groups in transition-periods, with summations over extended planning periods;
3. Seeking and benefitting from "location effects" on production and its potentials, land and water costs, lean technologies, and delivery of raw materials and produce;
4. Gaining from "intensity effects" – prescriptions for Alpha Units for inputs and system functions, from start-up to annual ownership profit calculation, including all estimated gains and losses for the ownership and Rural System; and
5. Studying carefully, and using continuing seasonal summation and analysis with feedforward.

We need total-crop and ready-food reserve optimization, as well as recreation and wild land services. We have a developing policy to *go beyond seeking to export* (or distribute

[35] Batie SS. 2009. Green payments and the US Farm Bill: information and policy changes. Frontiers in Ecology and the Environment. 7(7):380-388. doi: 10.1890/080004.
[36] Ibid.

nationally) to overcome what are merely the results of ineffective production control, and to purposefully plan both the kind and amounts of food shipments in light of circumstances in potential recipients. However, we shall welcome potential recipients who persuade Rural System that they are engaged in "self-help," at least as suggested, by making a strenuous effort to augment supply and annual profit through evident work toward family wellness. Overall, Rural System policy emphasizes system economy in performance, measures, requirements, and enforcement, dynamically balancing supplies, demands, periods, and prices.

We shall study small-scale fish protein concentrate, a clustered pond and stream resource (perhaps for export or garden soil development) for sale through a modern, well-monitored fishery (Chapter 7). We plan relations with analyses of land fertilizer supplies and costs, particularly N, P, Ca, Manganese.[37]

With several Groups, we may cycle furniture and operating equipment, and work toward national scrap collection and sale, including that from the abandoned mining country. We shall work toward recovering valued metal, especially waste and scrap and hidden sources, intent on reforming rural structures and creating *value in form* of the collection. We shall evaluate costs of collection, continual cost/sales analysis, storage, and marketing (e.g., for copper), and cautious development and maintenance of supplies of lumber, mulch, and metals on contract ownerships. We anticipate energetically-sound structures developed with glass, metal, and wood from this practice.

We shall resist commodity payments, for unless they are well-monitored, these "green" payments have been found to increase ambient pollution beyond the purpose of subsidizing intensive crop production (in which we will be carefully engaged).

System-oriented work can tend to ensure that a wide range of environmental and economic goals are met together. We stress synergism, resilience, and gained reliance within rural clusters, with computer-aided, specific-allocations of time and spaces for whole rural sub-systems and their adjacent relations. Rural System will attempt to limit Alpha Units to *bounded production* levels, avoiding the potential excesses of the past in depleting soils or other elements of "the environment" itself.[38]

SBNodal, the Small Business Component of VNodal

A major, largely independent part of VNodal is to be **SBNodal**. Small business software has been badly needed for farms. "Just any-old program" was all that a farm or small, rural business could get or afford, and some have been useful. "Just get the job done" was often the thought. For many years, the most pressing software issue for any small business has been to find one software unit providing a single, integrated solution for helping manage their office—the whole thing.

The problem has been that an architectural framework has not been laid out with a vision in mind to fill in the gaps with the appropriate technology. Therefore, instead of using disparate software applications, each with their own proprietary databases, Rural System seeks a unified, central software system for all aspects of the corporation—one component being small businesses—unified businesses, as if a "business ecosystem," but with a software and corporate

[37] Brooks DB. 1966. Low-grade and nonconventional sources of Manganese. Baltimore (MD): John Hopkins Press.

[38] Victor DG. 1998. Green Markets. Ecology. 79(6):2210-2211. doi: 10.1890/012-9658(1998)079[2210:GM]2.0.CO;2

component serving the many parts. Thus, the "Small-Business VNodal," or "SBNodal," was proposed to serve each of the many Groups of the Rural System Conglomerate.

SBNodal will deal cost-effectively with contact management, email management, document management, project collaboration, telephony, scanning, and more. SBNodal will be designed as a single business solution—a small subsystem that can manage these communication activities and bring separate reports or business documents for staff and board members, and then other relevant parts to system landowners, Land Force members and the public.

Demand has increased for such a system. The lands and waters of ownerships are now of more critical importance, margins are much tighter, technology races ahead, and the importance of clear options from a vastly complex system become more crucial daily. Small businesses are reported to fail because of inadequate "paper management," among other challenges.

SBNodal will be Rural System's solution to meet such management needs. We have rejected offering a subset of programs for small to medium businesses. To date, there have been a few solutions that can actually perform all of these features, and truly offer a single, integrated solution. The present systems known to us are not fully integrated, because they were not designed to be that way and their scale has been wrong. We now see a need for a large, complex system for few, nearly-unique ownerships. The market is small and likely growing, the accepted likely business returns are grim, but the needs remain great for rural land owners and others.

We now design a system to serve Rural System … but having that, we will not sell the system, but sell its services as developed by our staff, operating it to the benefit of rural land owners for their many and varied needs.

Sustainability of Project Outcomes

Long-term planned progress is a founding principle of the described system, and is an integral—and continually evaluated and improved—component of VNodal. In creating a systems approach to management, there must be elements to achieve lasting success. The proposed system (being of a time- and site-specific nature) requires recurring land analyses, using an updated knowledge base relevant to current trends and possible entrepreneurial activities, to accurately prescribe precise management practices over a period of 150 years. Hence, there will be an ongoing relationship between the system and the landowner.

We continue to study a proposal, one that Rural System would function as a membership-based entity (in addition to the land-lease option, and payment exclusively from crop-land-related income). The owners and managers of lands utilizing the prescription service, as well as those businesses utilizing the shared resources available through System Central, may be subject to reasonably-priced membership fees. These fees will cover the costs of the system's services, as well as provide for growth and improvement without the need for future funding assistance. In return, the system will improve profits for private land owners, promote the creation of new entrepreneurial endeavors, and promote the sustained, lasting growth of small businesses.

Evaluation of VNodal

We intend to measure the following imagined outcomes of VNodal-assisted work:

- Private landowners and managers in Central Appalachia, receiving prescription services from VNodal, are seeing increased revenue from their properties, measured by evaluation criteria from landowners utilizing our services, as well as VNodal feedback.

- New small and medium-sized enterprises, suggested by VNodal criteria, are created and maintain reasonable success in Central Appalachian communities.
- Increased employment is available to rural residents through the new enterprises, measured by unemployment statistics and data collected through the employment website.
- A reduction in out-migration from rural Central Appalachia to urban areas is apparent, measured by USDA census.
- Improved community capacity in terms of a skilled workforce, due to increased high school completion, or GED equivalent, in Central Appalachian communities as well as enrollment in industry-targeted training programs, measured by the American Community Survey.
- Community adoption of the neighborhood wellness and social networking project and intensive use of the online resource hub for small business tools and services, measured by website metrics and member survey on wellness and the quality-of-life index.

After seven years, the result will be optimized, profitable activities on privately-owned lands over a long period of time—150 years—achieving a high profit margin for rural land owners and managers, and leading to improved quality of life in the region.

Feedforward: Prediction and Now-Action

Feedforward is action today within a system to accommodate well a likely future period or condition. No, it's not future-telling. It might alter a future condition, but that's not its function. Feedforward is a word with conceptual usefulness in the systems approach of Rural System.

Plans are about the future. A plan may exist for the present, as in "I have a plan," but it addresses the future. One element of superior plans is **feedforward,** best understood by comparing it to feedback. The best popular example of feedback is the thermostat in the house. It is a procedure that senses the temperature, compares it to the desired temperature, and holds-fast or changes the furnace or air conditioner functions until the desired temperature is reached. It is one named "thing," but it is composed of several actions.

Feedforward is a parallel concept; it predicts the future, compares it to objectives, and makes adjustments in the major elements of the present system so that the total system will be very responsive over time to predicted future conditions, as predictions change. Foresters are among a special group of people who must use feedforward in society. Predicting the future and planting trees for that future is one of the most long-term projects, with estimated payoffs far outside of the limits for most current businesses.

For example, if a forester predicts rapidly-growing interest in a special type or color of wood, he or she might re-forest appropriate areas with those species of trees. In effect, they would be getting ready for the predicted future. Feedforward is not a "prediction" or a "forecast," but the total process (a mini-system) of *preparing now* for the future.

In another example, a building may be needed, and the number of people to be eventually served is estimated to be 200. The costs may be too great to build for 200, and no more than 100 would be served in the first 5 years. A building is then built for 100, knowing it is too large now (there are only 40-50 initial users), just right for 100 later, but ultimately too small for the growing group. Feedforward involves taking risks and using careful analysis of the meaning of being "most right over the long-run." In some cases, average annual performance will be a good measure. In other cases, there is a need to keep the deviations (e.g., peak loads) small.

Another example is very important for some agencies and programs. A plan is written. It is reasonable to write several scenarios for the future, i.e., if certain laws or policies (now in the "hopper") are passed. We know future conditions will be different; we even know that the change agent is active. We must put in the *present* plan the responses to the several limited likely futures. This is a specific act of feedforward.

No one can know the future. Feedforward was omitted from early development of general systems theory, for it was unknown in biological systems. Yet, the future can be estimated; estimates about the future are called "predictions." Some things are known at such a high probability that they can be assumed to be known (e.g., water running downhill, the sun rising). Otherwise, it seems reasonable to discuss the *probability* of future events.

Some psychologists believe that some people never reach a stage of mental development or maturity in which they can see or imagine the future. Few people buy insurance, implying some things about their expectations, concept of the future, and what, if anything, can be done *now* to prepare for that likely state. Few people have a "nest egg," partially because of economic conditions, partially because the likely future conditions, some pretty bad, cannot be very real to them.

There are methods and procedures for improving future decisions, by going beyond collecting data and analyses and using them in decision-making. These methods include:

1. Using continually updated and improved models;
2. Using linear and non-linear regressions and trend analyses;
3. Using Delphi exercises (sharing of estimates within a group of experts);
4. Conducting conferences with discussions and special lecturers about the future;
5. Holding essay contests and making writing assignments about future scenarios;
6. Holding contests about future trends, ideas, innovations, and desired conditions;
7. Reading *The Futurist* and related magazines;
8. Holding "limits" discussions to seek and describe limits and the consequences of nearing or reaching them;
9. Holding "perturbation" discussions, examining the likely consequences of major changes caused by people, technology, or nature; and
10. Doing retrospective reading of the Transactions of the North American Wildlife and Natural Resource Conference (and similar records).

An example of a change analysis is that related to a sharply decreased supply of nitrogen. As a result, more areas in farms are needed to produce the same amount of food, reducing forests and wetlands, thus leading to more intensive use of some forested areas, and less intensive use of other areas (e.g., old growth). A similar pattern might be used with decreases in the supply of phosphorus, thus major decreases in crops. Reduced amounts will be in ponds, and thus reduced eutrophication. Crop wastes will decrease due to the shift in production …with wild faunal effects.

Feedforward includes the special concept of a failsafe action or operation. Depending on how sensitive a system may be to failure, or how harmful will be the consequences of failure, backup or failsafe mechanisms are needed. The failsafe action looks ahead, attempts to describe worst-case scenarios, predicts the consequences, and then attempts to take action at reasonable costs that will prevent such failures. A police person or agent traveling with another agent as "backup" is a simple example.

A modern agency, failing to get a license increase, will likely have a failsafe mechanism. Endangered species, for example, may need intensive protection by officers, but this may not work or be insufficient or may contain lapse periods of no protection. A protective fence may be another simple example of a failsafe mechanism for this problem. An officer carrying two guns and an educator carrying two projectors are other examples. For truly important events, double backup is always suggested (and even that may fail, but the costs of further backups can rarely be justified, given the odds of multiple failures). Practical people on tight budgets will rarely tolerate having around apparently unused things, the backups for the things in use.

Feedforward seeks to estimate or comprehend the future, and then to revise the present system based on that perception. It is not just future-telling (any more than a thermostat is just a thermometer). It is not prognostics or futurism. It is a multi-technique approach to seeing the future and acting today to adjust the now-system to meet these tomorrow-system conditions. Much needed, nevertheless some land owners are put off by the notion that feedforward makes today's system wrong or sub-optimum, but allows the system to be most-right or least bad—optimal—over the long run (however defined or decided).

Computer programmers often use feedforward. Building a software program now, with a view for the future use and other uses, and with a means to add easily a new module (scalability)

or with an extra translation program to unify two programs are examples of using feedforward. The common situation is that a present program is bigger and better-documented than it now needs to be, and thus inefficient. However, seen as feedforward, over the long run its eventual expansion and completion may be *very* efficient. Estimating the future and taking action *now* to respond to that future is a very human activity—nowhere else present in nature.

As a more specific real-life example, I hired a person a few years back to work with me on the Rural System concept and development. Unlikely to gain capital for the continuance of Rural System in a timely fashion, I still asked her to write, for Rural System, a paper on her specialized knowledge and experience in disease ecology. I wanted notes as they might apply to reducing risks, costs, interruptions, and even legal action in the future for Rural System and its managed ownerships. I had seen and heard of minor oversights and omissions of well-meaning "environmentalists," whose actions did much more harm than their years of well-meant field work … because of just such a blind-spot or omission.

I committed wages because the strength of my belief in the *future* of her successes and in the active use of her *to-be-written* text in future work. I spend very real, limited funds in the present with great doubt and (scientist or not) no way to *know* the future. There is amateur feedforward optimization involved, balanced investment now for highly probable and highly-valued knowledge and payback for about a third of the 150-year planning period, moving forward.

Chapter Five

How Do I Know Rural System is “Right,” or the Best Option?

With looming limits for food in 2050 AD and water in 2030 AD, effective, responsible natural resource management is more important than ever. How do you or I or anyone know whether Rural System will be effective in meeting the desperate needs of global peoples for water by 2030 AD and food by 2050 AD? To answer this question, we will share our approach to gaining and using knowledge. We encourage you to apply the epistemological tools we discuss in the next two chapters to evaluating Rural System concepts, and to presenting your own ideas for solutions for the rural future.

Many of the most important modern environmental problems result from human activities that threaten Earth's life-support systems. Habitat alteration and destruction, species extinction and overall loss of biological diversity, stratospheric ozone depletion, and global climate change rank among the most serious of these problems. To a large degree, the problems are ecological in nature, but they are also simultaneously economic, esthetic, and are strongly rooted in energy availability and policies. An integrated policy, planning, and management framework, based upon the best knowledge that can be provided from the social and environmental sciences, is needed to deal with current and emerging environmental problems.

The rhetoric that pits the environment against the economy is a false dichotomy that can be replaced by the emerging view of opportunities within Rural System, resulting from the strong linkages between the environment and the economy. A challenge is to manage natural resources and the environment in a manner that provides for both the evident needs of today and those now emerging. Decisions about natural resources and the environment have long-term and short-term economic consequences. Experience demonstrates that managing environmental systems in a sustainable fashion will be economically advantageous in the long run, but balancing economic development and the management of environmental resources remains one of the greatest challenges for any region.

Since the late 1960s, when environmental issues first received notable international attention, the discipline of ecology has made significant contributions to peoples' understanding of environmental problems. In the 1990s, the ecological community developed an intellectual framework for acquiring and disseminating ecological knowledge required for developing many resource systems to provide for human needs. Rural System builds on that framework—a rational basis for analyzing systems, designing them, and for identifying important areas for ecological research.

A comprehensive, environmental, knowledge-base-building program is needed to produce or gather the data and deliver the knowledge required to make informed policy and management decisions, understand and minimize risks to the services provided by ecological processes, identify mitigation procedures and restoration strategies, and evaluate the economic value of so-called ecosystem "services”—all at a reasonable scale, cost-effectively. Rural System prioritizes:

- fully using our *current* knowledge about ecological processes when making environmental decisions;
- developing a strong knowledge base in those areas where the necessary information is currently lacking; and
- developing decision aids for using many large knowledge bases in making complex decisions.

If the region is to have the knowledge needed, the scientific community may need to adopt a Rural System approach to research, or more informal "studies." Rural System is devoted to *disciplined* inquiry. It will assist in setting research priorities, conducting efficient, planned studies, communicating the value of research results to the public, and providing sound information to policy-makers.

There are three areas important to knowledge-base-building:

Stable Ecological Systems – answering questions at the interface between ecological processes and human social systems. We need to understand when natural and managed ecological systems are stressed to the point that they are no longer capable of being sustained for human needs, how to restore damaged systems, and how to manage natural systems so that they can remain productive to meet the needs of the human population.

Biological Structure and Processes – understanding how complex communities work. We need to know how anthropogenic changes affect ecological processes and results, and thus the benefits produced by outdoor systems.

Global Change – understanding the ecological causes and consequences of global change, including climate change.

The inextricable links among the region's economic and environmental well-being underscore the need for sound environmental policies and decisions. Complex environmental problems, with many factors, require a coordinated and comprehensive program. The importance of each part of such programs can only be known *after* decisions are made, "end-values" are stated, a priori, and results are resolved.[39]

Rural System's Advanced Studies Program

John Dewey wrote that studies are "...The means for the continuous discovery of new truth and the criticism of old belief."[40]

Rural System is a relatively sophisticated system, now being planned for guiding managers in making difficult, often very diverse rural land management and economic decisions.

The land- or resource-manager is *not* an easily recognized person with common education, abilities, or on-the-job training. Many managers do not have the knowledge or experience that allows or encourages them to make the best possible use of the many products of the land—recent graduates of university programs may not have developed the necessary skills and abilities. Because of the new, sophisticated, complex demands of modern land use planning,

[39] Based on: Lubchenco J, Brubaker LB, Carpenter SR, Holland MM, Hubbell SP, Levin SA, Macmahon JA, Matson PA, Melillo JM, Mooney HA, Peterson CH, Pulliam HR, Real LA, Regal PJ, Risser PG. The Sustainable Biosphere Initiative: An Ecological Research Agenda. A Report from the Ecological Society of America [Internet]. [cited 2017 Apr 20]. Available from: https://www.esa.org/esa/science/sbi-agenda/.

[40] Dewey J, Boydston JA. The Later Works, 1925-1953. Carbondale (IL): Southern Illinois University Press.

few land owners have staff with resources for the timely and cost-effective development of such plans.

There are many people in public resource agencies without advanced degrees. Many need and desire them. Because of area locations, professional responsibility, and family circumstances, many employees who desire advanced degrees (typically the Master of Science) have been unable to obtain them. Rural System presents a need for such education and an opportunity to both offer and gain parts of it. One need may be met by having experienced staff intimately involved in developing Rural System. Coworkers will be needed to complete phases of the System, to capture past investments in diversified research and knowledge-building, and to encourage personal involvement with and loyalty to a quality system under improvement. Rural System will arrange for them to participate in a new **Advanced Studies Program**.

Professional biologists and wildland managers may apply to a local graduate school. Upon admission, they may take part in on-campus work, electronic educational experiences, computer-aided instruction, short-term intensive seminars, and may simultaneously create a major component of Rural System under careful supervision. This component would be equivalent to a master's thesis, and not unlike management plans, computer programs, or policy analyses already widely acceptable as part of master's degree programs in universities across the country.

The enrollee in Rural System's proposed Advanced Studies Program will not have to seek a degree, but may participate in any or all of the many resources of the program, including textbook discounts, information systems, computer resources, software, computer-aided instruction, tours, field trips, demonstrations, short courses, and electronic education of various types.

The results of participation in the Advanced Studies Program may be:

1. career development;
2. pride of "ownership" in parts of Rural System;
3. rapid development of Rural System;
4. quality inputs to Rural System from the diverse experience of participants;
5. lowest-possible costs for educating staff and building Rural System;
6. unique timing, scheduling, and an alternative pathway to an advanced degree if one is desired;
7. educational opportunities with general systems theory orientation (which is so highly relevant to land-use in *all* agencies and ownerships across the U.S. and the world); and
8. likely continuation of the planning process and an improved Rural System based upon it.

The typical participants will have more than 3 years of experience in rural land work—resource-related work in public agencies or within the private sector. They will present letters of recommendation for participation from their supervisor, and one letter from a former supervisor or person familiar with their work. They must have extensive rural experience (or present a rationale for an alternative pathway), and have an acceptable grade point average in advanced undergraduate courses (typically 2.8 or greater, in the last 2 years of a recognized Bachelor of Science in a related area). The applicant must develop a contractual relation with their supportive employer for at least 3 years of work after graduation (no matter how long the actual course of studies may require, since these hours will typically be on a part-time basis over many years). Pay-back provisions will be included for employees who move to employment in another agency, ownership, or organization position in less than 3 years.

The degree program will be designed for a "standard" M.S. program. Instruction will differ greatly from conventional programs. The time required is likely to be extended. The thesis requirement will remain, but the type will vary, for it will describe and demonstrate a working component or a major component of Rural System.

Rural System has a policy or philosophy of using studies and research. It rarely will *do* research, partially because it has a working hypothesis that an attempt has already been made to answer most highly-relevant rural questions, and that the job now is to find such reported work and use it ... at least in some approximate or tentative way, objectives-related.

We are struggling, still, with the means and with receiving the diffused knowledge. We believe research to be given far too much credit, and that there are many ways to know anything. *Induction*, typical of the scientific process, is only one way to know. We favor *deduction*, and then approximations used within models. We tend to believe that we know much about systems—that the parts vary, but that they can be approximated. The generalized results of good models will probably give us more useful information, approximations, and feedback appropriate for changing field conditions than the very best field research (always with its sequenced delays and inability to achieve required controls).

We know that within Rural System we cannot be against "science," but we appreciate Wolfram's *A New Kind of Science*,[41] and tend to hold that the uncontrolled, long-term, and highly variable conditions (many caused by people and exotic insects and diseases of the rural areas) are not appropriately addressed by conventional science. Perhaps that is one reason why adaptive procedures have gained such quick fame. Adaptive management, however, dodges the issues of *how* we know *when*, *if*, and *how much* to change ... or the appropriateness of the probability standard for the "after" condition. Adaptive management omits feedforward of the modern systems approach, and has little role for standback (Chapter 2).

There are major advantages of Bayesian methods for informing land and pond restoration and production decisions, especially about lands and waters in transition. Bayesian analyses are providing innovative solutions to research and policy problems commonly faced by environmental scientists and decision makers. Two distinct advantages of Bayesian analyses are that they allow expert knowledge and knowledge from other, similar situations, to be incorporated in the form of *the prior*, and they characterize total uncertainty in a compact and useful way via *the posterior* distribution.

While expecting to exploit the vast, hard-won resources of past research findings, we will engage in specialized, directed studies. Research has provided information and conclusions that have become the basis for much of the analyses, decisions, and content of Rural System and interior Groups. Research is seen as a subsystem that provides inputs to decisions. It is one of the ways that people come to know things, one major way among 10 ways of knowing discussed herein, and includes inductive and deductive methods. Research needs to be continued in a strategic way, *a system of studies*, on carefully-selected topics that will allow informed changes to be made in profits, *very* cost effectively. Results of past studies need to be used in the system; results need to be synthesized and used together. Data and photos (etc.) need to be protected, and all must be backed up. All results need to be brought to bear on area decisions; preliminary and pre-publication reports are essential, and part of an evolving, named system.

We are aware of how limited we are, and how short of time for additions and developments. It is very hard to predict ecological events and their consequences very well. The systems are very complex, well-known to have many parts, most of them varying, and there are

[41] Wolfram S. 2002. A New Kind of Science. Champaign (IL): Wolfram Media.

many biological linkages and sequences. We remain unhappy with the fairly persistent but un-sustained investment in measuring rural resources and developing predictive models. We intend to participate in changing such conditions, with work to meet our needs and to demonstrate the great potentials from such spatial and temporal studies, related to future production potentials.

We are especially interested in "sequence" of presence and action as an important factor in our systems, perhaps more-so than the conventional, readily-observable factors that we now include in our models. We hold that economic analysis will be the bridge being built and used in Rural System *between nature and the people of rural areas.*

How Do We Know Anything?

How do I or other people know anything? Not “what” or “who,” but *“how”* do you know? I surrendered long ago trying to answer “What do I know?” for others graded me on that—both its number and magnitude—and found me, as I knew, wanting.

Then I encountered the question of “How do I know anything?” and I continue quests for those answers. I’ve learned from others that there are 11 ways to know anything, maybe more. Probably there are only alternative or preferred groupings of ways, called by some “criteriology” or “epistemology.” I assert no creativity, only a collection of ways or criteria useful to me (and hopefully to those of Rural System) to know the topics upon which we all now rely.

Criteriology leads to images of “truth” being within bounds—a “ball-park”—or within the volume of a multi-dimensional, multi-faceted, high-truth or high-belief object.

Words are not adequate for many topics. Pictures, moving ones, 2- or 3-dimensional, may suffice. Poems are said to serve in special ways. Different languages handle topics better than others because of the available words, techniques, and their long-accepted uses.

“How do we know?" may be a question answered best (for one meaning) by saying, "read chapter Z in book K," the book’s author(s) referring to a criteriological base of authority. "How we know" may be a topic for a psychologist, or better yet, a neurologist. An anatomist may be correct in pointing to the exact part of the brain where dimensions of knowing occur.

I hope you will not diminish the question. For the future of the rural world and its people, all of us need to know the ways that people know as rapidly as possible. We must struggle to use the most appropriate ways in the most refined and discriminating ways possible. We need to move the condition of knowing onto the platform of action, of rational robustness, discussed in the next chapter. We often assemble “what we know” with “how we know,” because we assign different weights, strengths and confidences, or sets of limits, to each thing known depending on how we know it. Even more importantly, for some questions, we assign a weight of strength and probability to each knowledge base.

The knowledge bases for Rural System use are:

- Authority
- Other
- Genetic
- Place
- Private
- Sensory
- Contextual
- Coherence

- Pragmatism
- Induction
- Correspondence

Each will be described in the order listed.

"Authority" is knowledge based on a power figure, some fount of truth. This is knowledge asserted by the expert or an undisputed source. It may also be a group authority, such as expressed in a creed. Primitive examples are the medicine man or wise person of the tribe. Modern examples are the authoritative text, a senior committee report.

Although limited, authority is a way to know. People who have worked afield for years as trained observers know an enormous amount. It is very sad to see environmental agencies not attempt to capture this knowledge when these people change areas or retire. (In Rural System, this problem is addressed in **Nature Seen** and **RuraLives**.)

"Authority" is weak as a base because it cannot handle the prophet or the spurious observation, and it cannot discriminate between authoritative groups. Parental authority is enough to make many people leery of this base. A sub-unit of authority is "privilege." "How do you know her salary is that much?" "I know; I am her supervisor." Not necessarily experts, some people have special or privileged access to information that others do not.

"Other," a modest escape valve for knowledge hidden from me, indicating means of knowing other than those listed and discussed here. These may include those insights induced under drugs, sickness, or brain-cell implant. This may overlap the private base. Overlapping is not uncommon throughout this analysis. Knowledge gained from "other" sources may be repeated or repeatable but only in a limited way.

Knowledge of presence or *place* (see below) is said to be gained in unusual ways, perhaps electromagnetism, as in migrating birds, or by some total, innate, multi-sensory comprehension of conditions, including impending attack and "imprinted" conditions of early childhood.

From a great knowledge base, a very-small constrained space, where "good" (or acceptable) may exist and may have been marked, leaving very few items or area as acceptable and believable, thus known as "not rejected."

"Genetic" is seen as insects emerge; some exist as adults for a very short period, perhaps only a few days, yet they know what to eat, in what patterns to behave, how to reproduce, and how to avoid some predators. Other organisms, including people, have some innate knowledge transmitted within the genetic code. The more dependent an animal is upon its parents, upon learning, the less information, knowledge for life, seems imparted in the code. The need for community-forming, demonstrated within wolf packs and in cub behaviors, is intrinsic. "Not knowing" results in "selection against" large numbers of individuals.

"Place" may be an epistemological base. A squirrel is not startled into jumping when a leaf falls beside it. It knows its terrain and actors. It dodges hawks; it ignores leaves. Short-lived insects know their foods, their homes, and their roles, but these can be claimed to be from a genetic base. A wilderness traveler sleeps soundly; the tenderfoot awakes at any hoot, every scurry in the leaves, every fire-brand collapse, and every rock roll in the stream.

From biology, we gain an alternative concept of how animals know anything, and that is "imprinting." The duckling knows its parent. A duckling brought from an egg incubator imprints on a human child or adult and behaves toward it as it might to its parent. There is evidence that birds and insects also "imprint" on spaces and structure. They return to the same nesting area; they build the same nests; they use the same nest-size holes. Wood ducks, raised in boxes, return

from migration to nest in boxes. Progeny of wasps, having built a paper nest on wires on the ground, return to the same wires. Migratory fish imprint on the chemical characteristics of their original streams.

Perhaps place is an element of "cover." People who grow up in grasslands love the plains and express discomfort at living among mountains. "Mountain people" tolerate, and express *ad nauseam* the beauty of coastal living, but long to return to the mountains. They know their place; they feel uncomfortable out of it.

In 2014, a note from The Conservation Foundation included: "Have you ever walked through a field or hiked to the top of a steep mountain and felt intuitively connected to that place – to its history and to the people who have been there before you? This month as we celebrate the birth of America and our 238 years as a country..." They were relating, I hypothesize, with "place" and a special kind of connection.

Place is an ancillary type of the coherent epistemological base. Most bases seem related. I cannot decide whether recognizing and knowing the name of a person (or a plant) or not doing so is a place phenomenon. Maybe there is only simple correlation in such observations, but I think failing to recognize an otherwise well-known person because he or she was in a totally unexpected place suggests the mental action of searching among several ways to know anything.

I visited northeastern China in 1989 and *knew* the place that I visited. I felt at home in the forest, though everything else was different. The species were different than those I knew, but the families and genera of plants were similar. The farms were the same. I could relate easily; I was familiar with the total, the "surround," a spatial gestalt. I knew the place. I knew what to expect. I did not feel at risk. However, I suspected that I could never feel comfortable in Senegal. Everything seemed different. I could not predict what was behind each tree, beneath the river surface, or what had caused the disturbances on the ground surface.

A student of mine took me to the Rann of Kutch in northwestern India, a vast, frightful, coastal salt desert. He was at home there. He loved the whole place; he knew it well. Place may be a way to know.

The **"private"** base is from those people who claim to have had very personal, perhaps unrepeatable experiences. They know something but how they know is private to them. It is perfectly sufficient, but its source is unavailable to others. Metaphysical experiences (revelations) are one of the grounds of private knowledge. The person having knowledge asserts "I just know!" to the question of "how?" Such knowledge cannot be investigated. The knowledge held is almost un-discussable. As Bendall asserted: "The notion of *truth* presupposes the notion of inquiry."

A **"sensory"** base of epistemology is that of "seeing is believing," a well-known phrase. Upon reflection, it is only true for the trained observer and then it is limited. The variation in courtroom testimony about what has been seen can be convincing that the base is limited. Training of behaviorists, scientists, and law enforcement officers is notable because a sensory base can be improved.

People learn to improve their sensory perception with eyeglasses, hearing aids, and microscopes, etc. Most of the technology of environmental sampling is designed to improve sensory perception of the ecosystem. The perfect observation cannot, however, overcome a bad sampling strategy or bad research design. A sensory epistemology is limited because of limited sensory ability, training, equipment, etc. It is also limited because of communication. An un-communicated or poorly-communicated observation is private knowledge.

A blindfolded person smelling burnt hair and touched with an ice cube will "know," erroneously, he has been burned! It is almost impossible to have a pure stimulus. The context of the stimulus provides its meaning. To “know” based on sensory perception requires knowing the context.

Perceptive rural observers of all types and ages seem to know what to observe. They have a structure, organization, or model as a means of assembling sensory perceptions and thus avoiding "noise." The entropy of information systems is essential to know, dangerous not knowing. Noise may cause people to observe the wrong thing or in the wrong way. The structure (or context), not the sensory experience, may be flawed.

The sensory apparatus itself may be too. Being hit in the head, a person might exclaim: "I saw a blinding light!" This could occur in the dark. Drugs produce altered states that either reduce or enhance senses (e.g., guard dogs search better when given certain drugs). Dreams are often so real that people report events that have never occurred, were never known, measured, or otherwise sensed to have really occurred.

“Contextual” is a base of knowledge from language, one based on continuing agreement among users of a language. We assume people know what we mean by "hard," "soft," "pain," or "wet." We may know what land "carrying capacity" (e.g., for a wild animal population) means because of the way it is consistently and usefully used in a given work. We have little basis for discussing “riparian” because the words used are weak, incomplete, and imprecise. The contextual epistemological base is weak because a process for agreeing on the language is usually lacking; the users change in knowledge and need for the words, and the words themselves are mere models, codes, a representation almost by definition and thus not sufficiently true.

The **“coherence”** base is knowledge that fits with the rest of knowledge. We know that water does not run up hill, and that the sun always rises. The bird digging a hole in the sand dune is not a woodpecker. I know that! It fits with everything else that I know. This base is strong because it is related to a large fund of knowledge, but it fails to be able to establish the truthfulness of that fund, only the level of agreement. "How did you know that instrument would work?" asks the student. "It just made sense that it would, based on size, shape, design, price, reputation of the company, and reported-prior-use of similar equipment." ("Reputation" is precisely related to coherence.) "How do you know your proposed technique will work?" asks the skeptic. "It has never been tried here before; I just know!" Not private knowledge (but possibly), this claim may be a display of the coherence base, or perhaps experiential or authority.

A large fund of accurate knowledge is key to the usefulness of this coherence concept. Starting at an arbitrary point, a garbage-pile called “knowledge” could be built. Starting is not arbitrary, however. Coherence overlaps strongly, as do other bases, with authority, contextual, and induction.

“Pragmatism” dominates agriculture, forestry, rangeland, fisheries and environmental fields. The epistemological test is whether something is useful or whether it works. It usually includes concepts of efficiency (high output per unit input) or effectiveness (high, specifically-stated, desired output per unit input or time). Knowledge exists if it works to aid in managing people and the environment.

How to define “it works” is a looming problem. What works for some people or during one period may not work for others or in a later period. "I know I shall not get sick after boiling and eating these old beans" may be a statement of high certainty today, highly satisfying, but deadly tomorrow.

Pragmatism may be sufficient in local situations, but does not accommodate events in the tails of the normal curve or sectors of a complex computer program. It cannot handle rapid change or the new relations that arise when a factor is added to a decision analysis, such as a player change made in a losing team game or chemical synergism experienced. In general, when pressed, the pragmatist must shift to another base.

"Induction" is the classical "scientific method." Baconian, it flows from hypothesis through test to conclusion. The last stage, publication or presentation, is usually omitted, but it is essential as a feedback loop for review and correction. The knowledge base is a small system with a shared conclusion, a knowledge statement being the objective. This procedure is logical, flows well, and the evidence is that it works. Knowledge through induction is based on processing evidence to arrive at results, then a conclusion.

This base may fail because of the sensory nature of much evidence used. I interviewed many professors before leaving a university and asked what should be gained from a Ph.D. degree. The most memorable answer included two major things: (1) how to ask answerable questions, and (2) the nature of evidence. The latter is a major difficulty of the inductive approach to knowledge.

Equally difficult to resolve are infrequently occurring events (e.g., earthquakes) and some for which evidence cannot be gained due to moral or other reasons. For example, "What is inside the church cornerstone?" Knowledge must await the church destruction. Can a person recover from a bite of a rabid animal on the shoulder? Can a person get rabies by aspirating air from a cave with rabid bats? The answers await immoral experiments or dangerous accidents. Some experiments are too costly to perform; some systems are too sparse to study except in some weak manner (e.g., endangered species); some populations are so variable that no conceivable experimental design will produce a conclusion other than that more studies are needed. The mark of experience and education, the evolution of a coherent epistemology augmenting the inductive, is to see the general in the truly unique.

"Correspondence," also called deduction, is the epistemological base of knowledge dependent on tests of reality that are usually made against standards. Often considered a process of reasoning from the general to the particular, it is the converse of induction which seeks general rules, premises, and descriptors. Languages and mathematics are model-building media and models are examples of general representations of knowledge. How well models represent reality is a qualitative aspect of this base. A picture or painting is true, faithful, or accurate to the degree it corresponds to that which it represents.

To perceive anything is to form a mental image of it. This is true for a sensory experience or some entirely mental activity, perhaps of some previously unseen relationship among agro-ecosystem components. Truth is an expression of the accuracy of the replica or model in the mind to the things outside of the mind. Every abstraction, every model, is, in part, a falsification because of what it omits.

Correspondence is an analysis of the truthfulness of the model. Not computer models, but communicated expressions of the model in the mind are the topic here. Without communication, the model is private. Correspondence becomes the major issue in deciding how well the results of questionnaires reflect reality, perception of scenery, willingness to pay for recreation, and importance of objectives. These are models, and how well they represent the human mind and the fundamental decision-making process remains an important question, a major dimension of deductive work.

Correspondence in human life may be seen in three dimensions. At any time, a person, enterprise, or agency may locate itself within a space among: (1) what they are doing, their life expression, (2) what they think and say they are, and (3) what they perceive they can become. The perception of what a person, group, organization, agency, etc. may become may itself be flawed, and may be either excessive (beyond any practical levels of attainment) or conservative. Resolution of these differences is in the literature of "human potential," of ethical behavior, of humanism, and, of course, theology as it may relate humans to their god-concept. Within psychology, the lack of correspondence among these concepts is discussed as "cognitive dissonance." In marketing, they are discussed in relation to what a buyer wants, needs, and feels he or she deserves.

How do we (anyone) know what's right or the best option? Anything? We can know well using the elements of epistemology. With each, we work toward answers provided within the framework (the context) of the elements, rates of change, timeliness, and perceived constraints… often assembled into models yielding answers with their probabilities and constraints. Defining "best" results is possible in a "ball-park" — "fences" of probability—within the constraints of linked criteria. (Computers are now ready to help with this analysis.) In Chapter 6, epistemological concepts are applied to Rural System's specific approach: rational robustness.

Heuristic Convergence

Within Rural System we propose to do deductive and inductive studies, explore the full list of criteria for knowing anything, and advance **heuristic convergence** of the criteria or bases for knowing toward tentative approximations and a pragmatic paradigm.

The Studies Group will seek an alternative to "classical research" within diverse rural resources under extreme pressures. We have a point of view that classical research may not serve the field(s) of rural resource management well, or adequately. **Induction** is only one way of knowing or discovering anything; **deduction** is also available, but limited. Even together, as we investigate heuristic convergence of the criteria for knowing, they may not suffice.

"Heuristics" is not a widely-used word, but it is an exciting one, full of subtlety and potentially quite rich. It is not a scientific word for it is much too imprecise, but it carries information and has its own ambience. Roughly, it means the way one finds out or discovers. (*Heuristic,* for us, means *a discovering*, often personal—an experimental, trial-and-error, exploratory approach to problem solving.)

Each approach is limited. Barriers to study abound. Classical research or studies are characterized by singular hypotheses, tests of falsity or untruth, tightly-controlled experiments, conservative conclusions, and journal-based publications with limited reading and few rewards for implementing results. Costs of studies and findings go unreported. There *are* strong alternatives, and an active one is needed. There are many reasons... sensed by a few people, and alternatives emerge from among them. *Alternative* is an emphasis, not a *contest*.

Reasons to Seek Alternatives to Classical Research

Reason 1. The scope of rural work is excessively large. Consider many animals, plants, ecosystems, history, endangerment, pest damage, operations research, economics, and all aspects of human behavior.

Reason 2. Simple, meaningful, stable hypotheses can rarely be formulated.

Reason 3. Classical research tests can rarely be made within a meaningful period. The lifespan of many animals; the lives of trees, shrubs, and vines; the changing nature of humans and their conditions over their life span; and the human alterations of land and environment away from sites being observed all deny the real possibility of "controlled" experiments.

Reason 4. The movements of animals prevent genuine controls. Islands and enclosures are used in some cases, and are stated as desired in others. The conditions of studies are *atypical*, but answers are desired from representative, *typical* situations.

Reason 5. Most research-based workers are employed by government agencies and moves are often made. Stability is rare. While 'control' over the environment might be made, appropriate control over observer differences can rarely be gained for long studies.

Reason 6. Even for short studies, control over observer differences for observing several *areas* or *periods* can rarely be gained.

Reason 7. There are too many topics to address to conceive of ever finishing an experimental effort. Even anticipating the long persistence of humans and the scientific community, expanded workers, efficiency, *and funds allocated*, the tasks ahead now seen seem unattainable. To act otherwise is irrational. The underlying premise of science is rationality. We approach awareness of limits and alternative needs. For example, consider the following questions and try making a rough guess or approximation for each question:

1. How many bird species are in your state, region, country, etc. (the area of concern)?
2. How many mammal species?
3. How many fish species?
4. How many aquatic mollusk species?
5. How many terrestrial pulmonates (land snails)?
6. How many crustacean species?
7. How many snake species?
8. How many lizard species?
9. How many turtle species?
10. How many salamander species?
11. How many toad and frog species?

Assuming the average citizen will estimate over 50 for each, there are thus 11 x 50 = over 550 species for realms of research questions and topics—animal species alone—and hundreds of questions are waiting about each species. There are thus probably thousands of species in our areas of interest, with a minimum of 50 questions on average yet to be answered about each species. Now consider the number of experiments or research projects remaining to address each question, even ignoring paired combinations of the above and the meaninglessly-large numbers of permutations of such live elements. There is a *very* large number of studies to be done, even during the remaining life period of many, very effective classical scientists.

Reason 8. The expertise to conduct the needed studies is not available and even under extreme assumptions about distribution, success per year, and educational system output of competent researchers, the numbers of experienced researchers likely to be needed will not be available.

Reason 9. The financial resources for classical research work are not likely to be available. In 2012 there were 6.2 million scientists and engineers in the United States. The

average wage for scientists in 2012 was $87,330[42] per year, so the costs of the needed, basic species-specific knowledge are clearly *very* large. The likelihood of the field of rural and/or faunal systems management *ever* having such resources for designed work seems very low. To act as if they will become available soon, even for a region, state, or country, seems irrational.

Reason 10. The time is not available. Species are being lost daily; crises are commonplace. Interrupted studies are common. Even with new computer power, eventual mastery of a small, stable system is not a rational model for faunal system studies. Inductive, observational, descriptive studies of fauna and their related floral systems seem irrational and inappropriate for rural and faunal system managers.

There are 10 reasons listed for why alternative studies are needed. The alternative I advance within Rural System is developing a pragmatic paradigm, one of *heuristic convergence* toward tentative approximations. How would we recognize it? This pragmatic paradigm will eventually be seen to have the following characteristics and actions:

1. Clarifying the realm of work, answers will be sought only to pre-stated questions.
2. Being highly predictive, such as in: "If *this* action is taken, then *these* consequences can be expected..."
3. Starting with the end in mind. If truth seems available in a situation, to what use will it be put? Assuming a perfect study yields results, what are the related uses? Diversifying inquiry to studies that produce results likely to be broadly useful, such as knowledge of processes (e.g., erosion, metabolism, and trail-following behaviors).
4. Seeking knowledge likely relevant to several species.
5. Studying *a priori* universal factors that provide massive control in perceived variance, such as abiotic factors (solar radiation, precipitation, evapotranspiration) and their related forces.
6. Creating universal algorithms for computing point, line, area, and volume relations.
7. Building transition matrices (e.g., ecological succession) that allow for the use of GIS with predictions.
8. Giving special attention to functional taxonomy, naming individuals and groups related to currently-perceived human benefits rather than to anatomical characteristics.
9. Paying attention to life-group or stage (e.g., turkey poult vs. adult turkey). There are greater managerial differences in life groups within some species than between some families of organisms.
10. Conducting "expeditions" to gain economies of scale and interactions among professionals and amateurs, e.g., coordinated regional and state faunal and floral surveys.
11. Attending to specific units of benefit provided by the resource, e.g., organs, pelts, and sightings.
12. Measuring and reporting demand for the units perceived to be needed by nominal populations of people.

[42] Sargent Jr JF. The U.S. Science and Engineering Workforce: Recent, Current, and Projected Employment, Wages, and Unemployment. Congressional Research Service. Rep. no. R43061.

13. Analyzing substitutability—how one faunal or floral event, experience, or benefit unit may substitute for another.
14. Making non-linear cost estimates available for decision makers, the expected faunal and floral benefits produced per unit of expenditure over time.
15. Rejecting the strenuous pressure for parsimony in models: a retreat from calculus models to difference models.
16. Using GIS software in optimization, such as in selecting optimum power line, water corridors, and floral management units.
17. Using, with feedback, the opinions and knowledge of aged, experienced people, often in expert systems.
18. Selecting and using statistical alpha of about 0.20 rather than the often-used level of 0.05 (the 80% rather than 95% level of confidence).
19. Paying attention to equifinality, the principle of finding multiple, different pathways to the same end-state in a system.
20. Paying new attention and reporting the role of observed *sequences* within natural, outdoor, or rural sequenced observations (e.g., pre-post rain, high-wind, days since fire).
21. Dynamically developing prescriptive systems, computer-based, with reports or plans that are temporary and grounded in dynamic databases, optimization programs, and report generators. These will progressively depend less and less on paper or hard-copy texts, maps, and illustrations.
22. Forming new institutional arrangements to increase permanence and utility of knowledge gained at such high costs, and often great risk and hardship. These may include data storage systems, hypertext, expert interviews, and video image storage.
23. Using non-governmental strategies (e.g., public observation, social media) to assure stability of research programs and long-term, essential studies.
24. Developing a cadre of supportive retired scientists and practitioners with a grasp of the now-foreseen needs before 2050 AD.

Research modes are well-known. They have served well. Many successes can be attributed to doing science in "the old fashion way." Yet regrettably, it becomes clearer to some that the problems of the rural and faunal resource manager cannot be solved in ample time, given expected resources and international dynamics, and with the likely talents available, by using classical scientific models.

The brevity of the 6-step inductive process has had great appeal as well as success, but a clear pathway to the future is not seen. We seek an alternative. The need is for diligent searching, creativity and engagement of a rational strategy for gaining knowledge, the truth spaces for active use by future managers of rural and biological resources and their human benefits. People now need help from studies, produced knowledge for confronting and surviving the yet unimaginable stresses of the near future.

A Heuristic Convergence Strategy

Key parts of heuristic convergence will be in the 11 classes of benefits (Chapter 2). Others are:

Hope – Strangely (at least to me) hope is no longer widely used, perhaps because it has excessive metaphysical connotations. Nevertheless, *hope* remains a good and useful word that includes concepts of both goals and expectations of their achievement. It states perceived desirability of X and a level of intensity of that desire, and is a statement about the pathways to that future instant when X begins.

Nascent Theory – Work needed is on what might be expected and on written reason, not just summaries of "more-than-30" observations, mere chance notes grasped from a tornadic data-machine. “What makes sense?” is the question as well as the *demand* from serious theory today. Stop collecting data! Theorize! The proposed theory’s *causative* may be true, even if not supported by the data yet. Within Rural System, we live based on the best available theory, processed, not the data. There is no more time for peripatetic moves through a jungle of ideas and experiences. Theorize!

The Basic-Applied Dichotomy – It is easy to understand and appreciate administrative, budgetary, and legalistic reasons why there needs to be taxonomic separation between basic and applied research. Only recently has it become evident how harmful that taxonomy has been to science. We know it exists, multidimensional but continuous. The fundamental difference between basic and applied is that of *when* the conclusions reached are applied. Basic research seems to take longer for its findings to be applied, a trivial distinction on a temporal continuum. Taxonomic and administrative problems arise when basic research is quickly applied, and so-called applied research findings languish in the shade.

There is no longer any meaningful difference between these taxa; they are artificial, and are intellectually, personally, and organizationally divisive. They are the roots of great ineffectiveness in the scientific community—especially those dealing with land-use questions. By focusing in the future on wholeness, similarity, and generality, predictions will be more correctly made. There is only one science.

Sequences – It seems conspicuous when looked at directly that a major aspect of the research application-rate problem is the problem of the sequence of discovery. Perhaps it is obvious, but emphasis is needed to prevent losing sight of the sequence phenomenon in research and to avoid attributing more to the basic-applied dichotomy than it deserves. The apparent scientific successes are those that, by chance or planning, fall in a fortuitous sequence. The fate of absolutely equal quality research (by any criterion) is a function of the environment in which the results are placed.

The analogy of a three-number lock combination is somewhat instructive. Three correct numbers will not allow entrance, only numbers *and* the proper *sequence*. The odds of the proper sequence are quite low. Ackoff (1962)[43] delineated *sequential* and *simultaneous* research strategies and their counter-balancing forces of costs, time, and risks. Sequential research has lower costs, takes longer, but involves less risk than simultaneous research. Simultaneous research is a broad, multi-worker, multi-lab approach usually taken in a short period.

I’m convinced that the scientific community has little time (i.e., until 2050 AD and world population abundance and food and water supply shortages collide) to aid people significantly

[43] Ackoff RL. 1962. Scientific method: optimizing applied research decisions. New York (NY): John Wiley and Sons, Inc.

and to preserve current living standards (at least for U.S. citizens). Only simultaneous assaults on major research issues such as land use seem appropriate. My conviction arises from observations of a host of environmental problems, the increase in counterintuitive consequences of many of the most altruistic actions, and the rate at which thresholds of tolerance and supply are reached.

Although I advocate simultaneous research—team assaults on major problems—in such projects there are likely inefficiencies and partial failures. Nevertheless, such projects seem advantageous because they buy society time. They quickly put conclusions and discoveries into the hands of decision-makers and shapers of society. Yet, there exists today a socio-political order that appears unwilling to tolerate costly, simultaneous research programs. The programs are needed, desperately, but they seem unlikely. Society will trade time for risk and time for cost. Instead of buying time, society spends it. This is very saddening; it is a decision that can be reversed, but it does not seem likely. Sequential research therefore is most likely to be done because of cost constraints, and because of the **social ignorance** that says (1) we have unlimited time, and (2) the burgeoning multi-country society with its demands is not at great risk.

The only current hope that can counter this failure is in independent, localized, small-scale research planning. Since sequential research seems inevitable, planning can reduce its costs, and importantly, allow all possible haste.

Research planning has been advocated for years. Its need is voiced again, but perhaps in more meaningful terms than the past. The planning needs are for solving problems like: (1) How can people maximize the total costs of delivering minimum, adequate in-dish meals to a person of specified sex, age, and weight anywhere in the world? (2) How can people achieve a sure, high-quality groundwater resource for all the people of the U.S. and Earth by 2030 AD? (3) How can people preserve, for use, the present gene pool in wild and domestic animals? (4) How, for example, can people plan and shape 200,000 hectares for optimal biotic production for 1,000 years?

These are problem questions appropriate for high science. They are timely, researchable, essential, and will require assiduous application of the scientific method, from the most esoteric and micro to the most philosophical and macro approaches. They cannot be achieved in any period of time that has relevance to the human condition without the most profound and scholarly thought, without at least one or more people thinking them all the way through and writing or diagramming their thoughts. Previously there was not enough known, or the technology was unavailable to do so; these conditions have changed. The plan that will result following such thought must exist; it must be charted, it must be a shared view, it must be begun, and it must be altered as need arises. With all this, the goal must remain, and pressure and leadership must be exercised to achieve the goal.

Of course, every scientist does not have to "join up" with a single simultaneous research program; there can be enough programs to occupy all scientists and require more. There need to be "outliers"—challengers—those with the viable alternate hypotheses, and they should be supported. There are enough parallels in biology to be convincing that long-term survival is closely tied to energy spent on monitoring, dispersing, and diversifying, and that society needs to fund these mutant efforts. But there must be a plan; the risk of planning must be assumed, as the only alternative to the risk of no planning.

Every study must have, at least, a well-planned home site. Research planning advocated herein has no similarity to the typical agency document called a research plan, little more than an open palm to Congress. More meetings held by planners will offer few aids. Neither will glorified statistical services or platitudinous reports offer much aid.

Planning involves seeing where we as a world society, as a nation, must be before 2050 AD, charting a minimum course to that destination, and creating decision aids to allow changes along the way to a clear end. Planners can say: "At least we must know B or at least we must have greater precision in our estimates of rate Q." This is possible in land use; it is probably possible for most of science.

Occurrence – Dr. Byron Cooper, the late dean of Appalachian geologists, once showed me a giant community water tank placed on a rock outcrop, and told me with unusual confidence that the particular rock *would* fail and the tank be destroyed—but he could not tell *when.* The people below it lived in ignorance. Thousands of people live on flood plains, fully aware of flooding, willing to do so with knowledge of high waters. They do not live in ignorance, only with uncertainty about when floods will occur. There are dozens of similar examples of mixed personal and social calculus, and Starr (1969)[44] suggested that people make conceptual third-power transformations when dealing with risk, i.e., they are prone to equate hazards to the third power of the benefits, real or imagined.

Society has not sorted out these complexities. It probably operates intellectually in a linear domain where the worst imaginable risk is loss of a member of the family. This socio-intellectual state neither justifies nor excuses scientists' snipes at those who create models and cannot match temporal events very well. I think that while risk taking can be investigated, it is ascientific. It is a human trait, a function of a historic, physiological, psychological, sociological, theological, and economic milieu. It cannot be observed directly, only behaviorally. Its expression in behavior can be manipulated.

There is no way to avoid a risky world; certainty of uncertainty is one of the “immutable laws” with which people must live. Thus, like assigning weights or expressing preference, assigning acceptable risk levels is a human act and at least for the purpose of this analysis, ascientific.

There are scientific laws, and these form the basis for a belief that occurrence of a class of things can be predicted with near certainty. I view estimating flood rates as a scientific activity, just as I do predicting weather events and the occurrence of solar and planetary events. These are activities dealing with occurrence and at least somewhat with temporal precision and magnitude.

The precise details of the future are not needed, even if it is possible to know them. Instead, what are needed are general characteristics of the future, expressions of orders of magnitude, and the near-presence of thresholds of concern. As Starr and Rudman (1973)[45] said in a parallel vein for land use: "While it is obviously not possible to predict the content and time scale of specific technical achievements which may be important in future social change, it may be feasible to see the *range* of the general characteristics of growth of that societal resource encompassed by the common term ‘technology.’"

Similar negative comments have been made about biologists' inability to predict micro-events about wild fauna models. Could the formation of an anti-hunter group have been predicted when law Q was modified? It could have. At least the option could have been explored, and strategies then developed for dealing with occurrences of high probability. Whether it would occur in a particular area at a particular time or with a particular intensity of feeling implies the existence of more knowledge than is available for even some of the better-known aspects of science. Such knowledge is not achievable at present rates of acquisition, with present

[44] Starr C. 1969. Social benefit versus technological growth. Science. 165:1232-1238.
[45] Starr C, Rudman R. 1973. Parameters of technological growth. Science. 182:358-364.

organizations, or at current funding over any reasonable future period, say the next 500 to 1,000 years. It is unreasonable to continue to behave as if it could be achieved. Rural System's rationally robust strategy (Chapter 6) is a viable alternative.

Returning to the problem of **sequence** above, the forester is well attuned to the site that is "perfect" for one species but is stocked with another. A timber stand exists if a seed-source was present, if a fire occurred after seeding, if the ground conditions were right for the seed, and if the rain fell before or after the fire. A stand is a function of *sequence* as much as *factor*. The forest scientist with complete knowledge (in the theoretical sense) of all forest factors cannot predict, *a priori*, a forest stand because of the innumerable sequences. Yet foresters can predict a forest will occur, and over time what kind of forest will eventually exist.

Limited knowledge is not discouraging; it allows the forester to explain what he or she sees, and to compute with various degrees of probability the future states of the forest on any land. People desire certainty; it does not exist. Even limited awareness from studies allows people to operate with less entropy or frustration, more attuned to the probabilistic world.

Duration – The expanding "confidence bounds" on regression analyses, examining the strengths of trends and patterns in data, are familiar. The farther into the future one projects, the less confident one tends to become. But prediction is not projection and the statement about increasing confidence bounds does not necessarily apply, especially if attention is given to the occurrence phenomenon above.

An example in resource use may be instructive. Elk forage following fire or clear cutting is known to follow certain rules of succession (*sequence above)*—being irruptive, and then declining to a fairly constant state over time (about 50 years). There are difficulties in predicting forage in the first 10 years (the confidence bounds are quite wide), but the problem becomes easier later. Aggregating these production functions can yield a far truer picture of regional elk forage in the distant future than the near future.

To understand land use change, and to predict it, one must understand succession.[46] Further advances in this area have been made (Chapter 4), and are sufficient to allow scientists to estimate now the long-term consequences of almost any act, such as those resulting from a spill of toxic material, construction of a power line, or building an airport.[47]

The interaction between **sequence** and **duration** is fraught with challenges. A host of degenerating, poorly-made decisions of the past still beset present society. Large dams, contaminated areas, exterminated species, and desert range overgrazing are examples. These are irrevocable. Their rate of occurrence has probably slowed, but it is still a positive rate.

Students once worked with my computer game, called Waterloo, trying to stabilize the shrimp in a coastal estuary. The shrimp are a biological integrator of most of the factors of the watershed. Only late in the game did they usually realize that they could not replace the silt lost to beach erosion by their watershed decisions. The replacement silt from the watershed is all trapped behind a dam that was built prior to their involvement and a part of the game. They were saddened and frustrated by this discovery. The best of managerial knowledge—perfection, if it exists—cannot overcome the constraints placed on their system by past generations.

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[46] Golley FB. 1977. Ecological succession. In: Benchmark Papers in Ecology, Vol. 5. Stroudsburg (PA): Dowden, Hutchinson and Ross, Inc.

[47] Giles Jr RH, Snyder N. 1970. Simulation techniques in wildlife habitat management. In: Bailey JA, Elder W, McKinney TD, editors. 1974. Readings in wildlife conservation. Washington (DC): The Wildlife Society. p. 637-654.

Retrospect – Lest there be confusion, a review may be useful at this point. Herein, the pathways have been analyzed to discover the role that science has in predicting futures. To this point a unified humanistic concept of science has been presented. It has within it a concern for the time when discoveries will be used for people, the concept that research can buy society time in this critical period, and that society is likely to opt for more sequential than simultaneous research.

To reduce the impact of this decision, it is important that rigorous research planning be given higher importance than ever before. Contrary to some who contend that prediction is out of the ken of science, I hold that it is presently well-within science, has historical roots in astronomy, and needs to be given more emphasis, not because of its shortcomings, but inclusive of them for the utility it has for shaping a reasonable environment for people. The limitations have been discussed under interactive topics of sequence, occurrence, and duration.

The Problems of Space – There are scant research papers that provide the latitude, longitude, and elevation where studies were conducted. So many phenomena operate in this real, three-dimensional space (e.g., electromagnetism, insolation, gravity fields) that additional controls may be gained on the variance that typically is observed. Besides this subtle point, it is possible to begin to focus on site-specific prediction.

Each point or cell on the Earth may be characterized in hundreds of ways. Computers are now capable of storing and retrieving these data and putting them together in the best ways currently known. These are the intricate relations of any site. A new scientific orientation to each multi-dimensional Earth spot can produce huge gains in predictive capabilities. There is no way to visit each cell in Virginia for research (to do so even for one hour each would take over 60 working years). Idaho has 2.1 times the area of Virginia; there are a few states in between. Scientists have classified and clumped data in the past to an amazing degree. There are regions and range maps of all types; “lumpers and splitters” take on new meanings.

The spatial domain is not unrestricted. Certain life forms have altitudinal limits. These can be used to eliminate the grossness and unpredictability of many animal and plant range maps. Predictability can be improved by managerially restricting certain areas from use. Land use zoning by people is somewhat related. A new zoning based on prediction is possible. Because we know that certain plants will undergo moisture stress in their lifetime if planted in cell of coordinate x, y, z, then let managers be sure that they are willing to assume the risk of that loss (or pay the total long term costs). Let society be sure pesticide use will not be required in a map-cell when that cell is near another one in which occurs a highly-threatened life form. By such action and containment, it is possible to reduce the mismatches in predictions and reduce the large number of alternatives that must be explored in struggles to see the future.

If site visits to the land are impossible in real time, Landsat imagery of only limited usefulness, and funding unlikely to increase substantially, then what are the alternatives for the nation and its scientists? Certainly, better planning is one answer. Research direction and leadership, a past anathema, will be essential in the energy- and money-short future.

Far more attention must be paid to sampling in time and space. No scientist, having carefully computed sample sizes, will add excess animals to experiments. No nation can afford unlimited or excessive research projects; the value of **n**, the sample size, must be carefully computed. Attention must be given to holistic computer models, particularly simulations that allow planners and managers to ask "what if...?" questions assuming goal sets as well as action proposed on the land. When equations are not known, then subjective probability needs to be used, computing using the best current knowledge in a system with abundant feedback over time.

The Energy-Matter Problems – Not enough effort has been spent on the net energetics of systems. Adopting an energy metric provides an invaluable aid to modeling.[48] Integrating various researchers' work and making tradeoffs and comparisons between quite different concepts can be expedited among these who adopt the metric and become attuned more closely to energy transfer and its loss relations in many systems.

The Variety Problem – Variety is a general word for variance, juxtaposition, richness, various aggregation indices, and diversity. It is interactive with the above topics. Knowledge of it adds another dimension, and thus increases the potential to predict and control temporal as well as spatial occurrence. It allows such concepts as **likely yield** and **site quality** to be quantified.

Modern science tends to be probabilistic, and thus is rooted in population theory. Variety or variance is a population characteristic. Inductive science has a role in predicting the future of *population.* There is little it can do for the absolutely unique event. It is far easier to remember that ecosystems are unique than that animals are unique. This premise needs careful handling for it can be misleading. In the same way that every person is said to be unique, every animal is also. Every geographic cell on the Earth's surface is different, by at least one characteristic. Classical experimental procedures generally assume internal similarity and work to achieve control over external variables. Such abundant computer data storage is now available that aggregation into statistics may not be necessary. Individual plants, animals, and ecosystems—even humans—may be allowed to retain their identity and uniqueness in a large matrix. They are assigned a place in a sequenced, scaled, n-dimensional topology. The observed individuals occupy space in a hypervolume.

The Resource Tetrahedron – To this point, the four major aspects of any natural resource have been developed.[49] They can be depicted as being at the four interactive vertices of a tetrahedron. By seeing energy (and/or matter) as having associated weights, risks, and desired or expected quantities (valued energy), the tetrahedron unifies the salient, stable dimensions of all natural resource and land use issues. The tetrahedron is discovered to be a means for bringing, symbolically at least, order and unification to the chaos of the resource and land use issue. From such organization and clarification people may gain additional hope. The role of scientific inquiry is to develop these mathematics, revise the statistics, and continually unify knowledge.

There is a fundamental epistemological question behind stating the role of anything. How do I know? The scientific method is said to include description, explanation, and prediction. The former two are means to the latter. The entire scientific enterprise can be viewed as being focused on prediction, in explaining the past, for the future is likely to function similarly. Clearly the future will not be like the past, but it will *function* like the past. It is in the understanding of these functional relations, used in synthetic models with high deductive skills, that the future can be known, that consequences of acts can be evaluated before they are performed, and that the future world can then be shaped as a proper place for humankind.

[48] Odum EP, Odum EC. 1976. Energy basis for man and nature. New York (NY: McGraw-Hill Book Co.
[49] Watt KEF. 1973. Principles of environmental science. New York (NY): McGraw-Hill Book Co.

Rural System's Time

Rural System and its Rural Knowledge Base Group will respond to demands of the rural decision-maker for many different response periods or over temporal-need horizons. The demands of landowners will relate to costs, perceived importance, gains, and expansive uses. Our possible time-related crops and biomass (energy) products include crop residue after harvest that must be gathered, processed, and compressed in order to increase efficient handling, and reduce time for transportation and storage for use.

We are locked into planning timing for:

- Inventories of data, maps, and text pages;
- 24-hour responses to select optimization;
- Annual reports and updates;
- 5-year annual analyses of objectives and projections;
- Recurring projections to the 150-year standard horizon;
- Limited analyses for a comparative present date, 0 to 5 years, plus 50 and 100 years; and
- Generalized forecasts and feedforward.

A changing graph with computerized links will be commonplace and will put each area under Rural System management in both a historical as well as a futuristic context. The oldest trees are physical manifestations of events when the seed sprouted, and a collection of survival response to unnamed events during the years of the tree's life. The oldest trees may be related, then, to the Jamestown Settlement, the Declaration of Independence, the surrender at the Appomattox, the 1930s Depression, and World War II. These events—the oldest trees—the present, and a planning horizon of 150 years can all be seen and related, at least linearly on a time line *(graph),* when presented. The relative significance or proportion of the future planning period to past events may be noted and comments developed in a separate, secure file.

Rural System's time is needed because relative time thought, even human time-value, is not constant or standard (e.g., hours before execution, before marriage, after exiting an art gallery, after a harmful accident, certain drugged states, after a desired election outcome, or the final dedication of a wilderness). The longer the planning period, the greater will be the effects of "present-discounting" estimates used[50] on the hypothetical or likely expenditures, with fixed-rate over time.

Within Rural System, staff may revert to "ecological time," but we may continually develop a useful concept of time as a condition—a named period not unlike "an hour," "a minute," "a year," or perhaps a calendar modifier (or only a coefficient). We work on the sense of relevant change, and the idea of both long-term production and the ponderous rate of nature in achieving certain desired conditions for people. There is no intent to suggest or imply that the future will be like the past. Many people believe that events and rates, particularly of recent technological change, have increased, and thus the timeline for the future should be decreased in length exponentially.

We also plan to continue to work toward comprehending and using knowledge within Rural System. For example, we know of and seek to comprehend the movement of Earth plates, the once-southern plates, equatorial—those of the Carboniferous period of the geologists, about

[50] Conlin WM. 1973. Feedback functions in MAST. M.S. Thesis [Unpublished]. Blacksburg (VA): Va. Poly. Inst. and State Univ.

300,000-400,000 years ago—after the experiences of the different periods, from the Carboniferous to the Cretaceous with its now visible sea-shell prints in the weather-resistant mountain crests' up-thrust stone layers. We see the evidence of where dense organic growth extracted nutrients, dried and formed dense organic layers, and were then covered by vast mountain erosion and volcanic effluent, forming today's gas and coal seams. Difficult enough to comprehend the ancient realm of fossil plants, that time-since thought must be overlain with awareness and comprehension of Earth plate tectonics – "floating around" …edges submerging others… slowly, another "time," back in the millions of years lost and found in the calculations of Earth-age.

There are named, temporal rhythms (timed changes) observed in nature, such as the high frequency ones of the human brain, heart-beat, and respiration, and there are about eight such named-rhythms experienced in life forms. "Circadian rhythm," is observed, re-occurring change in life-forms (at about 28 hours), and exists in the absence of rhythmic environmental change, e.g., daylight.

Within Rural System, time consciousness is critical to staff in understanding the dynamic status of an individual organism (or subsystem being managed). That animals vary widely in response to the same stimulus (e.g., to a capture-dart drug) should come as no surprise if the response occurs at a different time of day. In a community, when an animal is different, the community is different. There is probably a survival component within the diversity.

As an example, the all-pervasive output of the adrenal gland, corticosterone, varies from 0.4 of the mean when sampled at 4 p.m., and 1.8 times the mean when sampled at 4 a.m. (in darkness). This change of 4.5 times can influence an animal's response to predation, pesticides, sudden temperature changes, and probably conception. Noise can increase estrus, decrease male fertilization, and reduce pregnancies and fetuses. The significance is that an animal on one day is not a "point observation" to the informed ecologist, land-use manager, or modern natural resource specialist.

Each land unit is probably unique, at least at a point of time. A planning period of 150 years (also called the planning horizon) is used within Rural System. In Rural System, the period is always estimated as from the current date. It is always shifting ahead one year to look ahead for 150 years (a sliding-mean software unit).

We attempt diligently to comprehend and use the rhythms found in nature, some newly found, some lunar-related, and others, when known, may provide controls—computer-aided and site-specific—over the essential processes for humans within the post-2050 AD Earth-Village System.

Chapter Six

Design and Rationally Robust Work

The thought processes and proposed policies and principles behind the Rural System design are expanded, made more practical, by the emphasis of ***rationally robust work***.

By now, you must be wondering about what the new procedures are that will be used to run Rural System, and to show good results. In previous chapters, I've variously listed methods and approaches to creating Rural System. What, more precisely, are some of the basic differences ahead? If so much of what has been proposed is not very new, just a new way of arranging things into a system, then what can be expected? Within Rural System, we have knowledge about where there *is* knowledge, and we know special ways about how to use it. We have incentives for using it, making reasonable "joins," both to make money and to reduce losses. We have an almost anti-science attitude about getting and using knowledge. We've studied history, and we know that the future will not be like it, because of rationally robust work.

I was taught and have participated in science in the Sputnik era, during which science was viewed with national pride and pursued with nearly religious zeal. I've debated "basic" and "applied" as if there was more at stake than a budgetary criterion of the National Science Foundation. With colleagues, I have been involved with the "scientific method" and wrestled with the interplay of *deduction* and *induction* (Chapter 5). I've created models, done curve fitting, and advised people on a wide variety of quantitative questions, some of which could be aided by statistical analysis. This experience has suggested the need for an alternative to the science paradigm. An alternative *must* exist for the rural system… it's *rationally robust work.*

There is nothing tight and crisp that I can call our work, like a paradigm or theory. Rationally robust work has a set of characteristics, many interlocked, that together are significantly different than some approaches and techniques used elsewhere. The work starts with the imperative of recognizing "a situation" and moves to achieve a "satisfactory condition." Rejecting the status quo, projects move toward results of optimization, having demanded precise objectives. Fuzzy objectives may lead to using consequence tables, the important consequences being rephrased objectives. Consequences are to be (often) estimated from computer models built for GIS maps. They use often-rejected concepts of risk taking, relaxed confidence and precision, greater use of *ranges* and *medians* than the *average* statistic, and the knowledge of equifinality existing within natural and social systems.

A dynamic knowledge base is created, managed, and maintained within VNodal, primarily for improving models leading to optimization. The knowledge then used is within decisions for a system to achieve a set of objectives for the 150-year future, all at very low expected costs. In a challenging reversal, operating a system for "making money" is seen as the cost of achieving those objectives. The following may help clarify the characteristics of rationally robust work leading to a satisfactory condition.

Anti-Science?

There is need for a strong, sustained effort for gaining and retaining and then using knowledge, parameters, distributions, rules, and procedures, known with high confidence. We have outlined the epistemological bases (Chapter 5), and we know that induction and deduction are the cornerstones of science. These two ways of knowing have served people well, but they are inadequate and overly simplistic for progress in Rural System and related fields. There is need for rationally robust work, a concept of decision-making and action-taking that is timely, tentative, and, in a low-risk, high-influence domain, always accompanied by feedback and timely response to the perceived future. It seems irrational to insist that rural system work (and probably many other related fields of work) exclusively follow the scientific method.

Research, like the good doctor, has an aura about it of objectivity, formality, and rigor, but it is not an aura needed in all fields. Research has solved some problems, given us some advances, and has given many people a useful pattern of thought for over a century. Increasingly, that pattern is shown to be wanting. Research is said to answer questions, but it is also said that "if you ask the wrong questions you will get wrong answers." Research is said to be descriptive, but of what?

There are many, many problems faced for which research has neither the answer nor an approach. Science can produce deceptive images, images where matter does not exist. Induction, while good, is not sufficient. It has little to provide in knowing the unique or rare event. It is of little service in highly variable situations with few observations. It is infeasible in many situations (e.g., hypothesis: rabies virus inoculation is not always fatal). A substitute is needed, at least an alternative.

The needs are conspicuous in rural resource management—and throughout the world. We may yearn for research, for the specificity and confidence it seems to give. The hard lesson, not yet learned, is that it is very expensive, takes much time, requires specialists, and after the reports of results are filed, risks remain, and there are persistent delays between discoveries, possible uses, and mature use. We have not learned that we do not work well with simple fruit flies in all cases. We work with incredibly large, complex and changing systems. Some are unique and their every sampling period or area is unique and they cannot be assumed as uniform as cloned white mice. They are about as predictable as the flight of a flock of pigeons. People with hard questions to answer are short on money, time, skills, and often alternatives. Answers are needed. Rationally robust work is badly needed for all of the realms of natural resource management... all rural areas.

It is easy to be hypercritical about anything. I center on general systems work, results urgency, and relaxed confidence demands paired with feedback.

One problem with research once came upon me like a hawk over my tree stand: research, in its traditional form, is prohibitively expensive. Suppose there are about 300 important bird species in India. There are needed about 200 observations about the characteristics or parameters for each bird to complete all entries in a wildlife information system. These 200 items are selected from a much longer list. Some factors needed for each species take years of study, others only a brief period. I round off my estimate at a very conservative estimate of one year needed for each observation, and then I suggest an even more conservative $50,000 required to pay and equip a scientist for a year. It includes all travel, rent, equipment, computers, support staff, and salaries but it has never been analyzed exclusively for wildlife research people. (Frankly, I think the amount exceeds $50,000.) While several observations will be made in a few days, I assume I can make one official entry in our database per year. That cost is very great. If there were 1,000 scientific wildlife researchers, it would only take 60 years.

We cannot meet the research needs of the birds of India alone, much less those of the world, by the conventional, accepted research pathways. We have not even mentioned the similar research needs of the mammals, reptiles, amphibians, mollusks… and, oh yes, the fish and, equally as important, the insects—whether we study insects as disease vectors, critical food supply for some other animals, or objects of specific management, such as the garden butterflies.

Once there was the notion of "do basic research" and then publish it. It was a rule within graduate schools, and the hidden assumption behind it was that "one day your findings, in a process unlike that of your own discovery, would be re-discovered and put into practical and to otherwise good use." In rural systems, with many parts threatened and changing, *one day* may never come. "Irrelevant" may be the near-perfect word for a discovery made for a species that has just become extinct.

In presumably the most logical of all areas, research, I now think I perceive an illogical underpinning. It is illogical for us to continue using the classical, experimental, inductive approach to gaining knowledge about rural resources. Wild faunal resource workers, for example, will never gain the budgets needed, the staffing and expertise, the time, or the requisite use rates of key conclusions to be reached. It is irrational for us to proceed in the current classical fashion.

I sense that the following components (with the traditional caveats about overlap and limits) create a current *situation* in which classical decision theory has no meaning and little relevance to significant rural resource decisions (and thus the future about which I write). The situation:

- There are now many more educated people in society than ever before (consulting base-date comparisons of 1949-50 and the multiple use, sustained yield, and planning legislation passed by Congress around that time).
- There are now, still, many poorly educated people in US society. Some are solipsistic, ascientific, folklorists, and metaphysical beliefs abound—even among university graduates.
- Many people believe that their every opinion (studied or not) is equally important or valid, following the peculiar nationalistic logic that if every person is equal then every opinion of such people is of equal value.
- There are few people in society with outdoor experience beyond weekend outings at a summer camp. There are masses with massive lack of knowledge about the "wilds"; ignorance is present even in those with outdoor recreation, farm, and forestry experience, and even after improvements in biology, ecology, and environmental education.
- Few people have farm experience (less than 30% of the US population is classed as "rural").
- There persists the flawed logic of the masses, i.e., that public forestry is the same as private forestry.
- Few people realize how many potential alternatives there are for every natural resource decision. The best place to put X (e.g., a pond, a recreation structure, etc.) probably has 10 elevation classes, 8 aspect classes, 4 slope classes, 4 landform classes, 2 nearness-to-stream classes, 4 nearness-to-road classes, and 4 soil/geology classes. Thus, the place must be decided from among 41,000 spots.

- There is slow increase in awareness (but an increase, nevertheless) relating to "landscape ecology" issues (i.e., generally the off-site but nearby consequences of local actions on large tracts of land and water, especially within or near urban borders).
- Few people realize that if a system has 7 components (and all natural systems have more than this) and the decision makers are 0.90 sure of each critical part, then the chances of a correct outcome are barely 0.50.
- Few people realize that *sequence* is a major part of natural resource decisions. This involves permutations … how many different ways (sequences) can things be done (like irrigating, fertilizing, and thinning). Seven components, for example, can be brought into a system or into a decision in 5,040 different sequences. The decision-maker must select from among these. Usually "the best one" is desired. The demands for even "good" (rarely "the best") decisions are exorbitant.
- Few people comprehend optimization, briefly meaning the computer-based means to select the best point or condition from among millions of options with named constraints. Optimization processes have only been computer-available since the mid-1940s. Some people demand their use; the majority is unaware of their existence, meaning, capabilities, or limits.
- Nowhere in society are planning horizons longer than they are in natural resource management and decision-making. Financial planning rarely exceeds 40 years; isotope half-life and nuclear energy waste disposal has not penetrated the national conscience. There may be evolutionary limits; the ability of humans to deal with long time-frames has not been tested well for its survival value. (Until recent time, such long horizons have not existed; human longevity was less than 40 years.)
- Because resource decisions in the public arena can be viewed as investments in the future (e.g., retaining old-growth forests, building dams, conserving soil for future farming), issues of rational investment decisions are appropriate. The profound effect of the interest rate used in investment decisions for the long-term is well-known. The proper procedure (or rate) for investment remains hotly contended. Even if interest rates and procedures could be agreed upon as policy for public investments, over the long time-periods of natural resource investment, national policies distort discount rates. Such rates, regardless of policy distortions, are conspicuously dynamic over the period of resource investments and they affect public resource prices and land values.
- There are more people with more leisure time than in the past (thus "free" or "abundant" time to dabble in public participation). Individuals within "the public," as part of public participation policies, have been asked to express opinions about topics with less time than the average legislator gives or gets to spend on a vote. There is inconsistent and always temporary public participation. There are inconsistent agents (e.g., due to lateral moves, career ladders, retirement options, relocations, etc.) to present a consistent proposal or set of premises and agreements, or sustained expert advice, to private land project investors or public land decision participants.
- Environmental impact analyses and assessments continue unabated, even with well-recognized limitations (e.g., no mandate, no social consequences assessed, trivially limited sets of alternatives, and disregard for actual or likely budgetary limits and

dynamics for the projects being evaluated). The public is unaware of the limitations of the analyses or of their non-effects, over-confident in the process.

- There is dynamic and inconsistent intra- and inter-agency policy that affects recommendations, risks, costs, and prices on private rural lands. There is changing scientific knowledge, changing technology, and thus changing efficiencies (and costs). There remain very large—but variable and unpredictable—budgets, and thus variable needs for private financial supports or agency staffing and advice. (Money, just as the sun powers ecosystems, powers all action on the land.) Delayed and unpredictable budgets (and frequently discontinued funding that prevents a project from achieving benefits for people) make every decision risky and potentially open to litigation, and failures are common. But commonly, these failures are not the fault of the agent or agency but of the budget process itself (call it an "exogenous force").
- Getting elected officials, with a 2- to 4-year electoral cycle, to deal with problems beyond their electoral horizon is an obstacle, unresolved after two centuries, to improved natural resource management.
- Notable scientific accomplishments and introductions to science have created, in the general public, an environment of excessive expectations for technology, resource manipulation, and data gathering. Science has been touted as the primary methodology for improved decision-making, but science itself is currently being openly criticized.
- The rise of globalization (e.g., T.L. Friedman's *The Lexus and the Olive Tree*,[51] and *The World is Flat*[52]) expands the scope of almost every decision, not only within the US (e.g., the impact of changes in logging in the Pacific Northwest on lumber prices and supplies in the Southeast), but the world (e.g., the tax on lumber cants sold in Japan related to North American timber harvest schedules that affect elk forage over many years). The climate issues are "global incarnate."
- With the rapid rise of committee-ism, such that no "one" decides, there are long delays in decision-making; anonymity is gained, conservatism prevails, and novel or singular ideas are dismissed (or never voiced because of the predetermined fate of such ideas). There has been a concomitant, rapid rise in litigious attitudes; many people and agencies are afraid of being sued. The direct penalties are small; the costs and delays are enormous. Youthful enthusiasm and zeal for resource management, land, and the agency, when embodied, can be jailed by punitive lawsuits, often arranged by people without standing to sue.
- There are many exogenous forces affecting every situation in which rural resource development is proposed, or projects contemplated. Trained and experienced people consider these as part of every decision. Few people in the general public now do so for some of the above-listed reasons. In decision-making on rural areas, the forces above must be combined with considerations of wildfire, storms, disease, insects, pollution (air and water), poaching, vandalism and theft… and increasing challenges from excessive drug users.

[51] Friedman TL. The Lexus and the Olive Tree. 1999. New York (NY): Farrar, Straus, Giroux.
[52] Friedman TL. The World Is Flat: A Brief History of the Twenty-first Century. 2005. New York (NY): Farrar, Straus and Giroux.

- The federal—and some state—rural resource agencies now seem to be in the grips of anarchists. The minority denies the rational democratic premise that after votes are taken, everyone tries to "go along." The minority can prevent the views and conditions desired by the majority from being realized. This failure of the entire current democratic process is not limited to one agency—this needs to be made clear to the employees of agencies and the public. I think it is a crisis within the US sociopolitical system as a whole… affecting rural resource use decisions, among many other topics and problems.
- Collaborative efforts are now rare within public agencies. Equal, diverse forces contest and cancel-out each other. Social objectives are unclear while sub-group objectives *are* clear, thus vast sums are spent on the contests, and people (like my grandson at his first soccer game) leave the "field" asking, "who won?"

Rather than continuing to add to dimensions and developing an abstruse argument, I assert from years of experience and observation that most of the above items are true and that, even if as many as half were flawed, the conclusion would still be the same. We do have a *new situation,* and it is not subject to classical decision theory or reasoning from science. We need an alternative, and the only one on the horizon is ***rationally robust work*** toward a satisfactory condition.

The Satisfactory Condition

The rise of environmental interest, while favorable, has had negative, unavoidable consequences within the realm of management. Maybe I cannot solve all of the problems, maybe none of them, but I think that by analyzing the situation and applying some creative effort, perhaps some tentative better condition can be created.

We can reject the quaint phrase: "we learn from history that we do not learn from history." History can be a wonderful teacher if we have the ability to hear. We also need a place of order where we can store what we hear and otherwise sense. We get too much noise. We focus on details and miss the messages. "There will be a flood!" This is near calamity, yet we concentrate on depth, flow rates, dollars lost, and other details. We need to sort out the things we now know, like that floods and fires do occur, trees grow, epidemics occur, and people need each other. People help each other. We know many acidity limits on plants, what will poison cattle, and that tomatoes will not grow well under walnut trees. We know a lot! We can gain new order.

I remember well a skeptical student, a veteran, noting the impossibility of predicting the leader that emerged from a Vietnam village and turned the tide of the war in an area. He was right, but that "leaders will emerge" can be predicted. When generalized, modeled, and retrieved in conjunction with other things we know, we will achieve our objective. Our objective is to know, not to do research. I have already discussed the means of knowing and the notion of degrees of certainty in Chapter 5. One part of that potentially-growing knowledge base needs to be from tribal leaders, villagers, and practical folks that have made daily outdoor observations as they have regularly tended cattle, poultry, bees, and their crops.

We have been held for years by the wisdom of the technical literature analyzing decisions. It varies, but it usually has the elements of general systems theory sketched in Chapter 2. Typically, there are objectives, facts and figures gathered, and they are processed in several ways (from very simple to complex computer means). In some instant (the tap of the gavel or a registered letter being placed in the mail slot), the decision is made. There may be feedback that

improves the decision when it is next made. Major decisions are singular, almost by definition. I now believe, however, that classic decision theory is inappropriate for public rural-related natural resource decisions. While there are similarities between classic decisions and the events within the public so-called "decision arena," I now believe the differences are so great that an alternative analysis is needed.

The Status Quo

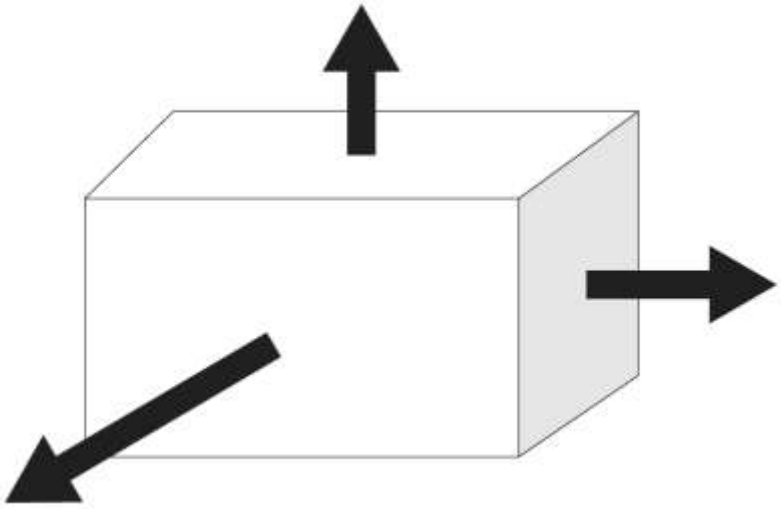
There is another option, of course. That option is not to change—to retain the status quo. This may be necessary if there are no means seen for change, no resources, no creative option. The status quo may be pleasing to some people. A generally bad situation may prevent an agency or individual from doing a particular "good" that is offensive to some group or individual. Some people have been said to "stir the pot" as a strategy to prevent action. Preventing action may be the intent—it can lead to analyses that can lead to major agency changes or their abolition … not intended.

It is difficult in some societies to admit that there are no solutions to a problem or situation and no hope for one emerging. Things may be perceived to be as good as they will ever get. Perhaps that is the case with large, complex problems, with long histories and strongly-felt needs, but conflicting objectives. The natural resource domain seems to have its own breeding ground for problems. Herein, the underlying assumptions are that within rural systems (and within the Rural System corporation being proposed) there is just such a problem, and that there is no singular solution. That condition—the status quo—however, is not acceptable, and thus another condition will be sought. It is unlikely that it will be judged to be good, only better than the former condition. It will be well-prepared for the next changes likely to come, as we discuss the potential crisis years of 2030 AD and 2050 AD.

We must return to epistemology (Chapter 5) and its question of how we know… including how we know whether we have a problem, a solution, or can fix it with the resources and ideas available within the time remaining. I suggest that we back away from the profound bias of "scientist" and start with person *qua* person, then advance to the knowledgeable person, living within a state of tentative certainty, grounded simultaneously on several epistemological bases, most importantly using heuristic convergence. The following are the parts, the major dimensions of rationally robust work for us all, together, on which we may work. Together, the parts become an effective, new, whole way to achieve the desired satisfactory condition.

The Procedure

People live in a perceptual, mathematical space. Here, it is shown as a 3-dimensional box but it needs to be imagined as a complex volume, much like a many-facet jewel, tumbling along. The arrows suggest that appropriate conditions have been exceeded and are outside of the box.



People want to stay within the box. This is what they know, where things are safe, where they know what their parents and their history and culture have taught. This is where their survival skills work. In some cases, the limits are laws. It is illegal to go outside of the box.

A simple box has three dimensions, and for people these might be food, housing, and clothing. Outside the box might be inadequate food or poisoned or polluted food. A little pollution may not be too bad, but if it exceeds a threshold, then sickness or even death might result. A reasonable person or group wants to avoid the thresholds, the limits. The closer to the center of the box, the better.

The sides of the box are not very precise. Many variables, including the variation in the health and abilities of the people within the group, influence the limits of the box. If a limit is threatened (e.g., effects of a toxicant), but no one knows the exact limit, then it is reasonable to make decisions to avoid coming close to such limits. The limits are fuzzy; the center is safe; avoiding the limits is conservative.

It is easy to understand and appreciate administrative, budgetary, and legalistic reasons why there needs to be taxonomic difference between basic and applied research. Only recently has it become evident how harmful that classification has been to science and to applications of research findings to rural problems.

Science is. It exists, multidimensional but continuous. There is no longer any meaningful difference between basic and applied research taxa; they are artificial and invalid under the rules of nomenclature and should be abolished as intellectually, personally, and organizationally divisive. They are the roots of great ineffectiveness in the scientific community -- especially those dealing with land use questions. In the future, we can stress wholeness, similarity, and generality. Then predictions will be more correctly made.

As an example of the rationally robust work, let scientists not engage in the debate over whether studies of the endocrinology of mid-line color changes in certain stream fish are basic. Such studies are the substance for interpreting the effects on fish of non-point water pollution from farming and forestry practices. When pollution disrupts the endocrine system, and prevents color change, there is impact. When color change is a basic sequel in a courtship ritual, then its failure to change causes reproductive failure and changes in expected population abundance. The real land use and impact question is not whether pollution killed fish, but whether it resulted in a

generation not appearing alive. From research, such a question can be answered, understood, and corrective changes made. There is only one science. It needs to be cast as rationally robust work.

N-Dimensions

If two topics, such as water and temperature, were discussed as they might relate to tree growth, then we could say that we are discussing a two-dimensional system. We could display it on a 2-dimensional piece of paper, a graph. If we discussed three factors (water, temperature, and light), we might imagine trees responding and being displayed within a box, a 3-dimensional space. Responses change in time (so we add the fourth dimension) and results differ depending on the region of the people being discussed. The area may change due to shifts in ownership, flooding, and wildfires. It is a changing, n-dimensional or many-dimensional entity. Difficult to imagine, the situation can be pictured in an elementary way as an ever-changing, moving cloud or blob. Thinking about a three-dimensional thing is easy; four-dimensional thought is difficult (except for a 3-D object tumbling through time, the fourth dimension); n-dimensional thought seems available to a limited few people. The natural resource situation typically requires n-dimensional thought, or aids to approximating it, with expectation or probability thrown into most of the dimensions.

The weakness in the footings of the present procedures has been presented above in order to begin to understand why an alternative means is needed to arrive at a satisfactory condition within rural systems and within many public natural resource agencies. Understanding the situation or “condition” seems necessary. An alternative is to ignore the present situation and creatively develop a perfect one, then to compare the present to that one and make changes. That's a dream, for it ignores the power that moves within and outside of agencies, as well as the strongly-held value-system forces at work in rural lands and the urban fringe, and then assumes there will be action as if history has no meaning. The problem: decisions must be made about system objectives… and by these, if achieved, people recognize “the solution.”

Naive people like to look for solutions, even "the" solution, but in very complex situations with long planning horizons, there is no singular solution. Even if one could be found, it will be judged inadequate the next day because conditions have changed (perhaps personnel, even objectives). Rather than a solution, we are looking for a condition, a satisfactory condition. It will not be right, or perfect, or even optimum. It will be satisfactory if we work hard, acquire knowledge and build a knowledge base, use available knowledge, and create systems that utilize well things that we now know about the way that complex systems tend to work. Specifically, we work toward achieving Rural System’s objectives. A new condition can be created. I call it rationally robust work and I describe it below and hope to work with you and others on seeing it clearly and implementing it.

Decision-Making at Fine Spatial Resolution

We once created, in Virginia, a database of about 50 factors in each of 1.1 million, 27-square-acre map cells. (It had no backup system and was destroyed by a political storm. But, much of it has been restored with more factors and greater precision.) Such a database allowed, for example, computation of the likely impact of a many-mile-long, high-voltage powerline, if it were in place, using 12 dimensions of impact, 42 critical characteristics of the cells, and a 30-year economic expectancy.

A Rural System Group, when developed (and even now), can supply a farmer or rancher information about similar impacts (defensive knowledge for protecting land from invaders of all types), but also about suitable crops, best grasses, likely forest site index, probable runoff, and holdings on request. The intent of such map-cell-specific databases is to bring to bear, on-site, the findings of science to make them relevant to the decision-making tasks of the owner. We have demonstrated that we have knowledge about and can be very particular, very precise, about land conditions. I now believe that the probability of any two spots (say, 10m x 10m Alpha Units) being alike, in any places in the world, is almost zero.

Thus, places for agriculture, the fishery, and forestry are unique. Because we now have or can cost-effectively create and manage such databases, and have sufficient computational power to analyze them (even on desktop computers), we no longer have a genuine need for a gross land statistic.

Even in developing countries, the ability (if not the motivation) to develop such systems cost-effectively is now available. Ease of use increases rapidly. Classification was once needed by the manager who took samples and made maps in order to form general pictures as the basis for making site-specific decisions. Now we have the knowledge of each site, with sufficient detail to assert the uniqueness of each spot on Earth. We do not have to make the reverse trip to generality!

Even though we cannot visit every spot in a region or large farm, it is possible to compute, in reasonable time and at low cost, the characteristics of every land unit, (the suggested Alpha Unit) using relative elevation, slope, distance to streams, gross soil texture, past land use, primary land cover, and time in shadow each day. Some of this spatial data is already available.

By more situation-specific work, some risks can be dodged. We must shift from generalized regions to specific, unique map-cell studies. The shift will not occur rapidly, given the historical evidence for changes, but current general knowledge can be used to "fill the knowledge about each cell" and it can be improved with models fairly rapidly… then gradually improved with several feedback procedures.

A little-acknowledged dimension of land analysis and prescribing uses is that *nearby features and forces* have more influence on plants and animals in a spot than on-site factors. Shadows and the presence of water in dry areas are examples. We can use the lessons of landscape ecology to relate "nearness-to" or "distance-from" ideas to an exact site. One Alpha Unit of land, five miles from a National Park, is a very different piece of land from the "apparently identical" one *inside* a Park.

Progressively, we shall be able to add a set of distant, but influential, factors to knowledge about each site. There are other factors that are invisible and not present on a sampling site, but we attempt to measure and note these with increasingly more perceptive and accurate technology (e.g., geomagnetic, solar, and tidal forces). These factors may play leading roles in the conditions or actions of things we now call "ecosystems." There will always be other things that are active in our systems, at least within the Alpha Unit, and we shall attempt to accommodate them in our measures of statistical variance, and to live with the unexplained or so-called "random" (sometimes even "mystical") forces.

Data Collection

If site visits to the land are impossible in real time, satellite imagery of only limited usefulness, and funding unlikely to increase substantially, then what are the alternatives for the nation and its scientists? Certainly, better planning is one answer (and use of remote sensing

technology). Research direction and leadership, a past anathema, will be essential in the energy- and money-short future.

Far more attention must be paid to sampling in time and space. In the rural community, we need to abundantly use computing to determine sample size (n), with the best current knowledge all within a system with abundant feedback over time. Within this development there is reason to be hopeful about the future.

Optimization

Like many words loosely used, "optimization" sounds good, but has some hidden evils. To me, it means a mathematical process of analyzing a system and finding a condition in which all of the variables, when in the right condition, produce a state that achieves the stated or designated objective. The procedures always require a very explicit objective, typically to maximize, to minimize, or to stabilize.

Suppose we want profit from bread. We know the ingredients. We solve the equation for bread-making, attempting to maximize the net gains from buying ingredients, mixing them, baking, and selling bread. The objective seems fairly easily stated. We can imagine mixing all possible combinations of flour, yeast, etc. at different costs to produce different loafs of bread. Some will be expensive, some taste bad, and some "flat." Each will have an approximate price, including zero for those that will not sell. We can study with the aid of a computer, as needed, all of the costs and all of the "output" loaves and their selling price, and state an optimum.

Even a simple problem of profits from good bread can become very complicated if profit is an objective. My experience in natural resource optimization is that the formal computer-aided process can usually suggest a 10 to 20 percent better solution than a human's best guess. In bread-making, a 10% difference in profits can attract attention from investors. I'm convinced from reports of others that improvements of even greater magnitude are waiting within natural resource areas. I know of reports that managed lands can produce twice the profits of unmanaged lands.

I do not know why aids have not been sought, but I can list reasons: unaware of the potentials, the methodology of optimization is difficult, there have been few demands, many variables, not all variables are easily quantified, and there is no expressed objective. I think the last reason is dominant. What exactly shall we maximize? or stabilize, or minimize? What of the risks, the startup capital, and who will supervise? What’s a reasonable planning or investment period? What is the percent return on the investment? What is an unconventional or unexpected variable not included?

Forestry boxed itself in years ago, with "sustained yield" slogans. (Modern groups persist in going down the same dark path with “sustainability.”) One interpretation of the slogan is that the goal is for there to exist a constant supply of wood from forests. “Constant” or “continual” or “continuous” are words with different meanings, but no matter what that word is, the intent was for wood production. Sustained wood production when prices are falling can lead to bankruptcy! A lumber mill with no market will be very quiet, very soon. The point of this comment about sustainability is only that it is very difficult to state objectives within rural or wildland and other natural resource fields. "More deer" confronts "less deer damage to crops and seedlings"; "more wood" contests "declining prices for over-supplies"; and "better roads" for some recreationists must go up against "closed roads" for other recreationists.

Conventional decision making requires an objective. Optimization can occur only after such decision making about such an objective. It has been very difficult to formulate objectives within rural land management circles. Without a clear objective, then any solution or set of actions can be argued as satisfactory. With no destination in mind, any trip...or staying at home...is equally as good. "Good" has typically produced the response: “as compared to what?" and the answer, after much discussion, is usually "as compared to *this* set of objectives."

Some farms are said to be “marginal.” They exist on the fence between profitable or not. Being profitable is the objective. One dollar, more or less, determines on which side of the financial fence they may exist. On one side, they fail. Some owners move to the cities. Because the fence edge is so thin, the balance so precarious, it is easy to imagine how small changes in management, information and risk reduction can move people well past the margin. Perhaps Rural System work can be considered a counter-marginalization effort.

Temporal Aggregates

If we can stop thinking that each 24-hour period is a very precise number for our analyses of differences and change per unit time, we will improve our models, stop much awe over great variance, and reduce the need for saying “more research is needed.” Time is a human construct, an accounting mechanism. A “day,” however, is grossly amalgamated solar relations, cumulative lunar forces, average soil movements, etc. It is the intrusion of variance into the most fundamental assumption about time units that seem constant and controlled.

We must replace clock units with accumulated biomass, or Langleys of energy received, or food metabolized. Sunlight is strongly time-related, but it is not equivalent to time. As we study grass, crop, or tree growth, we know the major differences among seasons, elevations, latitudes, slopes, and aspect as they each affect the meaning of a clock-unit of day length. A day is a way of coding and recording when ecosystem radiation starts and stops, and each day is unique in its measured changing energy received at a point. It has no intrinsic meaning to knowledge of plants or animals.

Convenient and unlikely to be replaced, we need to substitute time (at least “days” and “years”) with one or more appropriate fundamental units, such as radiation within a solar day, potentially accumulated or received solar radiation. Whatever else was at work in the greenhouse, the lab bench, or the forest between 6AM each morning when the clock buzzes, is the unit for study, not a named unit called “time.”

Farmers discuss seasons being “late” or “early.” Ecologists study phenology, the study of the timing of biological events such as grouse mating, leaves falling, select plants blooming. In rationally robust work, including phenological time will help clarify chronological time, and will give that classical measure a new dimension, reducing claims of excessive variance in studies (and thus, the needs for more, expensive samples and their analyses).

Few workers in the environment know that they can gain massive statistical control within systems by knowing two factors: elevation and latitude. Slope, aspect, land form (ridge, saddle, etc.), watershed boundaries, stream channel location, stream order (and 20 established relations), and topographic indices (40 or more known relations) can all be computed just from elevation in cells across a landscape. Knowing and working with these fundamental relationships gives us great, rapidly developing modeling power, and control over potentially influential factors of the landscape.

Day length and radiation estimates can be computed from latitude and slope. Precipitation and temperature records can be adjusted based on nearness to multiple observation centers. Temperature estimates can be adjusted by solar radiation and elevation. The list of available models is extensive. Workers in rural systems need to gain a knowledge base of the key abiotic factors, the non-living "things" to which plants and animals respond. With amazingly few values, great predictive power can be gained over major system performance measures.

With site-specific models, optimization can be done for crop, plant, livestock, tree site selection, and production units. Plantation failures, and disease and insect epidemics, which are often the results of introducing a production unit into the wrong place… ***can be noted and avoided!*** We can improve existing models and create tentative models with much that we already know. We can probably advance more rapidly by using and adjusting theoretical models than by whining about excessive variance and decrying the lack of funds for curve fitting.

The knowledge base that we build will be within the models, documented, and changing as we cast ahead curves, find limits, bracket in coefficients, add variables and delete insignificant ones. We are skeptical of models now because they have not been used well, given far too much promise. Expectations were not fulfilled and the procedures were ceased, not modified, recast, or allowed to grow in light of new understandings, redefinitions, and reformulations. Data care and adequate modern storage were also missing.

Consequences

Every action in the rural lands has many known and identifiable consequences. A tree is cut, the soil erodes; as the soil erodes nutrients are removed from the area. "Nutrients removed" is a consequence of cutting a tree. Each consequence can be estimated based on studies and experience. (We do not have to do a study to confirm that water runs downhill!) Every action has many consequences, some more than others. The more we learn, the more connected the consequences will become. We decide that, admitting to consequences that we do not know or cannot measure well, we will deal only with a maximum of 5 levels of influence. Levels might be described through the tree example:

1. Tree removed
2. Shade reduced (insolation increased), temperature raised, wind velocity increased
3. Soil eroded, calcium leached from the area, litter decomposition slowed, etc.
4. Average antler size (basal diameter) reduced
5. Hours of quality-weighted hunting reduced

We can imagine several more levels—effects on plants, then effects on insects feeding on them, then effects on pollination, then effects on contributions to the mix in the litter layer, and others... These are the studies and tales of ecologists that believe that everything is connected. Many things are, but within this concept of *the satisfactory condition*, everything cannot be known; there is no time or money for studying everything; many things have effects that are not significant, not connected quickly. Decisions are to be made in a timely fashion. The time to develop a meaningful consequence table for every major action can be very long… too long. The computer analysis may take only a little time but preparation for the run can be costly and delaying.

A planned rural resource knowledge base must eventually embrace plants as well as animals, soils as well as forests, geology as well as climatic factors. There is no logical

separation for topics of wetlands, watersheds, coastal zones, and precipitation of the water budget. Is a plant in the gut of a deer a part of the animal or exclusively a part of the plant world? I think that “wildlife” in the past has meant all wild life. In order to manage plants well, a great amount of knowledge is needed. All factors about each plant cannot be learned in separate studies. The plants themselves remain enigmas. Where one species stops and another starts is still debated. Genetic discoveries dominate daily. Mobile plants, such as the liverworts, have animal characteristics. Plant forms and their characteristics differ on different sites. Trees of some species unite their roots, making clumps-of-tree-like-forms the relevant unit, not a “tree.”

A general knowledge base is needed, one that is rooted more in "expert systems" than in conventional taxonomic keys. So much has been learned of plants over time that many generalizations can be made. There are many fields of knowledge already in a computer information base filled with an expressed high degree of confidence. The entry has to be general because now we do not have the time or the money to continue our studies, plant by plant, species by species.

A computer simulation is said to be a means to compute answers to: "What if *this* and not *that*? What will be the changes?" and “What will be the consequences if I change this factor, build this roadway?” The consequence table is a report of multiple consequences of an action; multiple runs of a simulation. "What if I cut this stand of trees? What will be the consequences?" The consequence table is a means of listing the major significant areas for which a report is needed, answers provided and used.

It is important to realize that the words used can lead us astray. It may be that "consequences" are categories of interest, and maybe “rephrased objectives.” We may want to know the consequences of an act on the calcium in the soil, but we selected calcium because we knew it is vital to plant and animal growth and health. Stabilizing or increasing the supply of calcium may be an objective. Maybe we are only approaching objectives through the backdoor?

If the consequences of an action seem bad (by some definition), approaching an undesirable threshold, adding excessive costs, or requiring major capital developments, then the action can be viewed as bad and, hopefully, not undertaken. The answers suggest whether the person or group will be able to remain within "the box." People want to know what will happen, what will be the consequences of proposals or actions. They know full well that precise statements are usually unwarranted, so they will ask for the "odds" or for probability statements. Progressively, rationally robust work engages in using computer simulation to produce consequence tables, expressions of the likely changes in the conditions of important objectives. They are needed to sharpen objectives and thus lead to optimization.

Equifinality

As a boy, I was more interested in "skinned cats" than in the wisdom of my grandfather's oft-used phrase: "there's more than one way to skin a cat." I could not imagine why there were so many such events or that a saying would have emerged. Unquestioning, I waited, for I had heard the non-answer enough times: "you'll learn one of these days." I think I have learned and I want to share knowledge of equifinality, because it has provided me many new insights and a pattern for some explanations (and related actions to be taken) within the rural environment.

A concept within general systems theory, equifinality deals with the observation that there are often several ways to arrive at the same end state. In arithmetic, the example is clear.

To get 9 we can multiple 3 by 3. We can also get 9 by dividing 27 by 3, similarly by adding 4 and 5. Different numbers and processes can lead to the exact same outcome.

This is true (but rarely noted) in the rural land sciences. There are many pathways to a mature oak tree, an adult deer, a mossy rock. A lot of water and a little fertilizer can result in the same crop yield as a little water and a lot of fertilizer. The emphasis here is that there are many ways to get to a desired end state, a position near the center of "the box." Many different abilities, tastes, backgrounds and experiences, even objectives, can exist within a group as long as they recognize the space that they occupy as suitable.

Analyzing pathways to determine equal crop or tree responses, or finding the "best," or "optimal" pathway (most cost-effective, etc.) are typical problems in agroforestry. Finding the absolute pathway or combination and sequence of factors may be time-consuming and expensive. Inputs to a system can change over a fairly broad range and still yield almost the best result. An important concept to be followed is that there are ecological thresholds in rural systems, e.g., most natural areas of the world will produce no more than a certain limit of phytomass.

The study of equifinality can provide new insight into the importance of objectives. If total tree fodder for farm animals is the objective, then there are many pathways to that condition. It may be that even after redefining the objective (e.g., total forage vs. percent digestibility), different conditions may produce the same particular end result. The need is to select a means that will maximize or minimize the results from among the permutations of these ways. In rural systems, each permutation is a potential pathway to the same end, one of many pathways of equal or often insignificant difference in costs or other criteria. (The number of permutations of 10 items is 3,628,800.) There is a vast area of financial and other indifference. The search for the best one, or more likely "ones," among the pathways will serve well.

When we do sensitivity analyses in the rural arena, we find many factors to which the system performance measure is insensitive. We can change inputs to the system over a fairly broad range before we reduce optimum conditions.

We believe this observation has evolutionary and survival-value roots, but the point is that it is irrational, counter to the available evidence, to believe that very great precision is needed or will be useful in work in the field with most factors. Of course, it will be irrational to fail to look for those factors to which the system is most sensitive or to fail to use those that are found with care or "by mistake."

Regression models of statistics result from making field observations and relating a factor of interest to some likely causative factor. The goodness of the model is judged on the basis of the statistical R^2 value. The closer the R^2 value to 1.0, presumably, the better is the model of the relationship, for the higher the R^2, the greater the variability that is accounted. I have seen vast amounts of field data scrapped because they "didn't shown anything" (i.e., the R^2 was too low). Not at all hostile to regression analysis, I find the concept of equifinality suggests the:

- enough samples (in each class, therefore in total) will rarely be available,
- there are threshold and non-linear phenomena at work behind every tree stump,
- a low R^2 is a reasonable hypothesis in the woods, and
- alternative managerial modeling approaches (e.g., expert systems) may be more useful than regression analyses.

"Biodiversity" lurks around every pillar in conference halls. I have a computer program with 18 ways to compute diversity (which I now call *variety* because of the diverse definitions of

diversity). I can change numbers (e.g., simulate stocking 50 animals of a rare species) and see what happens to the index. Invariably, changing the animals causes 9 of the biodiversity indices to increase, 9 to decrease! The frequently-used Shannon-Weaver index is notable for its ability to produce the same index from very different numbers. A community with 55 animals in each of 10 species has a diversity index of 0.23... as does a 3-species community with 50, 100, and 400 animals in each species. The index is descriptive of an end state.

The details of estimating diversity are not at issue here. It can be comforting to know that there are several ways that it (whatever *it* is) can be achieved. It can be comforting to lawyers to know that the biodiversity index "sword" has 2 edges that cut both ways. The sparkling edges, points of lights, will be of little comfort to those claiming in court that diversity has not been achieved or maintained. There is a great amount of very difficult work ahead on the concept of diversity as a system performance measure and its estimation. I suspect there are several characteristics of the desired end state loosely and too hastily expressed by "diversity" and "biodiversity," words now in the law.

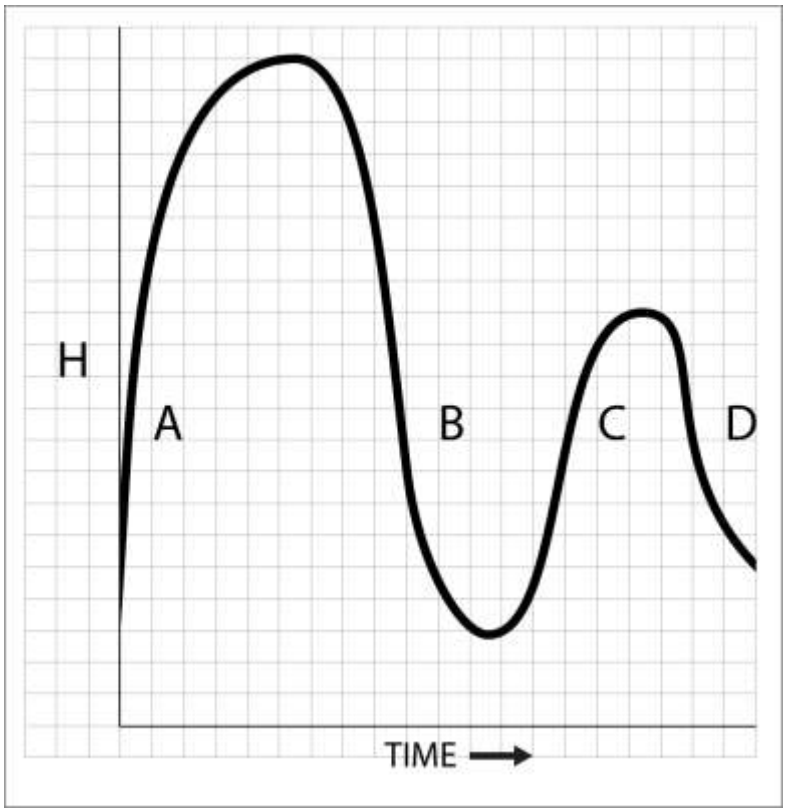


Figure 12. Computed system performance is identical at A, B, C, etc., although quite different factors may have had these results.

Cyclic natural phenomena are obvious examples of the same recurring population or economic numbers. Presumably there is one system at work producing the undulations, but the alternative (and I believe more plausible) hypothesis is that there may be very different phenomena producing the "curve." The end state, at points A, B, and C in Figure 12, are identical. They are manifestations of system potentials overriding constraints, and probably unique combinations of usually over 300 conspicuous, generalized working factors in an average

forest or North American rural land. The potential relations (R) among this n = 300 factor system is merely R = n (n-1).

Ecologists are said to study relations. They may be irrational even to pretend to engage R relations (here only 89,700) as well as to work with n specialists.

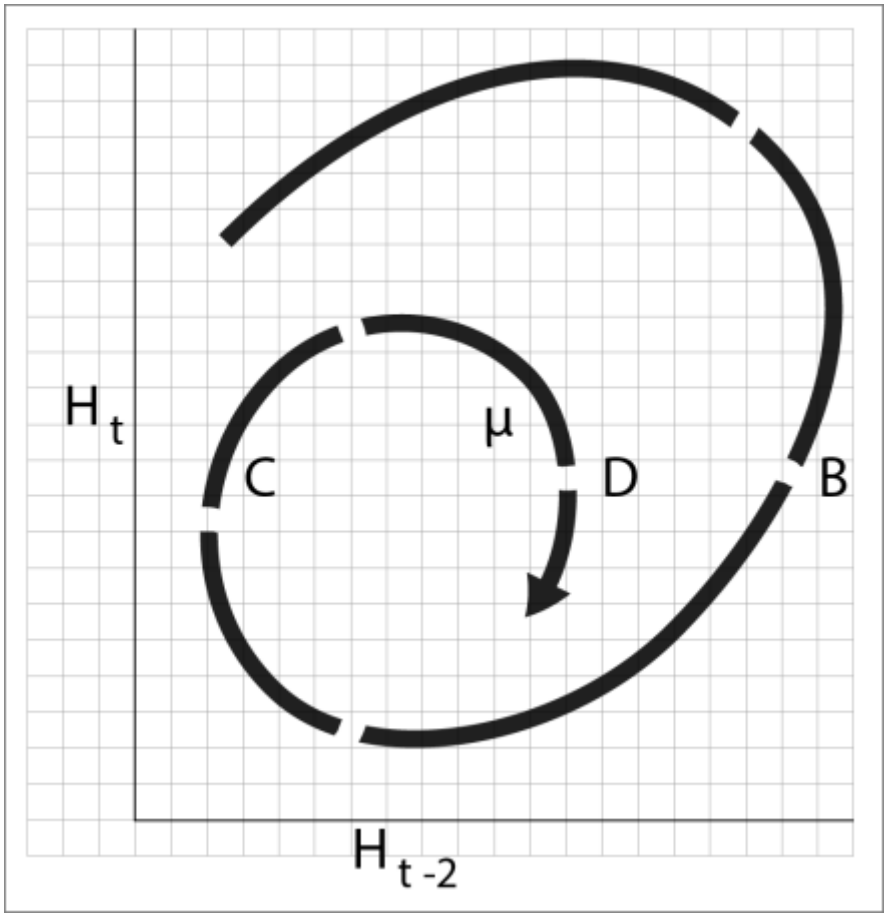


Figure 13. Harvests in one year are likely related to those two years previously. Equifinality occurs at B, C, and D. The mean, μ, is shown at the center.

Harvests in one year are likely related to those two years previously. Equifinality occurs at B, C, and D. The mean is shown at the center. Infrequently seen is a graph such as Figure 13, a picture of deer harvest as related to the harvest two years previous (often a strong inverse relationship). Equifinality results in nearly identical harvests as a result of three very different harvests as at B, C, and D.

These ideas (shown as cyclic or irruptive populations or as the circular so-called “phase plane”) (Figure 13) can be combined to produce a picture in 3 dimensions that can be very instructive (Figure 14). If not careful or resistant, an observer may relax with the conventional wisdom of two-dimensional blackboard images. As seen in Figure 14, there can be many states of systems that are working that produce the "coil." When managers quickly generalize about systems, they often use the central tendency. This shaded center-core (Figure 14) does not exist!

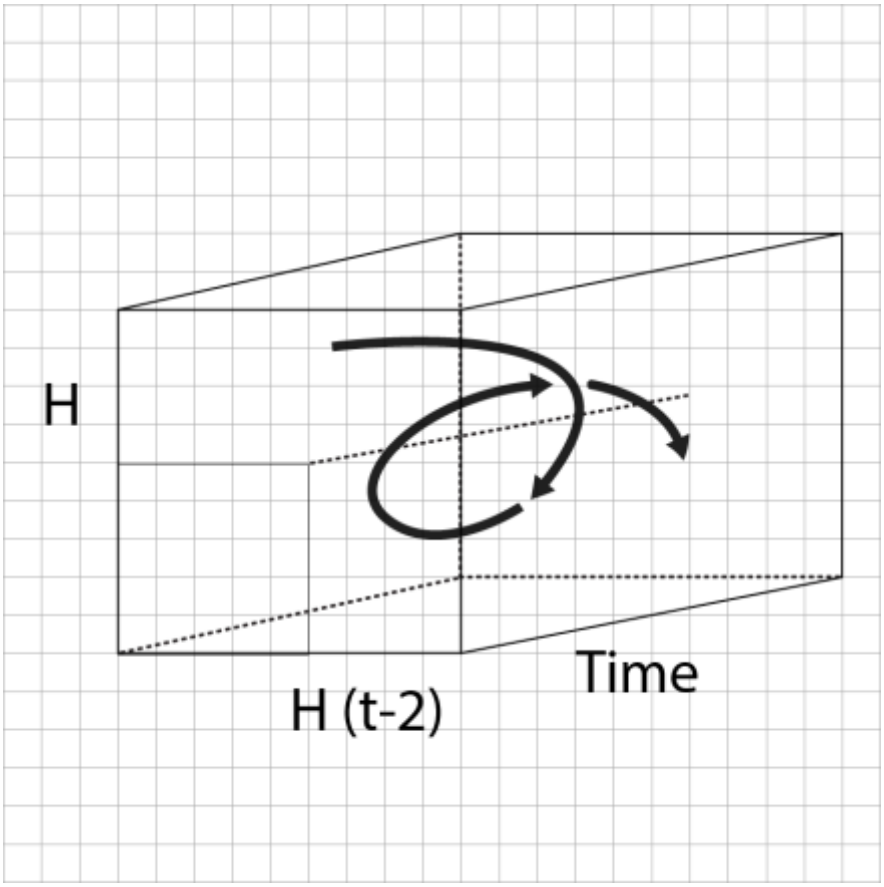


Figure 14. Information in Figures 12 and 13 can be considered in three dimensions. The central tendency is shown at the dotted core. The system may never occur in the central tendency, usually represented as an average statistic.

No point on the curve showing final states of the system occurs along the shaded line at the center. Equifinality is descriptive of the ways that points on the curve are reached. It does not describe how the non-existent center is achieved.

Forests and related natural resource systems are not 3-, but n-dimensional. Knowledge of the center space, the "central tendency," is not likely to serve practical, responsible managers well in the future. What can serve is knowledge of the systems that produce measurable ends. A step in that direction is to concentrate on the maximums and minimums observed. What comes next (or first, or simultaneously) is clear thinking and articulating the forest objectives—the complex, desired end state.

The rural resource system manager needs to assume that equifinality may and does occur in all complex systems. It often occurs in cyclic or periodic ecological phenomena.

Statistical tests of factors that affect some system output or end-state need to be carefully and reluctantly used. The Y variable (dependent) can result from many combinations of different Xs. A low R^2 is highly probable. Improved and reduced-cost sampling schemes can be devised.

All means to the same end—to some equifinal state—probably do not cost the same. Lowest-cost pathways need to be sought.

Range-Related Knowledge

Many natural phenomena are not normally distributed (bell-shaped line graphs). Because of this, the statistical median often better reflects central tendency than does the mean or average. When one value must be used for a factor in a 50-factor model, then the median should be used. The median has been effectively estimated in engineering and military work for many years and, although used to develop estimates of time needed to complete a project, we believe it can be used with low risk in other aspects of rural work when experts are available.

The principal advantage of estimating a median value is that estimates of parts of the equation for high, low, and likely can be obtained quickly from experts, available records, or observation. Intensive sampling and measurement is not required to make at least a rough estimate of the median. It is rational to use estimates such as this for crop production, tree yield, charcoal yield, animal weight, and other aspects of rural work. It is irrational to deny so-called sensory and authority epistemological bases of the people of the country and to ignore the growth, survival, and potential harvests and real benefits from forests, livestock, and croplands. We must deduce with feedback. Cost-effective development of dominant relations among all major biological and social factors seems reasonable.

Maximum and minimum values are often easier to establish, and may provide more information about natural phenomenon being investigated than an estimate of an average or mean. It may seem unreasonable to use statistical range, for such use seems to relax our efforts to achieve great precision and ability to discriminate. However, hope for gaining knowledge lies in using the ranges and also increasing the number of dimensions of an analysis, not, as in past studies, in emphasizing increased sample size and precision in only a few dimensions. The result of using ranges will be to limit the sample sizes and, thus, time and costs.

The observations of the range include those from a global maximum (e.g., the maximum temperature ever recorded by any weather station in the world), to a regional maximum, to a stratum maximum. Bayesian analysis suggests the practical use of *a priori* knowledge of such phenomena as maximum temperature in a study area. The probability of two states of nature, above or below the range limits, can lead to a set of values (perhaps in a uniform distribution) that can be used within computer models. By such use, sensitivity of the system performance measure or 'success score' to each variable can often be determined. Eliminating variables that need further study or that must be expressed precisely can lead to major savings.

There is a feeling, generally, that knowing the range of values for some aspect of a system provides little information for decision-making. In ecological systems, functioning over very long periods, what is *now* observable as “the system” is really the “remainder” of plants, animals, etc. after extreme or episodic events. (Those surviving are said to be “fit.”) Because of this, the range is probably the best value for use, especially while the “long-term” and the “sustainable” system phrases gain political and research-agency-support vogue. Ecologists see a multi-dimensional space within which people or plants or other animals may exist. The walls are

the outside limits to where they occur. The walls are the ranges. The space is called the creature's "niche." Endangered species have very small niches.

The ranges from field studies of rural factors of interest can be mapped within GIS software. All work to date, using more than seven variables, has produced maps of great complexity, detail, and counterintuitive patterns. These maps seem to provide at least as much resolution for decision-makers as conventional yields from statistical analyses.

Many factors that operate on crops, trees, or animals suggest a feasible space or defined hypervolume within which they may survive, production may occur, or profits may be obtained. My emphasis is that ranges are important; an optimum might be found, but computer searches and field tests need to first address the space defined by feasible or reasonable upper and lower limits of all relevant factors.

Tentative Confidence

Almost everyone likes to make decisions with high confidence (or a probability of 1.0 minus risk). People desire low probability of "being wrong," but there is ample evidence that they do not behave in a way that is consistent with such a theory. People marry with fairly low confidence for success (by several criteria). They make household purchases with only modest amounts of information about best options. Farmers or foresters rarely farm or practice forestry as well as they know how. Making decisions at some high level of confidence seems reasonable, but it is often inconsistent with human behavior.

Risk-taking behavior is never singular. It is always a combination of a perceived probability and the effect of the consequence of being wrong in the present instant or longer future. The consequence of being wrong may be thought of as the combination of the effect on an individual, the number of individuals, and the magnitude (especially over an area) and duration of the effect. When confidence or the probability of an error is computed separately, meaning of risk for a farmer or a community is lost.

Scientists, the community, have adopted an arch-conservative, risk-averse paradigm in the standards for confidence in their micro-environment, tightly-controlled experimental decision-making. That paradigm has been taught and widely accepted, insisted upon for human drugs, generalized for everything else, and thus the general educated public now has excessively high, excessively costly, excessively delayed contributions of "science" to decisions.

Most rural research is stuck in a 95% probability rut. Taught in college as proper, the level influences decisions throughout many aspects of rural decision making. The perception is that we can tolerate an improper decision (e.g., whether crop production was significantly increased by under-planting vegetables within a grove of trees) no more than 1 time in 20. Given that 10,000 such experiments have been done in the past 10 years, then 500 erroneous decisions have probably been reached. People concluded that there was a significant difference due to fertilizer or irrigation when there was none. The reason that the possibility of 500 mistakes does not bother many people is that they seem to know at a high level of probability when something *did* have an effect. They are more confident than 95% even though the test statistic is only working at that level, the 0.05 level.

While we would all like to be absolutely certain of almost everything, i.e., decide at a confidence level of 0.9999, such a criterion is unreasonable and excessively demanding in most Rural System work. For corporate boards or directors, a mere 5 to 15% improvement is acceptable. A stock portfolio must have only 5-15% gains as compared to losses or failures. A

game population only needs to be "relatively stable." The population being over-hunted, for example, can be easily restored in a few years (often increasing in a post-hunt environment with surplus food and without crowding) or by simple adjustment in future harvest regulations. These observations about how other people deal with confidence or with acceptable levels of accuracy argue for me that it is unwarranted to assume that farmers or foresters operate substantially differently than they do. Using high levels of confidence such as an alpha of 0.05 (the 95% level) in most Rural System work is inappropriate.

Achieving high confidence requires typically great sample size, thus, high data processing, storage, and analytical costs, and produces results that are often inappropriately used, not reported, not stored, or not critiqued, and thereby violate many of the premises of classical science. The use of the confidence level as a separate statistic is inappropriate; it must be unified with effect, people, and time. A much lower alpha level needs to be adopted on the grounds of appropriateness, high expense per sample (in all dimensions), inevitable alternative sources knowledge, and on the grounds that rationally robust work involves a clinical approach, one with active feedback over relevant time.

Simple computations can demonstrate the high costs resulting from establishing inordinately high requirements for confidence and tolerable error in studies. The statistics of brief, controlled studies do not apply to the rural situation. Assuming that they do apply may more than double the costs of studies. Given the massive needs over vast areas, the extreme pressures on resources, the desire for answers as quickly as possible, the extreme shortages in money and expertise for studies, the complexity of the problems and their analyses, and the relative adaptability and resilience of natural systems, confidence levels of 0.20 need to be used, followed with applications and adjustments.

Within rationally robust work, staff seek to find the fewest number of pieces of information (the system inputs) that, with regression and other models, give estimates for the greatest number of important Rural System models possible. Acceptable control over the system is judged when model goodness indices of R^2 values above 0.64 are observed.

Continuing species-specific, highly precise pursuits now seem inappropriate. Perhaps other people, who continue classical studies, may contribute to Rural System work and knowledge. Knowledge, however gained, will surely be welcomed to improve estimates throughout the complex models that will be used.

Looking Back

Herein, I've discussed some of the pathways to discover the role that science has in predicting futures. I've suggested a unified, humanistic concept of science transformed into rationally robust work. It has within it a concern for the time when discoveries will be used for people, the concept that research can buy society time in this critical period, and the opinion that society is likely to opt for more sequential than simultaneous work. To reduce the impact of this decision, it is important that rigorous research planning be given higher importance than ever before. Contrary to some who contend that prediction is out of the realm of science, I hold that it is presently well-within science, has historical roots in astronomy, and needs to be given more emphasis, not because of its shortcomings, but inclusive of them for the utility it has for shaping a reasonable environment for people.

This chapter is partially about heuristics. Roughly, as we discussed in Chapter 5, heuristics means the way one finds out or discovers. It is a long chapter and probably relegated to

cosmic otherness, losses that might be tracked by learning-forgetfulness curves and probability functions for ideas accepted. The desire I have is that you, the reader, may later adopt and improve, perhaps reconstruct a personal rationale, a viable process of study and rationally robust work for people. You are encouraged along my tortuous, conceptual path toward the ground for hope for the future of rural people.

The entire Rural System enterprise can be viewed as being focused on a desired future and that is dependent upon rationally robust work. That includes explaining and making predictions about the past, estimates of the future likely to function similarly. It involves more than this, for making decisions and implementing them, assuring their performance, and then managing the results is the enormous work ahead. It is in understanding of these functional relations, using them in synthetic models with high deductive skills, that the future can be known, that consequences of acts can be seen and evaluated before they are performed, and that the future world can then be shaped as a proper place for humankind.

The Football Analogy

I remember a special day after retiring from the university. I had been thinking and writing about Rural System, as was common. I began watching American football on the TV and my mind turned again to the developing, potential Rural System corporation… perhaps "a Conglomerate"—and then a thought struck me.

The developing Conglomerate can use the analogy of American football. Of course, the leather football on the playing field is important, but the total football enterprise is very large and diverse. It includes uniforms, the stadium, food, drink, clothing, advertising, grounds, publications, fan clubs, and more. The ball is important, but compared to the greater football enterprise, the ball is almost irrelevant.

By analogy, the tree or the wild animal on the land is essential, but in the context of a total regional, rural, recreational, and viable economic land-use system, they are almost irrelevant. Perhaps people in forestry or natural resource management and closely-related activities have had their "eye of the ball" for too long. Perhaps just attracting visitors (as in ecotourism), or producing more wild animals has not served us well, and that it is now time to concentrate on the total rural and natural resource enterprise. More precisely, the enterprise can generate *profits* from beautiful, productive land, catering, lodging, equipment, products, organizations, and guides, etc.

By analogy with football, when it comes to the regional problems, we have talked about "ball handling" too long. We have talked about trees and fish and complained about environmental regulations. We've been "brought up" to ask for government help. We can ask for help, for resource protection, and broad-scale studies, but that has not been and may not be forthcoming. There has been little change after 50 years of spending carefully, well-regulated, the little that has been provided.

We (the farmer, the local natural resource specialist) are in the grip of all of the limitations of the single "cottage industry." We have rarely pondered the potentials of an integrated modern regional enterprise. We have been independent landowners, brothers and sisters of farmers! We can be independent... and meanwhile, lose something we hold in common: the vital county. We need an alternative model.

Later, the alternative was created; Rural System, Inc. was formed.

Chapter Seven

The Abiotics: Control or Response?

"Everything is related" is a truism, but naming, understanding, and moving those relations into computer forms for computations and improved decision-making (with payoffs and achieved objectives) is the quest within Rural System.

Wild faunal managers are really more than wild animal managers, and often deal with trees, shrubs, and other plants (flora). They often change and manage plants in order to cause animal populations (fauna) to change or stabilize in desired ways. "Wildlife," in general use, seems improper and imprecise, and is not often helpful in analyzing problems or communicating desirable actions. Though quite ecological since its inception, wild faunal management must now, as never before, be seen as very "abiotic" (not just the plants and animals) in expertise, unifying the forces of relevant environments, such as soils, geology, geomorphology, climate, and atmosphere.

Ecologists tend to be diversely interested in the biotic and abiotic, but quickly add to their study of plant and animal relations to each other: "and everything else." Foresters and wild faunal managers, too, see the need to add "everything else," as they work with sociological issues of tree harvests, tree density and soil and water relations, deer depredation on tree seedlings, hunters' damages, song-bird population density, road construction over trout waters, and visitor-views from forested roadsides.

We now see needs for useful hypothesis-making, gaining data and knowledge about the abiotic factors of the environments. Working with these now seems to be a viable strategy as we work to understand and gain predictive abilities for plant and animal supports of human populations, Earth-around.

Climate Change

New abiotic interests and emphases have grown. On Dec. 12, 2015, 195 countries agreed to reach for limiting Earth warming below 2 degrees C, or more specifically, 1.5 degrees by 2100 AD. Average global temperature is an abiotic factor of profound, sweeping, importance in all Earth-systems, an ecological factor that might be controlled, but is unlikely to be because of lack of understanding.

Failure will be seen in the continuation of climate change. CO_2 concentrations changed from 290 ppm (parts per million) in 1880 to 400 ppm in 2013.[53] That gas forms a transparent blanket over Earth. (It is imagined as if a cloud of smoke is the glass and plastic of a "greenhouse" over Earth.)

Greenhouse gasses will rise by 2100 AD, along with droughts, storms, sea levels, and coastal flooding… and will threaten 1 in 6 species of fauna with extinction. "*Change*" had better

[53] NASA. The Relentless Rise of Carbon Dioxide [Internet]. [cited 2017 Apr 21]. Available from: http://climate.nasa.gov/climate_resources/24/.

be the focus of university education and our proposed, educational PowerPlace (Chapter 11), as all specialists concentrate on the abiotic dimensions of their worlds, including land slope, aspect, elevation, depth transformations, evaporation, transpiration, wind velocities and major directions, albedo, moon-phase light mixes of those of lunar forces, and tidal forces… all at work in the global greenhouse… for good or evil.

Within Rural System we embrace energy conservation and alternative collections and uses, including solar, wind, hydro-tidal, wave, nuclear, and biomass. Still, we have little hope for success in limiting warming to less than 1.5 degrees by 2100 AD (coal, oil, and natural gas supply high amounts of carbon in the atmosphere, but even attacking these major sources will not likely achieve carbon reductions that seem needed).

Massive temperature change effects are unknown. From studies on important Douglas Fir trees, scientists found the trees relatively drought tolerant, and some trees more tolerant than others. Study-needs loom large for predicting the coming changes, their effects, costs, and specific responses needed for species survival.

The forests in America have been estimated to remove nearly 12 percent of total US greenhouse gas emissions, annually. These "emissions" include the estimated volume of extra carbon dioxide. Native forests have absorbed carbon dioxide, which has been variable over the years, but now both the amounts and variability have changed substantially.

There are already sets of strong cause-and-effect relations within changing climate, but also some resulting from human management actions and natural disturbances. Trees and other plants burned by wildfires give up significant amounts of carbon dioxide and other gases, and now there are conflicting, planned prescribed-burns in select timber-management procedures. Regional droughts complicate the picture (worsened by climate change, but also distinctly notable for reduced carbon fixation as wood volume and organic matter volume—generalized biomass—decrease). Insect outbreaks and invasions destroy plant materials and change growth rates (and thus carbon fixation). Not only the acreage, but the number of trees per unit area, the volume of the trees, and their photosynthetic and related physiological abilities to absorb carbon may be very dynamic.

One route of that dynamic is "diminishing." Forests are logged; forests may not be well managed; full stand stocking is rare; dynamic management plans for maximum carbon-bearing substance per unit area are rare. Of course, some forests on some areas are preserved. Some cannot be harvested, but even these are not managed for full carbon storage or "sequestration." Forested lands are changed for housing, airports, industrial development. Carbon in wooden structures is well-recognized as sequestered— “hidden away” —such as in long-term human structures where it is sequestered an average of 30 years.

There are some pressures to develop forest land into crop land, but most such commercially feasible transition has already occurred. New equipment for logging and transportation, and extensive energy use will continue forest-carbon losses, as well as rangeland-, pasture-, and soil-carbon losses. Carbon release to the atmosphere is not balanced by carbon storage, and one of the most likely and least costly now-known means to increase storage is within well-managed, long-term, planned forests.

The evidence is now seen that forests and organic elements cannot match the abundant, diverse human energy use of carbon-centric fossil fuels. While foresters and others wait, perhaps the best use of some last-available fossil fuel energy is to develop CO_2 collection and storage (as in well-known metal containers) ... since the rate of perfecting sophisticated forest-growth areas

with massive, stable volumes (limited harvests, and protection from diverse 'forest-health' issues) seems unlikely.

Within Rural System we're trying to describe one way to clean up our mess in the air using managed forests, gaining our Earth portion of capacity for storing carbon. In doing so, we shall work with forests of each tract, gaining benefits for climate as well as those for groundwater volume, storm water management, soil vitality or recycling, birds and mammals, threatened plants, reduced erosion, and landscape visual wonders. Only continuously, intensively-managed forests can provide faster than normal additions of carbon in the storehouse of vertical trees—the carbon columns.

We see fire, insects, vandals, and thieves producing carbon leakage from our forests. We shall use wood for building, well-aware that net carbon storage benefits from using wood-based products are greater than such carbon benefits over time when using fossil-based energy-intensive steel, aluminum, plastic, and concrete. Wood products store carbon for hundreds of years; fossil-energy-based products have high carbon releases during relatively short lives.

The carbon stored within Rural System forests (and all forests) will always be changing as a result of forces and sequences of temperature, moisture, and a host of "ecological" factors and forest-stand factors, even including tree shape. We shall monitor the carbon (changing over a management period). We shall manage the forest, not a "collection of trees," with rotation in our work over areas to provide both insurance, base enhancement, and soil carbon. Total forest-captured carbon is our work, and we shall gain a recognized market value of the wood produced and secondarily-valued, relative benefits per acre:

- game species and aesthetic fauna;
- specialized "energy forests" (high-energy-bound-species) and arboreta systems;
- carbon estimates for all managed grass and forb fields, layer-one;
- thousands of cubic meters of layer-one soil carbon;
- reduced layer-one and layer-two carbon losses due to erosion control;
- groundwater volume additions related to managed forests and soil controls;
- reduced wind damage to structures and crops; and
- increased real estate sale value.

Costs of thinning forests are high, but thinning high-value stands can help achieve the objective, i.e., maximum solid volume and financial gains per unit area, stable over time to counter effects of changing popular wood prices. The cost is significant, both for thinning, but also as a part of stand management including harvest and replacement over extended years. Partial costs of management and replacement (replanting as needed) may be gained by sale of thinned wood and terminal-stand cuts.

Losses to fires, theft, pollution, flooding, and disease may initiate replacement costs, because the objective is typically maximizing the benefit/cost ratio, where benefits are strictly in this current crisis, total tons of stored carbon each year. It is very unlikely (a year here or there by accident) that a preserved forest area over 50 years from preservation data will match the stored carbon of a managed forest for 50 years on a similar site (or sites). Critical for combating climate change, carbon storage now "tops" other benefits. Decided harvest dates for each stand will differ because of a monetary criterion for harvest and a probable carbon-volume-weight growth criterion difference.

If climate change is allowed to happen, what will be the cost of the damage (presumably the repair work cost)? ... Should we try to prevent these costs, or pay later? Most such questions will be answered with GIS assistance.

It now seems clear that there is human-caused global warming of the atmosphere. Yet governments discuss prohibiting discussions of climate change in their courts! If not prevented, in Virginia climate change will result in sea level rise, increasing the coastline, increasing wetlands, but reducing the fertile coastal plain area. Hurricanes are likely to increase (due to sea warming), and their erosive forces in the uplands are well known. Ocean animal populations will change in unpredictable ways, thus birds that feed upon them will also change. Changes are predicted to be several decades away, possibly within a 20-year horizon.

Though there are global warming skeptics, scientific consensus now exists on anthropogenic global warming. A debate remains over specific impact predictions. The future cannot be known, only predictions made. Different models are used, and thus different results are expected. These include: between 1.5 and 4 degrees C by 2100 AD, 1 to 3.5 degrees C, and 0.5 degrees C. While the numbers appear small, they are enough to change an iceberg into water; prevent some fish from hatching; cause some plants to stop growth and others to progress too rapidly for successful fruiting; and some insects to hatch before their food supplies are available. Small changes over vast areas over many years can produce enormous consequences for people.

Xiao Zhang and Ximing Cai from the University of Illinois at Urbana-Champaign said that the amount of agricultural land available globally will change by only –1.7% up to +4.4% depending on the emissions scenario used.[54] Yet, this change will vary depending on the region. Zhang and Cai's estimates show that some regions of the world will gain arable land, while other areas will lose agricultural land in large amounts. Higher latitude regions, such as in Russia, China, and the US, may see total arable land increase by 37–67%, 22–36%, and 4–17%, respectively. Tropical and sub-tropical regions, however, are likely to lose agricultural land: South America may lose 1–21%, Africa 1–18%, and India 2–4% of arable land.

To respond further to climate warming (1-2 degrees C by 2050 AD) we must also address the re-encroachment of malaria and other mosquito and gnat-borne diseases. Water tables will drop, rainfall recharge will fluctuate more, and streams will have more variable peak-flow effects on fish and other organisms. Stream habitat of mayflies and other indicators of stream quality will change, and the indicators will thus become meaningless. Threatened aquatic snails and mussels, with their delicate, complex set of fish and habitat needs, will be compromised.

Major reductions in greenhouse gases—greater than 30%—are needed. Past changes to reduce our pollution have often resulted in profit gains. Perhaps the costs of change will be low and the suits and injunctions for industry by landowners who are harmed by the warming will be sufficient to make a financially-justified case of participation in halting global warming before developing nations prevent any reasonable remediation or recovery.

Rural System began developing a program for practical responses to climate change in 2013. We sought the advice of Mr. Waldon, formerly the head of Virginia Tech Conservation Management Institute. We hoped for national, international, and state action—a diverse, massive, coordinated effort—but we did not expect the high risk of likely inaction. We tried to develop a program within our 150-year planning horizon composed of:

[54] Liz Ahlberg. 2011. Study Predicts Large Regional Changes in Farmland Area [Internet]. University of Illinois. [Cited 2017 Apr 21]. Available from: http://news.illinois.edu/NEWS/11/0323farmland_XimingCai.html.

1. Maximum carbon containment and on-site capture of carbon;
2. Maximum financial gains from various government and corporate sources related to carbon credits for such long-term carbon capture;
3. GIS-related techniques for documenting carbon-credit-related forest stands and facilities;
4. Planned response to near-future, costly climate-change phenomena on our contract and designated lands;
5. Selection of plants consistent with values but also resistant to temperature warming phenomena; and
6. Carefully-reflected messages furthering behavior to capture carbon and to reduce continued abundance of atmospheric carbon.

We hold that the climate is warming, thus weather patterns and precipitation are changing. Effects of these changes will occur locally and influence land use throughout. We are attempting, too late, to respond to climate change with the needed behavioral changes and preparations for our common future. We are limited; we shall work to those limits within this perceived crisis. Rural System staff will attempt to integrate science into decision-making, actively use the NOAA Climate Services Portal prototype (Climate.gov), and cooperate with others in bringing together climate science and services information. We shall actively translate related information from scientists into action on the land and water, and use active feedback.

We appreciate multi-national action in 2016, responding to real, inseparable problems. The problematic phenomena we examine and intend to model are:

1. Regional temperature-increase changes to phenology, hydrologic cycle, migration, and plant growth seasons, together specifying and limiting the plants that survive, their rates of growth, their likely disease and insect problems, maximum growth and health and susceptibility to frost damage—all of which can now be computer mapped;
2. Ancillary high winds and soil erosion depositions onto seedbeds, as well as increased tree blow-down events (accompanied by secondary effects, such as those of root thrust-ups);
3. Animal behavior responses to increases or changes in wind, such as, potentially, foraging aggregation and increased predation;
4. Accelerated evaporation;
5. Altered evapotranspiration;
6. Snow occurrence, sequences, and depths;
7. Changes in soil moisture;
8. Stream temperatures;
9. Base flow temperature changes, thus ecology of decomposition in those high-elevation, low-volume reaches;
10. Changes in seed germination and seedling survival, strongly related to evaporation;
11. Key insect abundance measurements in plant communities;
12. Rate of soil litter decomposition;
13. Rainfall and other precipitation events and amounts;
14. Debris slides caused by freezing and thawing (moisture weight buildup within soil);
15. Pond debris, plant-mat formations, and eutrophication; and
16. Forest dieback and injury to the conductive tissue of hardwoods, caused by extreme thaw-freeze cycles in winter followed by drought in summer.

Rural System's program for responding to climate change will include the following actions, not yet in preferred order or grouping but with data collected from public sources. These

actions will be processed within VNodal, and will be issued as prescriptions for local actions, with alpha-unit precision:

1. Identifying changing management practices caused by knowledge of any/all aspects of climate change;
2. Furthering scientific knowledge or significant alternative knowledge bases (Chapter 5);
3. Listing and value-weighting resources likely to be vulnerable to such change and using the list to relate needs with priorities for action;
4. Relating vulnerable vegetation to strongly-related wild fauna, and other resources to "biodiversity" (carefully defined within the program);
5. Relating forest type/stand characteristics vulnerable to changes and forces;
6. Relating changes in riparian zone conditions to stream water quality/quantity, and then to fish and other notable organisms;
7. Relating roads, trails, and costs of access for tourism and work;
8. Relating rare or at-risk wild plants or animals on our contract lands;
9. Developing concepts of ecological resiliency; and
10. Relating ecological resiliency to economic resiliency within the System.

We progressively seek detailed strategies for handling the above, most of which can only be executed cost-effectively by in-house teams. We shall look for adaptations, substitutes, and careful cost-benefit analyses.

We'll work with others in a sub-project to relate changes in relevant variables to our riparian studies and those of the stream fishery and "Healthy Streams." Models will have to be used to explore the phenomena suggested here to reduce uncertainty and decision risks. Rising water levels threaten shoreline human communities, but also the areas for larval fish, feeding waterfowl, and marsh fauna. These waters need management, not just diversion. The wetlands of near-ocean shores require radical change from input analyses to implementing cost-effective priorities that will produce acceptable conditions for people for the likely future. Responses to shore-land proposals for change will have to include resisting development, as well as new management for riparian zones' coastal marshes.

The influence of insects on tree and understory plant growth, and food supplies for other insects and organisms, requires stressful, combined, coordinated observations of "services" for all normal functions from forests and streams—bottoms to forest canopies. Bark beetle outbreaks need special climate-change analyses. Trees, poorly spaced, are stressed by moisture excesses and shortages, and will begin dying, giving off pheromones that attract beetles. Observers will erroneously conclude that the beetles killed the trees, for they will see beetles on trees that are dying. Dr. Heikkenen's studies need further confirmation, but he showed the beetles are attracted to already dying trees (Chapter 4).

Climate change has a feedback function which we shall describe. Some forests will grow and store carbon; others will be intolerant, die, and the physical changes after death itself will add more carbon dioxide rapidly to the atmosphere.

We may be among the first to add specific gravity to our models of forest carbon and its capture or "sequestration." Foresters know the likely weight of wood of each tree species; we'll use this knowledge within our VNodal models with tree volume estimates. Thus, we see the pathway toward a software unit in VNodal to perform rapid, cost-effective forest ownership analysis for carbon sequestration. Owners, and Rural System, need to know now the range of consequences for participating in a carbon-capture program—costs, gains, timing—and how all

these variables affect the bottom-line. A preliminary simulation will probably lead to knowledge of essential system components, provide sensitivity analyses, and point to cost-effective optimization software to be selected or constructed.

Precipitation and Erosion

We have had thoughtful work done by Rebecca Wajda on precipitation in Western Virginia Ecosystems.[55] We use major parts of that unpublished thesis as part of our direction, understanding of the available data, and perceived need for a climatologist or related specialists to work with us. We shall study and report on precipitation factors for each area, for these factors describe each area anew, previously known well only by long-term owners and assembled national and state databases.

We see precipitation on the ownership as action by variable, named factors of the abiotic realm. Factors of the area are influenced by measures of estimated monthly precipitation of all types. We study how to merge them, model likely conditions, and report on rainfall, snowfall, hail deposits and effects, evapotranspiration, analyses of precipitation chemical content, regional fog-drip estimates, and local records of cloud cover.

Vegetation buffer strips act as barriers to reduce soil movement on slopes.[56] We shall seek desirable erosion control efforts with vegetation in mountain areas, and thus utilize vegetation buffer strips for gaining relatively fast stabilization of disturbed hill slopes, gaining time for large-area control applications. Furthermore, timber and other vegetation will be harvested in a manner that will leave appropriately-located buffer strips.

We plan to study sediment deposits from wooded strips and those from nearby similar areas, especially as related to sediments likely to enter streams (not restricted to the banks of riparian zones). In the field, Rural System staff will need to use erosion soil loss equations to estimate loss/unit area given slope length (i.e., strip width), slope grade, and other factors later in equations combining Riparian Zone totals and pond dynamic volumes and borders.

Soils: Dynamic Places

As throughout this book, everything seems related to something, a function of something. There are relations, but few interrelations or *inter*-actions, the term often used within definitions of "ecology." The study of relationships is of especially vital, lasting importance within soils of rural areas.

Soil names have been changed in the past, and so differ among countries and organizations. In addition, "soil" is an *overloaded* word including large to small earth particles, plant particles of recent or long-past organic death, soil solutions essential to plants, and some solutions that are plant killers. Soil may be called "polluted," perhaps due to unintentional chemical spills, but other substances are added on purpose to kill or reduce an unimaginable number of different organisms, from microscopic ones to emerging "weed" plant roots.

Many names have been added to "soil" to suggest the range of differences, such as those of particle size—generally sand, silt, and clay. The combinations of these with organic matter,

[55] Wajda RK. 1993. A site-specific rainfall model for Western Virginia ecosystems. M.S. Thesis. Blacksburg (VA): Virginia Tech.

[56] Heede BH. 1990. Vegetation strips control erosion in watersheds. Rocky Mountain Forest and Range Experiment Station. Research Note RM-499.

moisture differences, and in variable positions on the land create a complex substance that can be mastered adequately for the future with computer power. When these factors are combined with the dynamics of adjacent soils, history of use (and abuse), flooding, wind effects, past uses, and shading—among other factors—they produce evident differences, with unique requirements and limits for each plant species!

Rural System staff, well-aware of the challenges, are intent upon the analyses of soils within each Alpha Unit. We shall start with published soil data and maps, and load the cells with topographic data (such as slope steepness, aspect, and elevation). We shall also look for other spatial data from state agencies, commercial services, and from our own Studies Group, as we use acquired equipment and a small laboratory for each Alpha Unit. We shall combine such data with our computer access to precipitation and other weather events, daily, year-around.

We shall conduct separate studies of soil fauna—the food of mice, shrews, and earthworms—of many classes. Sampling methods will change with project interests and funding, and species information will not only be added, but will contribute local knowledge to active models influenced by feedback and set for improved decision-making.

Well-aware of forest site index effects on forest species suitability and growth, The Forest Group will work closely with The Soils Group. Diverse, rich soil is a base for mice and shrews, and *they* spread fungi throughout the top forest soil layers; fungi then transport dissolved soil minerals into roots of growing trees. Knowing, holding fast, prompting these relations, and stabilizing desired results will be parts of the jobs of all Rural System Groups as they work diligently for benefits and market products for a profitable future.

Rural system will continue to develop robust soil models in cooperation with state and federal agencies, especially in relation to data on appropriate uses of differently-named soils. One among many soil dimensions studied, and that we must further, is the soil carbon of "humus." We shall use the results of a study by Leak (1974): "Humus depths averaged between about 20 and 50 nm, depending upon the slope of the land (humus depth (mm) = 60.8-0.946 x slope %). The maximum single measurement was 101 nm."[57] We shall study parallels and try to quantify carbon amounts and dynamics throughout all Rural System areas, especially in advanced-age forested areas. With respected others[58] we know that soil organic matter (SOM) levels are "cornerstones of soil sustainability and quality assessments," but standards of goodness have not been established.

Since 50% of Earth's land surface is dedicated to agriculture, therein is "the largest terrestrial stock of carbon," thus Rural System's interest and action to understand its dynamics throughout our areas. We have concerns and seek "conditional" elements for definitions and other processes (drought resilience, sediment loads, and nutrient dynamics) that may together have measurable, consistent effects on crop yields.

Rural System staff have been actively involved in soil units of rural tracts for many years—from basic analyses through county-level soil and GIS applications, to a smartphone garden app for interpreting garden soil analyses. Rural System criteria for soil analysis include:

1. Estimating minimum diversity, at reasonable scale (similarly within no smaller than an Alpha Unit, within the scope of cost-effective allocation and singular characteristic);
2. Ready automation and adjacencies;

[57] Leak WB. 1974. Some effects of forest preservation. Durham (NH): USDA Forest Service Res. Note NE-186.

[58] Wood SA, Sokol N, Bell CW, Bradford MA, Naeem S, Wallenstein MD, Palm CA. 2016. Opposing effects of different soil organic matter fractions on crop yields. Ecol Appl, 26: 2072-2085. doi:10.1890/16-0024.1

3. Characteristics easily, consistently measured, and recognized generally as likely influential to plant growth; and
4. Gaining separated results consistently for input to categories of:
    1. Slope,
    2. Flatness,
    3. Aspect (compass direction faced),
    4. Aspect type (a-conventional; b- coastal, inland, continental),
    5. Elevation,
    6. Vegetated type,
        a. none
        b. grasses/forbs
        c. forest seedlings
        d. pole-size trees
        e. trees, basal areas; height
        f. forest fire scarred, aged
    7. Soil organic matter (SOM),
        a. Zero inches deep and see above
        b. 1-5 inches deep
        c. 5 inches deep (average)
        d. Under water (ponds, streams, marsh, seep)
        e. Rocks and related (native rock, sand – no vegetation, solid cover concrete, etc.)
    8. Inches of surface organic matter.

The results from one perspective with which we plan work are "gross," but in a one-acre tract there are 43,560 square feet and 40.52 Alpha Units, wherein information can be automatically analyzed for answers to relations with other above-listed characteristics. The probability is small of finding reasonable, certifiable-for-use statistics within actual rural areas.

We recognize the costs, time, great variability and dangers, and shall hasten to master the above variables locally. We may converge on interpreting "soil health," resolving: does SOM volume per m^2 indicate soil health? If so, what aspects of soil health does it indicate?

We see that SOM may:

1. Store nutrients for sequenced uses and limit leaching;
2. Release nutrients from plant material;
3. Provide spaces for decomposers;
4. Provide energy and nutrients for decomposers;
5. Provide nutrient access to plants present;
6. Provide soil structure category;
7. Improve drainage;
8. Reduce erosion;
9. Influence surface evaporation;
10. Support wild fauna foods;
11. Store water;
12. Provide criteria for future definitions of soil health or farm/crop health;
13. Contribute later to food security;
14. Contribute to drought resilience; and

15. Decrease pond sediments.

We shall build SOM by adding organic matter to soil. We shall assess amounts of available organic matter (and calculate total needed for field coverage at a 6-inch maximum), observe the effects of our applications, and adjust in future applications to gain rapid, total integration of deposit, smoothly even throughout fields. We shall measure carbon capture based on our lab procedure for allocated volume/acre to produce desired carbon levels. We may develop a strategy to build proper SOM for each crop and for carbon capture (likely in conflict with SOM). There's interesting work ahead.

Functional soils, feeding plants as well as providing support, provide plants nutrients dissolved in waters. Rural areas of the US, and many throughout Earth, face water shortages. The problem is no longer secret, and faces all of Earth's people around 2030 AD.

"Water crisis" sounds unimaginable in many regions of Eastern USA; proof is that people will not imagine it and act upon such knowledge. As fertilizer is needed for plant growth, so too is clean water—irrigation to enhance or achieve adequate crop and livestock production. Fertilizer supplies, now costly and insecure, must be carefully managed within the waters supplied to plants.

Glaciers melt, and now this "extra water" (from the recent past) causes the sea to rise over coastal areas, thus salt-water splashes over and into once-crop-rich lands. I've visited areas where well-water for humans is now unusable—too saline—wells closed!

I worked with a graduate student years ago who wrote a Master of Science degree thesis exploring optimum computer pathways for sending "cool-clear-water" from Virginia mountains to its massive, urban coast. The needs are not new; alternative sources seem needed… but not as much as restricted preferential uses, greater care, massive storage, and best-use policies developed for an increasing human population (and with world populations experiencing effects of variable climate change dynamics among 190 or more countries).

Linked: Stream and Pond Systems

There are many other factors influencing crop success, but water is significant, and performs only under a long, complex set of conditions: timely abundance, access, competing demands, nearby climate conditions (affecting land preparation), and plant-seed germination and growth. But as Dr. Tamim Younos, president of Green Water-Infrastructure Academy, writes:[59]

> Water is a limited resource. Water demand for energy production and electricity generation is increasingly in competition with potable water demand and food production. To cope with this challenge, energy conservation and developing renewable energy technologies with high water use efficiency are critically needed.
>
> This can be accomplished by adopting, where feasible, a multitude of decentralized and water-efficient renewable energy technologies such as wind, solar photovoltaics, geothermal, bioenergy, micro-hydro and other developing

[59] Younos T. 2016. Younos: Energy use and water resources impacts [Internet]. The Roanoke Times. [cited 2017 Apr 21]. Available from: http://www.roanoke.com/opinion/commentary/younos-energy-use-and-water-resources-impacts/article_141c09a9-dd19-53ce-bb44-5e4cc6418f27.html.

innovative energy technologies. Policy and economic incentives should support this challenge.

The need seems great—a lasting, giant intertwined challenge—to be met and solved in major proportion before 2030 AD. Rural System trembles under the weight, though hopeful, and plans to develop local, small, integrated irrigation systems, water-capture systems, and careful-use systems.

Water management is so fundamental to management of all aspects of rural systems, yet it and its complexities are assumed "handled" by "unnamed others." Except in river, lake, and urban centers, abundant water cannot be used to explore the effects of relative water abundance on very diverse ecosystems. Yet, though it seems excessive and "reaching" to call water a "trophic currency," it has unlimited use, value, possession, and roles as "food." The elements of management (to be handled by The Water Group), rarely listed, require attention to the following:

1. Plant species requirements—seasonal and group
2. Topography—slope and aspect
3. Elevation—freeze period and degree days
4. Floodplains—area and effects
5. Animals present
6. Precipitation—amounts, and sequences
7. Leaf shade, fall, and collection mass—leaf mass forming moisture, and its dynamics
8. Ground water storage and evident movement
9. Soil moisture (influencing leaf mass moisture, forest root extension in moisture, and thus "site index," an expression used by foresters to describe the quality of an area for growing trees)
10. Prescription (of small, very local manipulation)
11. Proximity to wind, evaporation, and evapotranspiration sources
12. Fog drip—amounts and timing
13. Local xeric plant options for significant water quantity losses
14. Plant species proximity, and shadows cast—influences to water storage or evaporation
15. Temperature, affecting suitability for organisms in soil solution formation
16. Timing of moisture presence and absence
17. Related effects of specific land irrigation in forest and range fires and extended drought
18. Scouring effects of floods
19. New aquatic mixtures from floods, storms, and irrigation

Virginians, as others, have given lip service to water being the basic resource. Worn phrases on the value of water, the quantities used, and complete human dependence upon it are abundant everywhere. What has been said and what has been done on the land are unequal; the words are far more impressive than the actions. There are exceptions in our broad view of watershed management and hydro-systems, but they are few.

The topic of watersheds or their management is frequently given cool reception, or the conversation quickly turns to so-called "watershed laws." Aldo Leopold decried this attitude, saying that, "The real substance of conservation lies not in the physical projects of government but in the mental processes of citizens." The management of the source of water is so important that it must be thoroughly understood by everyone, from park sitters to successful agriculturists and miners. Mental processes must be cultivated so that citizens in a properly-functioning

democracy realize their part in the "physical projects," especially those projects and units of knowledge affecting water resources.

The technical aspects of watershed management are complicated, but the basics are within reach of almost everyone. It is oversimplifying to say that good soil, forest, and wild fauna management are good watershed management. True enough, people seldom go out and "practice watershed management" like they might "plant a forest" or plant an area with wild fauna foods. Watershed management is an integral part of every sound land resource practice. It must be a basic consideration in every wise decision on land use. Watershed management, like other resource responsibilities, cannot be left to "someone else."

Within Rural System, we now stress and study watershed and stream relation and add the concept of **Crescent** management, to emphasize new approaches and intensities for future studies of headwaters and those large, often-mountainous land triangles that exist between adjacent streams flowing down toward a common large stream or river.

Near the Top of the Crescent

There is abundant historical interest in landscapes and growing interest in landscape ecology. Previously, I discussed rural land areas that need to be studied and exploited to gain precise, predictable, timely control of all "scapes"—landscapes, odorscapes, soundscapes, and viewscapes (Chapter 2).

"Watershed" is a fairly well-known word but I shall not risk personal depression in testing such knowledge or its limits. (It has several definitions.) It's an area with ridges of land within which rain and other precipitation and waters from small streams flow, and then collectively flow to larger, similar areas, then to rivers or seas. Their shape is like half of a pear, cut top to bottom. They are where trees and crops grow, streams discharge their waters, ground waters are recharged, flood waters form, and where streams become rivers.

A little thought immediately discloses that every unit of land is part of a watershed. These statements add up to *the structure or basis for a total, sound program of watershed management that may ultimately reach the national, even the world goals of wise land use.*

"Comprehensive watershed management" might meet the needs seen for the future, but as comprehensive and as powerful as its past research and applications have been, it is not sufficient alone. "Crescent management," described herein, is intended as an escape from the institutional, corporate, and educational limits imposed by past use of the term "watershed" in meeting the now well-seen needs of unification: ocean edges to mountain tops, past to likely future, and glass-full to aquifer-empty.

Crescent is a proposed plan for an Alpha-Unit-precise land and water management system, and includes the fishery (discussed later in this chapter). We can make large area maps of rural streams, ponds, and Crescent boundaries based on elevation maps. Inside a Crescent boundary, we can load all of the Alpha Units, and specify the aspect of each Alpha Unit as well as over 50 other ecological factors.

Past watershed management has not been adequate. The usual objectives of watershed management are to provide required yields of water, and to prevent damages from floods. Herein, we propose to add dimensions of water quality, risk assessment, and minimizing costs, as well as profits from sports, diverse uses, wildlife observations, and more.

There are two apparently-opposing objectives. On one hand, the need is to produce water, on the other, to control and clean it. In Virginia, as throughout the nation, there are areas of

critical water shortage. On such areas, increased water production, collection, processing, and delivery is demanded from the watershed planner. Other areas are flooded annually. The people of these areas demand less water, greater directional controls, removal, or restrictions on when and how to use flood danger areas. The solution to such an apparent dilemma can be reached by informed citizens, and the actions of *Crescent* managers.

In the past, many people have falsely rationalized that: water is closely linked to climate, people can do little about the climate, and thus people can do nothing effectively about water supplies. Some government projects have done something with water, and made an active program of watershed management. Many times, defensive or rebuilding programs were inadequate, requirements massive, land-use change effects on water unpredicted, and control limited.

Gaining comprehensive knowledge is very difficult in any field, particularly one as complex as watershed management. Educating all resource workers with such knowledge is a mere dream, yet its importance must not be treated like a dream. The only option available for reducing poor decisions, avoiding counterintuitive results, and improving water management, is a highly practical, highly accessible, dynamically-improving computer system to assist the resource worker. Such a system, with a small group of highly-educated advisors, can make significant changes in the way lands are managed. Computer systems can be used at all stages of land use, from preplanning, through daily work and reclamation, to monitoring and evaluating final developments, and making useful adaptations to local conditions for the near future.

Previous systems, such as those developed by my former students, were designed to face some harsh and embarrassing realities about watershed models in general, and to present knowledge about soils and water relations in managed or mined areas. Trips to the moon notwithstanding, scientists do not know or cannot confidently estimate likely site-specific changes in overland and subsurface water flow, and related sediment losses, in forests and other terrain, or their distributions in time, space, and stage of plant after rain or snow. For example, snow melt rates need correlations with diverse field conditions. We need to unify such knowledge in computer models, add recent study results, and use new electronic information transfer capabilities for rapid use in rural areas.

Computer models, with active feedback forces, can be improved. There are a thousand streams to monitor; there are ten thousand times that many dollars required. *The studies will not be done in realistic time!*

An option is needed. The answer is *relative* models, using the best possible relations known, the least possible inputs, and maximum computer transformation and correlation of data, producing practical decision aids for the manager or decision-maker.

The needs are thus for robust models based on physical laws and phenomena. We need those that are modular so that whole “chunks” can be replaced as knowledge expands, those that are balanced or have proper regard for significant figures, and those that are sensitive to the wide variety of changes highly likely in a multi-factored system, i.e., one that can be plus or minus 10 orders of magnitude different even with complete knowledge! Models are needed to seek even improvements of one-half-of-one-percent in decisions, because a small percent improvement in 100 areas over 150 years is a massive change.

We have seen that for many watersheds studied, about half of the map cells in a single watershed face different directions (have different aspect), which means different sunlight, rain runoff, snow melt, evaporation, groundwater recharge, forest site index, and insect and disease

habitat suitability. We must cease over-generalizing for *watersheds* and allow computer processing of *Crescents*.

We shall work for specific, multi-factor precision management of named map areas. The map of the likely ridge-crest-center is no longer as important as it was once; now it is only a single map factor among hundreds, and their thousands of combinations. Fog drip, for example (that beautiful, rare frost seen on tree and shrub stems), is capable of causing differences in perceived precipitation up to 10-25 inches in local forests.

"Crescent management" is a decided choice between "whole-stream" and "formerly-watershed" management, in favor of the former. It is concentrated work, from observation to working model, of the whole Crescent area—every Alpha Unit, and every known or hypothesized factor affecting or affected by the whole stream.

The stream is statistically the "dependent factor," the mappable unit, evident flowing-water and its related land, a dynamic entity. The whole-stream is perceived, minimally, as a function of other systems. For example, the climate and upper hydrology of adjacent Crescent units are interrelated, as are the hydrology and geology of adjacent Alpha Units, including stream-bed elevation (stream-flow rate), geological layers, "placements" observed in influencing significant stream change (e.g., geological features, or forest trees), and stream barriers such as constructed ponds, dams, and roadways.

Within Rural System we shall work toward a crew that can effectively enter and embrace the full needed measures of a Crescent, and cost-effectively move these measures into models and useful graphics to aid in policy formulation (e.g., required monitoring and data-updates and reports; dependence on human food production or removing barriers) that balance competing demands and visions for each stream system, adjacent ones, and evaluation to stream-based riverine system influences.

Rural System (as suggested by Poff et al., 2003[60]) will seek funding partnerships, but will form a unique, membership-based organization for two Rural System Groups devoted to streams, and thus to climate dynamics and river ecosystems and their management. We understand the diversity and complexity of streams, and see riparian volumes as part of the effort needed for "whole stream" work—with assured payoff.

We know the needed monitoring to gain flow rates … one major function of the perceived "whole stream," and then to contribute to whatever riverine flow is encountered. With others encountered in stream-life interests, we'll hope for mutual aids as we discover and try to match species with conditions (using GPS and GIS) that may be replicated for increased species' safety and existence. We need to know that we can increase a limited population of aquatic or riparian volume species to become convincing in meeting the costly needs of effective species restoration, including "certified" past stream flow dynamics and their flora and fauna.

The stream or river is the performance measure of the working land system. It can be depicted by annual hydrographs and thermographs, both of which are primarily determined by the surface geologic and geomorphic setting, and vegetation cover of the stream sides. We know of and can model each of the fluvial processes—geomorphology, channel form and equilibrium, bankfull, hydraulic forces, sediment transport, sediment budgets, sediment sources, and even how geomorphic processes affect statements of stream health.

[60] Poff et al. 2003. River flows and water wars: emerging science for environmental decision making. Frontiers in Ecology and the Environment. 1(6):298-306.

We start at the top, along the mountain edge or crest. There is a mystery in the Crescent, faced by every forest worker who must mark for mapping the watershed boundary and the upper origin of a small leaf- and debris-hidden rural stream called the *headwaters*.

Pinning flags into the border of a watershed, or "Crescent," may be easy in rocky areas or tall forests. Just where is the center line where water (if even present) no longer flows toward the stream being mapped? Where is the place with the fewest steps that will allow an imaginary line to be cast where imagined water will move to a collecting center stream? Where is the point at which a stream most likely can be observed, and marked on the ground as the "start," or the headwater origin?

A headwater stream may be invisible for a distance. Some run under leaves, wood and soil, and are very much a function of visible topography or season of the year and time since the last rain... the stream eventually "shows." That place, a point, is unique and nascent, and will likely be changed with time and many factors. It needs to be marked, and the dynamics of the point need to be noted in order to understand the stream and the life within it.

Headwater streams are at the origin, a linear feature at the ridge or mountain top. The riparian volume stretches from below the running water to several meters on each side, and then to the top of streamside vegetation (the system of a named upper-length of stream, called a "reach" within some areas). The volume is likely to be a dynamic area (soil, litter, limbs, tree bole, etc.), contributing very diverse life and substances to the stream below. The edges, like forest "seeps," may harbor life forms unlike those found elsewhere in a Crescent.

Riparian areas of the Crescent, "where the terrestrial mingles with the aquatic, are special places... they have strong ecological connections to uplands and provide resources to the downstream system," wrote Szaro (1990).[61] We suggest work with the riparian volume of Crescents, perceived invaluable sites for the future.

We shall observe the distance from the stream to where aquatic and terrestrial amphibian assemblages rely on the stream and riparian habitat, and attempt to manage a zone of 10 meters from stream to ridge line. Larger trees ultimately lead to larger pieces of down wood, which form critical, diverse faunal habitat both on land and in streams. Tree growth is great where headwater streams are nearby. The streams provide continuous water, special habitats, high carbon capture in associated trees and soil, and ground cover.

Diverse salamanders need a minimum distance to move—from headwater stream elevation to up and over ridgelines—to achieve gene flow. Preservation/management is also needed for large trees for creating habitat at these high headwater sites for refuges and essential travel areas/zones for salamanders, terrestrial pulmonates (snails), and some key insect species—all related to micro-climates, litter fall, substrate mixing, sediment flow, and faunal diversity.

After study results, we are likely to see clearly the need and potentials for (1) protecting head waters; (2) making presentations, visits, and teaching about their differences, roles, and importance; (3) making new comparisons with forest seeps; (4) providing and assuring trail crossings with local protection; and (5) suggesting GIS analyses of potentials for "over the ridge" movements of diverse genetic populations within these type-1 stream sites.

A "Broke" Fishery

[61] Szaro. 1990. Southwestern riparian plant communities: Site characteristics, tree species distributions, and size-class structures. Forest Ecology and Management 33-34:315-334.

Much research in watershed management is needed. Local monitoring stations are needed, but the first order priority is for a fully-operational, highly interactive, permanently in-place and operating computer system to aid the practicing field person. It is now possible to rapidly digitize the watersheds of an area, or to use watershed boundary software that locates the "edges" of watersheds. These maps can become overlays for dozens of other GIS layers including slope, aspect, land cover, soil depth, and forest type.

The entire water drainage, within boundaries, may be digitized and analyzed. That is, all streams within the boundaries may be digitized, and third-, fourth-, and fifth-order watersheds delineated. Any areas which do not fit into these watershed boundaries may be divided into similarly-sized management areas. Worksheets may be produced for each watershed area; perimeter, and line length data taken from the digitizing process; and elevation data may be coded directly from the maps. The ownership boundaries may also be traced onto maps.

I've discussed the Crescent, the revised concept of land and water management within which streams exist. Fish live there, as do many other organisms and diverse resource benefits. Writing this chapter makes me sad, for I've seen vital streams in Piedmont Virginia, and mountainous Augusta County, Virginia, and have heard tales of trout in feeder streams of The James River. I've turned over rocks looking for seasonal insect larvae. Dr. Ken Hungerford taught me about the underwater walking bird of Idaho mountain streams, the water ouzel. I cried beside a stream near Oakridge Oregon, for I had known it at age 24 and knew others would not see it or understand what they saw, and that, working then to have significant impact on such beauty and functions for the future, I had been, and would remain, a failure. I did not have the tactics, tools, temperament, or power to save the stream… and lived a continent away. My possible impact on rural streams was small, germ-like.

Back home, I've tried to forget the shacks near the orange waters of western Virginia, and drives along streams beside coal-dusty modern houses, too-close to streams within the coal-fields. I try to forget the audience member of the late meeting who appealed for a clean stream cleanup so that people living along the stream could again be baptized there.

I knew a small, rushing mountain stream in a National Forest within my wildlife management area in Virginia. There were hundreds like it. Most of them had once held brook trout. Conditions suitable for the "brookies" had been lost, over-fished, and once-remembered "trout water" were stocked with brown trout, not the native brook trout. I had begun learning about "a fishery," a little like a system, with mixed objectives (being in mountain-forest, fast water, wanting "bites," being in touch with nature, past excitement, family tradition, possible contests with family, and contests with the fish themselves).

All fishery objectives are dependent upon natural forces. The angler is aware of the beauty of the adult fish and conflicted over whether his caught fish is "native" or "stocked," among dozens of other questions: stream scale and velocity, the floor beneath the stream rocks, new fishing flies, vegetation in the stream zone (producing foraging insects—fish food), and new challenges of disrespectful "other anglers" seeking an outing and not a fish.

Yes, a *fishery* is a thing—a whole sociological, hydrological, entomological, geological, ecological, ichthyological, ornithological, geomorphological, economical *thing*. So far it has had no clear objective, thus no means for feedback, and many obscure processes, inputs unsorted and unanalyzed for named uses, an uncompiled history, no standback to await the changes in groundwater and surface water before 2030 AD, and no one to name the context for the social challenges of a hungry human population in 2050 AD.

I learned, when working above that stream in Oregon, that every stream, especially every reach, was unique. I knew then that I did not *know* the stream—it could not reveal its complexities. And though I had known it longer than many others, it would not last; visitors would see only its edges, if at all; for it was now all dressed up with a parking lot. The fish were safe, never to be harvested or otherwise appreciated by people.

In some areas streams are problems, impediments … somehow abnormal, thus not natural. Some are not recognizable, so unwanted and so polluted that Total Maximum Daily Load of pollutants is written or said so often, people just mumble TMDL.

I've had wonderful drinks of cold stream water when I was a youth, camping in Virginia. I cannot now, for the water is too dangerous … everywhere. It makes me sad, not "crying sad," just childhood-depriving sad, fresh wonderment lost.

There can be only one way for a modern stream resource to emerge. It won't be justified only by counts of fish or counts of anglers. Not fish, but a modern fishery creates a *resource* and maintains it for many people, for many years, with many benefits. The needed and named benefits are associated with waterfowl, fur-bearing mammals, aquatic insects (seasonal), foraging snakes, raccoons eating crayfish (those crayfish just missed by a wild turkey), and anglers from near and far. Managers must consider, too, anglers' tackle and clothing, and their bait—whether handmade by wounded warriors or cast-aside late in the day at the stream edge as "worm pollution" (mixing the genetics of earthworm populations, local and distant, without an extra thought). Who can or will call *"danger ahead"* before the first trauma, or apparent wellness is lost?

In Rural System, we see potentials within a complex, comprehensive fishery. Not "broke," we need one that can expand to meet some of the food needs becoming clear in 2050 AD. The task is to expand a diversely appealing, job-creating, money-raising, Crescent-enhancing, recreation- and tourism-satisfying *modern resource.*

From fish, like the "canary-in-the-mine" may come our warning signal for the condition of Crescent areas and widespread land quality. Rural System plans elements of all of the above, for streams need to be seen, understood, visited, experienced, protected from a dozen challenges, and improved. Each fish species can tell people much about water quality. As a source of food for future human populations, trout streams are not the place to depend upon. Factory fish are needed to meet human food needs. Instead, the trout stream is our warning system, sensitive as it is to the conditions of the whole Crescent.

One in three Americans, or about 117 million people, get their drinking water from public systems that rely on streams.[62] Streams and wetlands provide many benefits to communities: they trap floodwaters, recharge ground water supplies, remove pollution, and provide habitat for fish and wild fauna. They're also economic drivers because they support agriculture, outdoor recreation, energy, and manufacturing. Science shows that streams and wetlands are vital to our health and the environment, so Rural System is committed to protecting them.

I visited China some years ago. That country's economic growth is reported to have been hindered by a shortage of fresh water. Experts there introduced a Water Agenda in 1998 to reduce shortages, pollution, and wastes, to increase better uses, and to reduce problems with

[62] Ortiz J. 2014. EPA and Army Corps of Engineers Clarify Protection for Nation's Streams and Wetlands: Agriculture's Exemptions and Exclusions from Clean Water Act Expanded by Proposal [Internet]. Environmental Protection Agency. [cited 2017 Apr 21]. Availble from: https://yosemite.epa.gov/opa/admpress.nsf/3881d73f4d4aaa0b85257359003f5348/ae90dedd9595a02485257ca600557e30.

flooding and erosion losses from storms. They are integrating water resource management and working with the private sector to solve water shortage problems, all while safe-guarding desirable socioeconomic development.

They understand the UN warnings about a great imbalance between likely water availability and use by 2030 AD. I think that Rural System, too, must concentrate on that date for all of the regions with which we work. In beginning a systems strategy, we approximate our objectives. Our general system objectives were discussed in Chapter 2, but each subsystem in Rural System must have its own clear objectives, including **The Fishery**. The modern Rural System fishery enterprise will work to:

1. stabilize or increase diverse, stream-related benefits and profits from meaningful work;
2. stabilize and enhance existing streams of Western Virginia to meet high standards of structure, function, and relations to their surroundings;
3. provide knowledge and services to repair, restore, and enhance streams that do not meet owner or government-sanctioned requirements and standards for healthy streams or their water quantity and quality;
4. minimize grief of fish removals (angling) and other losses; and
5. provide advice and services for landowners to gain economic advantages from their streams.

There are many prescriptions to be completed toward achieving these objectives. The primary ones include:

1. Implement minimum stream stabilization and improvement practices;
2. Work to achieve headwater stability;
3. Improve or redevelop forest and farm roads;
4. Carefully and precisely develop a *riparian volume* plan, protective of the stream, its surroundings, and benefits;
5. Implement a Crescent strategy with minimum silt as a monthly water quality requirement for the outlet waters;
6. Integrate local studies and work for the region near neighboring federal areas;
7. Treat each stream as a unique resource to be visited, photographed, analyzed, and characterized;
8. List and develop financial gains for each stream: art, pictures, booklets, special fish tournaments, tagged fish (rewards for capture), and paid visits to see and learn the fish of each stream;
9. Conduct high-school classes, and Eagle-scout and adult organization stream-improvement expeditions;
10. Develop a pattern for characterizing a stream and assign a numerical scale value;
11. Design signs identifying stream functions and workers;
12. Conduct bus-load visits of adults to streams with campfires and music; and
13. Teach units about **The Crescent Strategy** and **The Riparian Volume**.

The Riparian Volume

Riparian areas or zones are vital edges between terrestrial and aquatic ecosystems that have a wide range of ecological functions and associated social benefits. They're the land and community along the sides of fresh, unbound water. The lower 48 states have about 900,000

acres of riparian zones. Healthy riparian areas maintain cool water temperatures, clean water, stable banks, aquatic diversity, wild floral and faunal habitat, landscape connectivity, and water flow, while providing wood, other forest products, energy, fish, and recreation for people.

Riparian zones have vegetation and physical characteristics that reflect the influence of permanent water. Lakeshores and stream banks are typical riparian areas, but certain ephemeral streams or "washes" are excluded that do not exhibit the presence of vegetation dependent upon free, continuous water in the soil.

Within Rural System we shall use and promote the concept of riparian volumes. Riparian "zones," are really volumes with width, depth, height, and are very dynamic. The riparian volume usually supports vegetation significantly different from that of adjacent inland areas. Some people argue that riparian zones are ecosystems between the aquatic and terrestrial, but this concept omits the stream itself, inseparable from the riparian volume.

Eventually, riparian areas will have to be faced as *dynamic volumes* influenced by adjacent tree canopies; the bottom of the still-explored hyporheic zone beneath the stream; the stream and its parts, floor, and surface; the ever-changing stream age, edge length, elevation, width, and depth; and flora and fauna. The riparian zone is a dynamic, 3-dimensional volume to be investigated… forever.

The Context

In general, Earth has an abundance of water. But only 4% of this water is fresh, and three-quarters of that amount is frozen in polar ice caps. That leaves us with just 200,000 cubic kilometers of useable freshwater, less than 1% of Earth's total freshwater resource. Most of this available water is found in groundwater aquifers, rivers, and lakes. The fishery works on the spaces and volumes of streams feeding and being fed by the groundwater.

Rural System plans to create an enterprise that profits from analyzing, restoring, and continuing to manage small streams on private lands in a region of Virginia. We will characterize and document our work, and provide the landowner with certificates that can be sold to a specialized stream-mitigation credit bank. We shall work with such banks.

Developers in the region may significantly modify streams in their construction, but are required under law to mitigate those changes or losses. They can avoid such losses, make changes on-site, or they may buy credits from the bank. The credits certify that within the relevant watershed and/or region of Virginia, a stated number of linear feet of restoration (dimension, pattern, and profile) and/or linear feet of enhancement (in-stream structures, bank grading, bioengineering, matting, and revegetation) have been developed. Habitat types (riparian hardwood forests, wetlands, etc.) present are specified as required for some mitigation.

We shall offer services to highway, airport, railway, governments, and other developers who impact streams credits through **The Healthy Streams Group**. Developers now need stream mitigation under national and state laws, personal concerns, and "green" policies. We'll supply guaranteed, full credits under Corps of Engineers and DEQ standards.

We shall market stream work to private landowners, showing direct economic returns to them from our action, stream improvement for personal use, improved livestock returns, reduced soil losses, improved groundwater recharge, an improved fishery, improved wildlife habitat for many stream-related species (e.g., bear, fox, bobcat, raccoon, mink, waterfowl, several songbirds), enhanced scenic and land-sale value, reduced risks (flooding, suits, etc.), and access to several funding sources within Rural System related to streams and nature study.

We shall differ from other, similar groups in years of experience, fundamental knowledge, available software, and GIS developments of stream and watershed characteristics and surrounding lands. We are also concerned with carbon credits on the same areas, having ancillary work units for later development, and having a vision for the whole future enterprise. While working hard to slow climate change, we have within our plans preparation for responding to increased storms, droughts, and water pollution problems that are becoming more frequent and severe as temperatures rise.

Managing the Streams

Rural System will deal with total stream systems, a major part of which is the total fishery. Only one part of the fishery will involve geographically-focused, scientifically-based work to protect, restore, and enhance the freshwater stream aquatic habitats and the watersheds upon which they depend.

We know that stream watersheds are very variable and contend that each is unique (hence Rural System Crescent management). To study a group of such basins is to encounter extreme variance in most statistics. For example, fish assemblages are variable, and they depend upon highly variable food supplies, though many are substitutable. To detect differences in fish or fish food in a stream watershed resulting from a timber harvest or change in range management is unlikely, largely because of such pre-existing variabilities. Logging effects are largely a function of surface topography (as well as the loggers' activities). To generalize about such effects will be difficult, for it will require many streams and many years of data to account for the variations known to occur.

As we study streams, we find some that need restoration. Rural System defines restoration not as change to a historic condition, but to a condition meeting the many objectives of Rural System, i.e., temperature, sediment load, structure, biological life, oxygen level, and low toxic substance levels. Typically, these together form a standard of the quality of faunal space for game fish, but within Rural System, we create and market a *spectrum* of potential stream benefits and services.

More generally, we seek fairly natural or primitive conditions and a rich stream fish community. We expect high variance in fish richness and abundance within stream reaches. We therefore continue to study and seek to express precisely the objectives related to stream restoration, subsequent stability, and productivity of many benefits. While scientific foundations are needed for decisions, there are other dimensions of accumulated experience, as well as anticipated financial gains, that need to be articulated in plans and project descriptions.

We propose providing analyses of the economics of stream ownership and restoration for owners. We shall provide a monetary estimate to both gross financial gains from stream and riparian stabilization, and especially an estimate of financial losses mitigated, influencing *net* gains.

Many forest streams provide esthetic benefits and increase land value. How forests are managed can influence forest streams and thereby influence:

- water quality (and costs of cleanup);
- groundwater levels;
- riparian (shoreline) vegetation;
- fishing quality;
- many related bird, mammal, amphibian, and insect populations;

- many wildflower and other plant species; and
- sediment collecting at the mouth of rivers of the region.

Forests contribute to the organic matter in streams, thus to the food of insects, crayfish, and other creatures, as well as to the fish that feed on them. The bark, twigs, leaves, etc. that fall into streams contribute 70-80% of the food energy of these creatures within the water. The volumes of insects falling into the water from overhead vegetation are even more important to the fish than the insects living within the water.

Vegetation over streams, particularly that providing shade between 10 AM and 2 PM, is critical in regulating stream temperature. Trout require cool temperatures; other species require warm water.

Forests, when well-managed, can reduce sediment in streams. Particularly hard on some organisms, sediment fills in pools (critical habitat for large fish), and buries spawning and feeding surfaces. When sediment loads in streams increase, streams become wider, have less shade, and water temperature increases. In the stream, as elsewhere in the forest ecosystem, one change usually produces several other changes. Stream sediment, as little as 17 parts per million, can have harmful effects on fish in streams. Any improvement in reducing stream sediment will probably increase the life in the stream. Bridges, crossings, culverts, and interior road ditches can be very harmful in producing silt.

Streams in the mountains are complex and diverse, strongly influenced by large wood that is within them or at the edges. Large wood creates pools, stores inorganic sediments and organic matter, and creates a stepped channel profile or gradient. Wood causes abrupt and persistent changes in channel patterns and positions, and is the major structural element responsible for backwater and side-channel formation.

Large wood maintains spaces for fish by altering the stream velocity, providing volumes where fish may feed and trapping biological matter, giving many organisms an opportunity to feed on or otherwise process it. Wood also provides protection to some forms from predators, shelter during high winter and spring flows, and an important attachment and feeding surface for invertebrate animals.

By placing large wood and boulders in streams, channels can begin recovery and fish populations along with them. Streams need to be "stair-stepped" with rocks, large logs, and tree limbs to reduce water velocities, reduce scouring, and to form and maintain pools.

Landowners who preserve forests are therefore also potential fish habitat and groundwater managers. By making small streams stair-stepped, forest owners increase groundwater recharge and (most importantly) reduce channel cutting or the depth of small valleys. The lower the stream, the lower the groundwater. The lower the groundwater, the lower the forest site index, a measure of how productive a site may be for tree growth. We might count the large pieces of wood along a 1,000m stream reach (or reaches) and find, e.g., 210 pieces. After 10 years and stream restoration, the count along the same stretch might be 2,200. Comparisons of fish numbers in the same stretch might show increases over the baseline condition.

There are many studies performed and within our files. Many of those are rich with descriptors (e.g., channel-as-pool; stream order) and need to be used consistently to develop, within VNodal, a current, changing, and probable picture of each stream, related populations, and their financial derivatives… to achieve (then protect) its full resource potential within the next 40 years.

I have emphasized cold-water streams and their fishery in this section. Equivalent and over-reaching emphasis is suggested for the farm-pond fishery, typically of warm-water species of fish. Stocking fish in warm-water streams is not recommended, since most streams, under normal circumstances, will be supporting the population that it is capable of maintaining, unless conditions in the steam have been altered recently. If the stream is near its carrying capacity, the newly stocked fish could upset the delicate natural "balance" between predator and prey species. This could cause a reduction in prey species which, in turn, would result in the reduction of predator species to a level below that which existed prior to stocking. Stream fish populations also tend to move within a stream. A fish released at one point might not set up population abundance until it has moved several miles, upstream or downstream, from the point of stocking.

The Rural System Pond Fishery: Angling for Profits

The farm pond is only one part of a complex rural fishery, and that exists within a complex pond cluster and small-lake aquatic resource presence—our local **hydro-system**. We use the phrase *hydro-system* to designate (for local use and ease of discussion) our on-going linkages of:

- Ponds with streams;
- Streams with headwaters phenomena;
- Headwaters with Crescent-Area boundaries;
- Crescent-Area concepts with conventional watersheds;
- Watersheds with interior “permanent” wet areas (seeps, etc.);
- Seeps with riparian zones and volumes;
- Riparian volumes with small nearby water sources (pipes, channels);
- On-site water sources with transported groundwater and others;
- Other imported waters with all types of precipitation sources; and
- Deep waters with fish and other aquatic organisms.

Rural System’s hydro-system concept is complex, encompassing everything water-related, including ice and fauna relations. The hydro-system is large, diverse, seasonal, and variable. We design and shall use a comprehensive means for rapidly and reasonably analyzing rural ponds, then to use those analyses to build a lasting human food supply of fish for regional populations, along with clean water, jobs, and recreational resources.

The work of **The Fishery Group** is part of an integrated plan for a large number of existing ponds on enterprise environments to be managed together, as part of a regional fishery. This Fishery Group has separate, first-order start-up potential, unlike the clusters of interactive work needed for many other planned Groups. We shall work toward an integrated program, fully aware of the enormous number and diverse scale of factors affecting our pond-portion of the potential regional fishery, i.e., air and water quality, climate temperature, soil management, pollution prevention, wild fauna and flora, treatment of each “catch,” and human resource uses within and around each pond.

The pond, a distinctive part of the rural setting, is capable of serving many functions and providing many benefits to owners and other citizens. We know that hundreds of ponds have been built throughout Virginia and continue to serve many roles and provide many benefits. However, we have learned from conversations with owners and personal observations that the

ponds change in importance to owners, and change physically, ecologically, and economically over time. We have accumulated a large library and seek knowledge of many aspects of ponds to reduce the disadvantages, costs, wastes, and to increase the benefits and noteworthy profits as part of Rural System objectives.

Ponds, seemingly similar, are each unique. Often the landowners' objectives, as a set, are also unique, and when combined, can create a truly unique entity within a region. One strategy of pond management is to ignore the unique qualities to achieve economies of scale, and *cluster* ponds together (conceptually, if not physically) in size, shape, public information, marketing water qualities, access, desired harvests or benefits, and proposed uses.

The Fishery Group analyses will begin with gathering physical descriptions for GIS-mapped county-locations, followed by detailed, computer-filed characteristics and understanding of each pond and the factors and processes affecting them, individually and in clusters—especially the fish biota, and their numbers and weights within them. The ponds, when managed in clusters, will each be recognized as related, but each will be treated as very special or unique for particular customer bases (e.g., winter ice-skating).

In 2016, eight authors suggested an action framework of four items for profitable pond management:[63]

1. Establish a water quality objective;
2. Quantify the difference between the present condition and that objective;
3. Assess the catchment sensitivity to change (as from Crescent or watershed activity—the balance between watershed and pond or catchment basin); and
4. Determine when the buffering capacity of a system will eventually reach a threshold (saturation) level, i.e., "the point at which small changes in the inputs to a catchment cause a rapid change in the aquatic ecosystem."

We propose to develop an operational system for rapid field analysis of a series of basin analyses to provide timely, on-site analyses of pond conditions related to fish habitat suitability, as well as that of other flora and fauna. The buffering capacity determined for the pond will determine the likelihood of achieving/exceeding the target of soluble phosphorus from landscape changes (cultivation, etc.). Our pond analysis system (PAS) will be a special, profit-oriented, pond-specific enterprise purposefully linked to water quality, and evident payoffs from an improved, intensive land use—the "farm pond" —year-around, long-lasting.

Not only for analyses of Rural System ponds and their dynamic changes, the PAS has been designed as a for-profit land-analysis unit, functional for ponds in the regions around Rural System. PAS is a planned system for precisely describing a mapped unit of land-use allocation, and preparing for investment in the potential benefits from parts of any local land ownership. It will grossly address basic Alpha Units with location, adjacency, and depth aspects. A three-acre pond, for example, has 120 such dynamic water and land "columns." Three-dimensional pictures will aid staff efforts toward forming pond clusters for diverse fish, characteristics, user preferences, access, and reliability. We know of over 500 federally-funded farm ponds in Virginia, and similar numbers exist in NC, SC, and Maryland.

In general, our working premise is that a fishery is a profitable resource enterprise for the region. Underlying our premise, fishery ponds of our target lands need intensive management to be profitable over time. Readily retrievable knowledge is now available, but must be collected

[63] Donnacha et al. 2016. Optimizing land use for the delivery of catchment ecosystem services. Front Ecol Environ. 14(6): 325–332. doi: 10.1002/fee.1296

and addressed to each pond, often and as needed. That knowledge needs to be used with feedback for pond plant productivity—basic to local fishery productivity—and needs to be further developed within the context of the stream fishery to achieve hydro-system-level economies of season, scale, and scope.

Our pond evaluations shall proceed systematically:

1) We shall compile physical descriptions (including GIS location), leading to understanding the factors and processes affecting each pond, and especially each fish population set.
2) We shall group ponds into clusters for management to reach economies of scale.
3) Next, we shall test and perfect the tools and reports about each pond for land owners and others.
4) We shall then compare ponds, and build models that unify that knowledge for predictive uses, especially for new demands for products as factors outside of ponds change.
5) We shall study and devise means to maintain and improve our present library and required knowledge base for use in models supporting prescriptions for pond-specific action.

We are statewide in orientation but focus first efforts within the Roanoke-Botetourt and Blacksburg areas, then expand westward. The "pond" scale quickly requires Crescent analyses, and these, like the ponds themselves, require Alpha Units. The *clusters* of ponds will bring in sub-regional analyses as we develop markets for anglers and others for fish-protein consumption.

We'll make cooperative-wide reports of activities and progress. Prescriptions, however, will be reserved for the Land Force use at each pond, and are somewhat proprietary. We'll summarize characteristics annually. We'll study the role of a Rural System annual report and the place within it of the ponds report. These may be seen as part of a growing knowledge base that itself may be available for use at some fee. Rural System will generate an occasional report of regional conditions that we shall infer from the ponds treated as regional samples.

We plan to employ intensive social media marketing, including YouTube videos, podcasts, and a fishery blog, and will actively explore creating mobile apps for fish products for customers of various types, as well as active angler recruitment and satisfactions. Visitors to Fishery Group ponds and pond clusters will be able to purchase fish food to scatter and view fish action. We shall seek cooperative relations with restaurants for use of our fish, and use pictures of customers enjoying fish, some of our fish on display in aquaria, and high-quality fish photos to enhance our branding. We may harvest algae for soil composting and eventual sale. After Rural System becomes stable, we'll be able to provide a membership price for year-around services within our pond clusters.

As in other enterprises of Rural System, I'll encourage branding of and enhancing recognition of our resources. In this case, the ponds themselves will be pictured and explained as enhanced by fish and fishing, and later by direct sales of processed fish, lessons for understanding them, and even cooking ideas. We shall work on the idea that people like food and experiences that come along with a story.

Only the conceptual, perhaps novel framework for the hydro-system, is sketched here for development in the near future. A diverse market can be created, with unique qualities and with productivity justified on the predicted needs for human food in the next several decades. We shall add esthetic elements of the ponds, recreational events, sporting contests, and diverse angling invitations for public sport, education, and recreation. Together we shall add an array of

services (i.e., keeping fertilizers out of ponds). Rural System plans to expand the full opportunities of a model national, regional inland fishery with abundant, diverse, profit-based enterprises and social benefits.

We perceive we are in a modest type of competition with state and federal fishery resources, but we offer differences for anglers and others. We shall actively use public resources of fishery scientists and public information and resource findings (treating these as public offerings, from agencies such as the National Cooperative Extension Service—as variable and as public as history, law, libraries, histories, etc.), public awareness, volunteered assistance such as in law enforcement, and in fish stocking—general approval, sharing of objectives, and illegal action observed.

The Fishery Group of Rural System is intently and specifically involved, year-around, permanently, in directly managing a geographically-specific fishery resource—that from each cluster of ponds and streams managed by Rural System. The fishery resource will be local, dynamic, and designed to meet the needs of many people.

Our Group title, "Fishery," does not suggest our emphasis on human needs or the total system upon which living populations depend, over many unnamed years. Our interests are not trivial, but tend to be inclusive with those for the total, diverse fish-related resource, much of which is on or over private land.

We hold that we are managing to meet the abundant "fishery" benefits potentially available from that *private* resource (other than state, federal, or oceanic). We hold the resource is private when most life time of each individual of each species is typically spent involved, and dependent, upon a named, freshwater impoundment or pond, largely or wholly owned by a private land owner.

We are fully aware of the complexity of the fishery resource, and work within the fishery—*the whole system*—well-aware of its size and complexity, and our limitations. We shall be aided by an active field and laboratory staff using modern equipment and computer efficiencies, well-planned action, and full response to the demands of "a systems approach" to a large, complex, evolving private-land-based natural resource: The Rural System Fishery. We plan to implement well that complex fishery, year-around, for bounded profit for at least the next 150 years, sliding forward a year, annually.

Water: Specific to General

We know of "water pollution," but not everyone knows of "non-point sources." Rainfall or snowmelt from suburban lawns, golf courses, and paved surfaces pick up and carry away natural and human-made pollutants, depositing them into lakes, rivers, wetlands, coastal waters, and ground waters. Roads, parking lots, sidewalks, homes, and offices now replace natural landscapes. Rainfall that once soaked into vegetated ground now becomes "storm-water runoff," which flows directly into local waterways (where some fish may remain).

As more natural landscapes are converted to impermeable surfaces or managed turf, storm-water moves across them. We need to stop pollutants, especially non-point sources such as sediment and nutrients, to vulnerable streams and, for example, the Chesapeake Bay. Storm drains on street corners need to provide water filtration. We now must exert efforts to retroactively address storm-water runoff from existing impervious surfaces, and address how to stop destroying water quality.

Will we be able to obtain more fresh water? Yes, gained at high costs by modern technology; or in Virginia, for example, it will be moved cross-country from mountains' rainfall to coastal beaches, for dense urban uses, and there packaged for energy-costly return trips, to Central and Northern Virginia. The coastal cities have inadequate supplies of fresh water, and high demand for water now abundant in the mountains.

Discussions and conversations about water bring phrases like "our beaches," "our coastline," "our clean water is going where?" and "…says who?" Then emerge pious thoughts about unified regions, state conglomerations, and 190 or more countries of the United Nations. I begin to wonder if water rights and solutions therein might *ever* be resolved, or those of Virginia, or those of the range-lands of Western United States where water was scarce even within movies of yesteryear!

Rural System successors will, as have farmers and developers of all similar lands and waters, encounter public and legal dimensions unimagined… but ever-present. My optimism for people of the rural future resides in current databases and knowledge of the Earth—now as never known or realized before. People can now see the dynamic part of the world in which they live, their adjacencies above and below, as well as mapped edges, and zones for seemingly inevitable conflict.

As never before, people communicate (reluctantly or not) and have GIS capabilities for seeing and working with the Earth's surface. We can move to clear, agreed boundaries and explore the wonders of the measurable benefits of family, community, coalitions, and conditional units. And now major, robust technology allows us to live within conceptual 3-dimensional Earth … it is very deep, Earth-around, and stretches far above into the atmosphere. Now, as never before, we can conceptualize this and we need not make a mess of it!

We know so much, and have opened the knowledge-book for everyone. We need not suffer now, for I believe we know enough to survive on Earth. Within 50 years, after 2050 AD, with wise investments into water system knowledge using what we know now, we may soon develop a structure for alternative advances and continued action against disease, ignorance, pollution, and multi-dimensional wastes. We may further take actions promoting/supporting multi-resource limitations and intensive management, limited human population, functional energy access, and the elements of **"Decent Work"** (Appendix 3).

In view of the year 2030 AD from here, there may be wisdom and excitement for the elderly as they study, plan, and invest for their Earth-conscious, respectful children …who have grown fearless of the presence and effects of radio-nuclide poisons in their waters.

Lunar Forces

This unit is preliminary and exploratory… an invitation to think about and perhaps investigate some of the possible lunar forces. It merely attempts to share some observations and ideas, and invite involvement in further work to create the necessary models to add information on lunar forces rapidly and conveniently into the dynamics within Alpha Units. There is a need to clarify the role of the Moon in ecosystems. The working hypothesis is that there are several lunar forces, and that they have profound effects in several parts of the forest. When involved together, they may be massive. Our hypothesis is that if the moon's forces were better understood, they could be used as independent factors or variables in developing explanatory and predictive models. If we can isolate and measure the forces accurately, we may be able to gain substantial statistical control over variance in several parts of the ecosystem.

We have found the Moon phase calendar and many other light and tidal influence resources, and we now see ways to integrate these factors into forestry, fisheries, gardening, and related activities. Not only for general interest, we propose to collect data on these factors and their relations, and display them for public interest, local tools and suggestions, but also for widespread "branding" of our functions and region roles.

Later we may explore gaining an aerial photo or space-image of people of the region shining night lights, clearly indicating the populated areas. The Earth, as seen from space at night, is amazing. Night Earthlights may affect migration and other faunal phenomena. Night glow, 25 times brighter than light from a full moon, affects pollution levels the next day. The perspective from outer space may be useful. Rural land managers do not know much about lunar forces, but who among them can risk evident study, given the negative connotations of "lunatic."

The gravitational attraction of the Moon and the Sun on the Earth's oceans cause the ocean tides to move in and out (from high to low). Because the Moon is nearer to Earth than the Sun is, it has a greater effect on the Earth's oceans.

The Moon's diameter is about 3,480 km (about 2,160 mi), or about one-fourth of the Earth's diameter. The Moon is influential within ecosystems, but we have not yet identified all of the ways or magnitude. Of course, it is not as important as the sun, and probably its influence is linked to many other factors (depending on the organism being studied). A usual situation in the field is to develop an equation that has some good predictive ability (it may explain 60 to 70 percent of the variance), and then managers are forced to say there were other factors involved. Just maybe, another factor was the moon!

A working resource expert, it seems to me, should not neglect an evident factor and seek other minute and unknown factors. Fame may come with such discoveries, but fame is a longshot. It seems unwise to accept variance as natural… as if wed to probabilism, as if giving up altogether to determinism. Variance, itself, may not be a natural phenomenon; maybe it is only what we see and settle to call "variance." There is no need to treat variance as mystical. It seems to me that big chunks can be removed from the variability in most systems by including explanatory variables within models. At least lunar forces, clearly cyclic and "non-linear," can be studied with new analytical tools, dropping the linear assumption in past analyses. Perhaps the moon, source of one of the variables of systems, can be included in future models.

The moon is typically listed among the abiotic factors of the environment. There are many biological correlatives with the moon, suggesting, partially by the diversity, that there is something at work in the ecosystem that is quite profound. Moon phase is only one observed phenomenon of the moon. I prefer and suggest discussing "lunar forces," for there are many. It

also happens, as elsewhere in ecology, that the moon does not act alone. Some phenomena are moon and solar pairs.

Most animals are night-users. Lunar forces (moonlight, etc.) are probably at least as important for these animals as any daylight. Insects are well-known to be related to lunar forces, and thus the food supply of bats and night foragers is too. A lunar forces map may become the key to controlling some variance in animal studies, such as trap response. Night is the profound wildlife cover, and cover can vary depending on the lunar forces.

Lunar force measures include:

- percent of visible disc illuminated;
- distance from the Earth (gravitational) at a specific time;
- relative light intensity (log(x+1));
- duration of light (minutes);
- cumulative light per 2-week period (with and without sunlight);
- duration of visible moon above the horizon (minutes);
- moon visible (yes/no) within an Alpha Unit (related to location and aspect);
- moonlight on a slope (and related to topographic shadows, related to predator-searching/prey-hiding conditions);
- angle above the horizon;
- shadow length cast (related to law enforcement);
- light during the growing season in each Alpha Unit;
- tide heights and timing (especially my local premise of tides within springs and perhaps within deep coal mines); and
- time since New Moon and Full Moon. (Heavy storms in the northern hemisphere tend to occur within 3 to 5 days after a New Moon and in the same period after a Full Moon.)

The Moon is not one ecological factor. There are many moon-related factors, as suggested here, and these factors need to be studied, some rejected, and those having relevance included in ecological studies as "constants," or things over which the manager has little control. The manager may not be able to change the Moon, but he or she can use knowledge of it to explain the differences observed in areas in animal behavior (land and water), and to move or acquire areas that have desirable conditions.

The ability to compute a value for all of the above parameters is not yet available. A program may someday exist that, given relevant times and locations, can produce values. Elements of Rural System will work toward finding, compiling, investigating, and relating these independent ecological factors into useful projects as soon as possible (related to staff, limited equipment, and travel to designated viewing sites, day and night).

Chapter Eight

Forests: Trees and Things

As with other rural topics, "forestry" is a complicated, multi-valued topic, ranging from the spiritual and poetic through to optimum growth, harvests, protection (from multiple enemies), harvest procedures, and international export issues. It beckons to many as a word-banner for conflict, touching topics well-beyond establishing, growing, and harvesting trees. Various definitions argue for forestry as a science-based profession, others just wish for a good day afield within tree areas, leading to good days in the office or lab with purpose, recognition, and increasingly sophisticated, efficient forest management for responsible public and private owners.

Forestry objectives and their intensity all differ and change within forestry groups, and groups differ on optimizing systems to achieve them—the methods, the available data, the corrective processes and rates, the past and the future. "Forests" are so beautiful! Money trees must be simple, success so easily satisfied and readily achieved!

I suggest a modest "not so," and a possible awareness (not a definition) of forestry as conceived and practiced by Rural System: a complex, modern, fully-integrated system, devoted to bounded, long-term profits with many, many active premises and constraints toward achieving objectives over the near future, i.e. 150 years, sliding forward a year annually. Given the complexities, we consistently use "forestry" to mean all of the practices surrounding intensive management of private land systems that have a predominant surface-cover of any age trees (i.e. even zero, as in just harvested and replanted).

Central Appalachian regions are still largely forested. Much of the ownerships mapped by GIS software will consist of trees, or places where they once lived and were removed by people. Each of these maps will display "Context": the whole forest and its surrounding, even outside the boundaries of the managed ownership. Rural System shall typically work toward a current description of forest stand areas.

As previously mentioned, each map will have Alpha Units dividing the land into unusually small, "micro" land and water management areas. Within each Alpha Unit, we shall develop dozens of other data sets such as slope, aspect, elevation, distance to roads, distance to ponds or streams, time since fire, and literally 50 or more other factors (including tree species). I tend to think of Rural System work as a special kind of precision forestry, with decisions and results considered in a long-term context: 150 years. Our forest investment is not always in the trees themselves, but in their alternative rooting sites, uses, investments, surrounding scenery, streams and wild fauna.

We plan to GPS-locate each tree within each Alpha Unit in our GIS database, with a site specificity previously rare or unknown. We shall eventually be able to quantify influences from adjacent trees. Species, bole characteristics, approximate tree height, and leaf-area index will all be measured. We may need approximate tree height, but we are most interested in the provable bole and the hexagonal canopy area of each tree stem. Ours is very intense, individual-tree work, almost personal, forester-to-tree relationships. With technology and refined marketing, each tree

may be valued for its role in carbon sequestration, harvested or used products, and the biotic and abiotic "surround" each tree contributes to Rural System forest management objectives (e.g., shrew populations in the forest floor, dispersed bird nests, seed beds within Alpha Units, or shade for recreationists).

Rural System will develop preferred-species maps for whole forest-system resource management, with multiple benefits from forest fauna species as well as trees. Whole forest-system management considers many variables, such as water (Crescent management), useful wild fauna, edible fungi, scenic vistas, interior forest gardens or recreational resting places, arboreta, and winter areas for deer.

We are sensitive to soil compaction increasing taproot production and significantly increasing the ratio of above-ground to below-ground biomass. We shall operate knowing decreased root production will decrease carbon and nutrient stores below ground, which may impact future site productivity. Now we know the specific gravity of each species, thus the relative carbon content of a measured volume of each tree standing, and within VNodal we shall make estimates of the diverse, ever-changing values of each tree (within dynamic markets).

The Forest Group will manage areas within ownerships and clusters to provide significant, expected proportions of bounded, present-discounted, annual net gains from ownerships over the 150-year planning period. The Group will add value to harvested wood by its sequenced procedure from seeding and germination to product transportation, local and international marketing, and (within a dynamic program) obtaining public grants for capturing and storing carbon. Within the growing periods, over several years, each tree will be planted within a bee-hive hexagon pattern. These are planned to be The Forest Group's "favored-trees" —those well-spaced, properly located, with scheduled growth, maximum lasting sunlight exposure, high protection, and foot-trails for efficient study, education, wild fauna management, and fire control.

Within Rural System, we shall start forming an approach to the complexities of "lands with trees." We know that land has value more than trees do alone. We shall work toward benefitting from those values, and enhancing them for the ownership, with extra benefits to society through knowledge. The Forest Group will increase land value in many ways:

1. The real estate value of the ownership (Chapter 12);
2. The value of sales of all types, including forest products and hunting of forest species;
3. Benefits from the interior of the forest, such as agro-forestry, recreation, water quality improvements and other diverse watershed benefits, carbon storage, tree growth increase, and modest, diverse, recognized benefits of active wild fauna being present, helping make the forest ecosystem "work"; and
4. Spiritual and aesthetic benefits, and citizenship and stewardship values—unquantified but strongly asserted, and of great importance to some owners, visitors, and real estate agents.

Unquantified and therefore less convincing, we can casually list significant other ways of adding value, as with species selection and care, increased forest soil quality, managed evapotranspiration, increased stream stair-steps within rugged terrain, and later, carefully, stored or sequestered biomass supplies for meaningful use, minimum pollution, and balanced stable production over the typical, long planning period for land with trees that may reach a size for *a reasonable financial return*, if harvested.

We shall compare probable real-estate values of tree stage on land to that of the land values without trees—the probable, differential managed tree values over time. We propose to study that criterion, for within Rural System we shall begin with the soil of the tree seed or local seedling, observed and understood in the context of last major events. We shall return to that, cost-effectively, after automated, kilocalorie-labeled firewood splitting and packaging; evaluation of markets; branding of superior Rural System wood and wooden products; sustained marketing and delivery; and arboretum and cemetery-grove management.

As one example of alternative forest benefits, woody debris on the forest floor—rarely of note or question—may provide fuel for heat and electricity. It might reduce the flammable material on the forest floor, provide a local niche market for wood, and reduce several local, wild faunal species. (We shall limit our wild faunal population investments in each forest to the estimated seasonal population needs over time, maximizing *neither population richness nor abundance*.)

Debris, as an energy source, costs too much for recovery, but that qualifier may change with price, equipment, access, etc., and it may become a competitor for other renewable energy sources. (The ecology-minded public no longer debates the value of forest fauna of dynamic debris volumes.) Rural System will explore "co-firing" —combined use of coal and wood—but past studies of biomass removal show the ease and speed of *excessive* biomass removal; some debris is essential for full-scale carbon storage, soil-carbon enhancement, and vital, lasting soil structure built by a coterie of life forms. (We shall study mice in the forest, now convinced that they spread essential micro-organisms under the forest surface that lead to needed moisture, freezing, and extensive rooting structures and functions.) We shall proceed, trying to avoid the risks and the high costs for superior soil functions, especially on Crescent areas (Chapter 7).

The Forest Group must manage each forested and designated-to-be-forest Alpha Unit on each ownership (about 1,230 Alpha Units in 30 acres). The Group will add jobs to the region, intensify *forest-other* action (actions enhancing values from non-tree parts of the forests), exploit data and software now available, and may provide additional learning spaces for citizens as well as guests.

The Forest Group will follow first steps toward optimizing long-term forest management with computer decision aids. VNodal will factor in probable future market prices for the targeted wood production and atypical products, such as mushrooms, soil amendments, floral supplies, or interior recreation, all with sound monetary dimensions and real constraints, specific to each forest stand—a feat previously almost impossible without computer assistance. The major active dimensions of Forest Group work will include:

1. Wild fauna resource management (e.g., insects, mammals, birds, fish, and amphibians);
2. Non-timber forest products (e.g., herbs, flowers, soil-amendments, and wind protection);[64,65]
3. Soil improvement;
4. Intergenerational land-value enhancement;
5. Timber harvest and future-energy forest creation;
6. Improved local forested-land taxation;

[64] Emery MR, McLain RJ. 2001. Non-timber forest products: medicinal herbs, fungi, edible fruits and nuts, and other natural products from the forest. Journal of Sustainable Forestry. 13(3/4).

[65] Jones ET, McLain RJ, Weigand J (editors). 2002. Non-timber forest products in the United States. Lawrence (KS): Press of Kansas.

7. Analyses of state and federal cost-share programs (e.g., fire control, watershed and Crescent management, and carbon storage); and
8. Managed, diverse, group-related outdoor recreation.

Some awareness of the scale and scope of the "tree-resource" are broad-brush sketched in semi-recent studies. For example, from a 2007 report on Virginia forests:

> In 2005, roundwood (the truck-delivered to a mill; a tree bole, no limbs) output from Virginia's forests increased 3 percent to 503 million cubic feet. Mill byproducts generated from primary manufacturers totaled 179 million cubic feet, 5 percent more than in 2003. Seventy-three percent of the plant residues were used primarily for fuel and fiber products. Saw logs were the leading roundwood product at 228 million cubic feet; pulpwood ranked second at 200 million cubic feet; composite panels were third at 57 million cubic feet. The number of primary processing plants declined from 234 in 2003 to 196 in 2005. Total receipts increased 5 percent to 515 million cubic feet.[66]

A more recent study (2010), commissioned by the National Alliance of Forest Owners (NAFO) and conducted by Forest2Market, "quantifies the economic impact of private, working forests on the U.S. economy. The study found a significant gap between the contributions made by privately-owned forests over other ownership types. On average, they generate $277,000 in state GDP per 1,000 acres, while public forests generate just $41,000 per 1,000 acres."[67] The message writ-large: "Here is a reason for people leaving the rural environment," but also, "Here is a place for major positive gains!"

Sixty-two percent of Virginia, or 15.72 million acres, is forested, and 66% of Virginia forest land is privately owned.[68] Of this area, figures differ on access and whether the trees can or should be harvested. Virtually all private forest, 10.38 million acres, may be the working domain of Rural System. A more modest target of half of privately-owned forest land being brought under sophisticated, profitable, modern forestry is seen for Rural System's Forest Group.

The local forests of the absentee owners' lands, with which we propose to be working, are now recognized by professional foresters as in poor general condition—linked to climate forcing, air pollution, grazing, exotic species invasion, habitat loss, shifting uses of wood and wood prices, and challenges from neighbors for other uses of the land while growing trees. To those are added: multi-source fires, recruitment episodes, inadequate advice, excessive haul-distance costs, unstable markets, regional insect attacks, and historical impacts of price-change on forest composition and structure.

Preliminary Gross Description of Management by The Forest Group

We are developing, for field-testing and VNodal production, a likely standard of forest management presenting available information about *each local property*, declaring objectives,

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[66] Johnson TG, Becker CW. 2007. Virginia's timber industry-an assessment of timber product and use. Resource Bulletin SRS-125. Asheville (NC): U.S. Department of Agriculture, Forest Service, Southern Research Station.
[67] Kinney SA. 2009. First ever study quantifies the economic impact of private, working forests in the U.S. [Internet]. Forest2Market. [cited 2017 Apr 22]. Available from: https://blog.forest2market.com/news/first-ever-study-quantifies-the-economic-impact-of-private-working-forests-in-the-u.s.
[68] Virginia Department of Forestry. Virginia Forest Facts [Internet]. [cited 2017 Apr 22]. Available from: http://www.dof.virginia.gov/stateforest/facts/forest-facts.htm

and listing and outlining system components for all tree species and other likely life forms. It is quite long, and so not appropriate for display herein. The Forest Group faces managing a major part of regional rural land, *the land with trees,* but within the context of the relatively small ownerships and the total System, while contributing to annual profits.

We shall analyze regional and state deforestation and degradation; hindrances to forest management; consumption and production patterns; local poverty and its influences; pollution; terms of trade and trade practices; policies related to energy, water, agriculture, indigenous people; and sharing of benefits (as in Rural System memberships). We shall work to influence the chief factors affecting trade in forest products and services, such as "certification" and the dynamics of forest taxation.

Using modern technology, well-established principles and tools of forestry, and a new concept of the privately-owned total land system, The Forest Group will unify a list of 47 diverse activities related to reasonable profits over the long run. The long list of actions is provided here to alert and guide decisions to be made by the growing number of urban investors and voters influencing the future of rural forestry, and its payoffs and benefits. This list suggests the intensity of work needed for the future forest:

1. GPS and GIS technology applications
2. Knowledge of the land and high payoffs from previous research
3. Alpha Unit management (i.e., selection of the right species for the right site)
4. A coherent, unified management system
5. Forest system monitoring for early-identification of diseases, pests, invasive species, and other potential problems[69]
6. Superior growing stock and regeneration management
7. Specialized units (e.g., walnut products, chestnut genetics potentials, single-tree profit projects, and carbon sequestration)
8. Optimum tree spacing (e.g., hexagonal tree pattern)
9. Site-specific harvest and “leave” tactics, including special thinning procedures and gentle-on-the-land logging
10. New site-evaluation criteria and local yield curves
11. Stem protection
12. Spot fertilization
13. Young stem release (alternative grazing and prescribed fire)
14. Beta harvest regulation (in contrast to area and volume regulation)
15. Assistance in land valuation (including boundary analyses)
16. Extensive reports and website hypertext
17. Appropriate levels of certification
18. Select faunal-species management (especially through other Rural System Groups, e.g., **The Deer Group**, **The Raccoon Group**, and **The Wild Turkey Group**) to include *forest other* uses and management for profit, including: (1) Hunting (intensive, managed hunts); (2) Bird watching (area permits and guided programs); (3) Angling (within ponds and streams within a developed regional hydro-system); and (4) Memberships (land-related resource and nature interests for adults and children).

[69] La Budde G. 2002. Monitoring to Promote Healthy Forests. Community Forestry Connection. Fall-Winter. Minneapolis (MN): Community Forestry Research Center of the Institute for Agriculture and Trade Policy.

19. A network of recreational and multi-purpose trails, within arboreta, a tree wellness program, and fungal web explorations
20. Timber marking for maximum long-term wood sale profit (including profit-based, individual tree selection and removals)
21. Intensive insect and disease profit-loss controls
22. Increased infiltration and groundwater recharge
23. Filtering and blocking fertilizers, pesticides, poisons, and animal wastes from entering ground water
24. Phyto-remediation (plant uptake of undesirable materials and later disposal), bioremediation (delays for decomposition, volitization, bacterial action, and mineralization), and photo-reductions of toxic substances
25. Protection and management of *riparian volumes*
26. Stabilization of inland wetlands and seeps
27. Stream-stepping with logs to reduce water runoff speed and silt carried
28. Conditioning of forested stream water (sediment, toxics, temperatures, solar—for aquatic organisms, fish, and wild faunal species dependent upon water in one or more life stages)
29. Riparian-volume buffers, agroforestry, alley-cropping, silvo-pasturing, energy forests, and nut culture
30. Prescribed burning, and strategic fire control (a role of **The Fire Force**)
31. Security systems against thefts, trespass, littering, vandalism, and poaching
32. Land and social surveys (with published design by reputable subcontractors)
33. Construction supervision and management of roads to reduce erosion and impacts
34. Viewscape management analyses to reduce current costs and increase future land values
35. Developing strategies for surpassing Sustainable Forests Initiative and forest-related concepts of ISO 14000 environmental standards
36. Solar-wood drying, partial-seasoning, and other product drying techniques
37. Short-log mills that are product-oriented, superior mill work and value-added sawing
38. Alternative use and sale of bark, nut hulls, and mill-waste, with diverse current uses like smoke/pollution filters for purification and polishing material, or heat co-generation of energy and ash/charcoal/ recovery for land application (biochar soil enhancement)
39. Market-price-based product storage (mine spaces, barns, structures)
40. Intensive cost and tax controls with modern lean manufacturing practices and technology (e.g., of Toyota, altering production systems[70,71])
41. Simulation-based, cost-effective land insurance (fire, insects, storms and accidents)
42. An array of superior wood products from Rural System enterprise environments
43. Cost-effective, specialized-product advertising
44. Specialized accounting and budgeting
45. Constrained optimization of the total system with modified, expected, present net value as an objective
46. "Scoring," or rating of forests and forest practices, for personal reasons, pride of ownership, display on an attractive sign, potentially for testimony in legal action, and land valuation for land sale or reduced taxation. Scoring could also be used for biodiversity, climate influence, and storm water control claims, and displayed in extensive website presentations.

[70] Ries E. 2011. The Lean Startup. Crown Publishing Group.
[71] Arthur J. 2007. Leon Six Sigma Demystified. New York (NY): McGraw-Hill Professional.

47. Woven wind barriers and seedling protectors

I've encountered, "why so many lists in this book?" There's a list of reasons, among them is the hope that they answer many questions for many people (in fewer words), such as: What's modern forestry? Why is it so important? At what points can modern forestry unite with other major elements of Rural System to meet the tasks ahead? The list suggests what studies, experts, and actions are needed.

Only after I completed the above list did I recall a professor's claim that I heard over 50 years ago. It was that, "forestry requires a special kind of thought, that being for practical decision-making over a very long time, perhaps longer than in almost all other fields." I quibbled about geology and architecture, but the emphasis on *duration and scope* has remained challenging.

Rural Environmental Health Syndrome

Rural System emphasizes an objective of achieving environmental quality (EQ). Prominent since the early 1970s, the phrase has been discussed and continues to have general appeal and a sense of well-understood purpose. We shall attempt to achieve, on our clients' properties, *superior land health.* As we gain acreage, it will become increasingly more important that we be able to measure and report whether our enterprise environments are healthy.

We feel compelled to ask about the meaning of "land health," and continue related explorations of "how do we know anything?" We seek a definition that will serve us well, give the guidance we need in the abundant, complex topics of both terms – "environmental" and "quality." The following concept will serve as Rural System's concept of EQ until revised by the Board of Directors, for multiple uses, one of which might be a scoring procedure to announce current and changed EQ. We anticipate a changing score based on changing weights of importance (national and international) of resources.

We study:

- An objectives-grounded management approach, reducing some difficulties;
- Indicators to serve as management targets;
- Available ecosystem metrics, some not well-related to practices being considered or used;
- "Measures of health," linked to specific probable human impacts and those that track management-labeled actions;
- Human performance metrics, finalized in measurable results or desired importance-weighted criteria—the summation expressing the health syndrome being managed;
- "Forest health," and its real or potential utility and discrimination within the members of the Society of American Foresters (SAF); and
- Possible linkages with One Health, the developing organization.

Health is a singular condition. Our **Rural Environmental Health Syndrome** is an expression of a temporary condition, that of a land or water community being free of a set of over 40 significant, pathological symptoms or conditions, potentially related in a recurring set. "Health" describes a condition, usually resilient to challenges and stressors, and apparently resistant to catastrophic change. Rural System will continuously monitor communities of

enterprise environments for their Rural Environmental Health Syndrome conditions, the optimum of which has the following characteristics:

1. No signs of or estimates of abnormally abundant plants or animals
2. Conditions are suitable for many conspicuous wild faunal species
3. Conditions are similar to nearby communities, not unique or rare
4. Expected understory vegetation is generally present (in forests or large plant communities)
5. Large areas of similar communities occur nearby (and are therefore likely to be stable and have "effective size")
6. Nearby evidence of advanced-age elements is present, suggesting the community has persisted a long time
7. Near to access to treatments, if needed
8. Free from needed treatment, inoculation, or major change for rare pathology or novel occurrence; no excessive insect, fungi, bacterial, or vertebrate pest damage is known to be eminent (i.e., thus avoiding treatment effects)
9. Having anti-gravity or stabilizing elements (slope, water/wind barriers, surface features, well-rooted vegetation); excessive soil erosion is absent
10. Carbon is abundant in the top soil layers
11. Drastic changes in soil moisture are not expected
12. Toxicant uses are banned or well-restricted
13. Vigorous (seasonal) growth in some elements of the community is present
14. A patterned, general vegetative structure occurs with a range of abundance, size, and shape distributions
15. Abundant, downed woody vegetation is present (including potential fuel loading); equilibrium is present in supply and needs for essential resources (e.g., nutrients)
16. Site is distant from adverse conditions; threats to plant or animal populations are infrequent (e.g., potential pollutants, radioactivity, odors, saltwater spray, and other destructive influences)
17. Regulated legal or educational action is present, against low-probability events at or near the site, such as mowing, excessive or delayed irrigation, trampling or compaction, intense grazing, sludge deposits and excessive fertilizer use, inundation (as by waters of a dam), and adverse wind currents (as from reshaping terrain or structures)
18. Outside of and/or distant from a very large area undergoing rapid loss of a species, e.g., due to significant climatic or disease change
19. Healthy individual plants and animals are present and free of significant pathological symptoms; individuals have a composite appearance of being healthy (based on activity, alertness, size, and "clean" appearance)
20. No sign of abnormal behavior by several taxonomic groups of animals (e.g., song, breeding, foraging, hibernation)
21. Perceived probable natural balance between predators and prey
22. The community recovers rapidly from small changes or "perturbations" (e.g., storms, fires)
23. Biodiversity 1: Having abundant, live, expected species in more than 80% of life forms; i.e., exhibiting natural or expected plants, fungi, and faunal-species richness
24. Biodiversity 2: Exhibiting different species among different communities in different enterprise environments

25. Biodiversity 3: Exhibiting and having reported metapopulation and "ecological complex" differences
26. An ecological indicator species population is present
27. Faunal and floral richness are equivalent to or greater than observed in the recent past
28. No new rare, threatened, or endangered species have been recently added
29. There are no more than three areas bare of growing plants (<50% of total area)

A sum of the weighted importance of each of these criteria will likely be used. Rural System staff will work actively, continually, on implementing a program of local, natural-community reserves, tracts within ownerships that reflect or demonstrate the functional realities of plant communities. Having measured the often-dynamic characteristics of slope, aspect, elevation, surface geology, major named soils, understory, shrub height, tree height, site index, and estimated stems per Alpha Unit, Rural System staff will be able to quantify and predict the effects of these variables' "presence" and "change" on plant communities.

Within Rural System, we are likely to encounter all types and names of natural, native, restored, and invasive plant communities. We shall need to name them all precisely, or else the work ahead is likely to be counter-productive and overly costly, with emphasis in community *destruction* or *loss* rather than on presence.

"Sick," "diseased," and "recovering" are words suggesting an observed condition, just a social, political, economic, ecological, climatological, often-esthetic, and historical problem. Within Rural System, staff belabor such words and their distinctions, recognizing parallels within "forest health" and within rural area use problems, as well as more direct parallels with wild and domestic animals and plants likely present. We play with "unwell." We stumble from diseases of fauna brought into our areas by pets and people as guests, and the range of disease transmissions among animals.

We discuss monitoring, watchful of disease expression, limited by the diverse, dynamic costs of surveillance… beyond fearful of treatment costs. Lives are often devoted to single-species human disease. We assume "silly" as tolerable, as we discuss amphibian fungal disease, declines in frog species, and ponder "biodiversity disease" as "a disease that has caused, or is predicted to cause, a decline in a wild species sufficient to worsen its conservation status."

Not only will Rural System staff learn of wild faunal disease and its very likely personal influences, we'll persist in fundamental reduction of animal contacts with adequate fencing. We shall engage in disease surveillance, reducing contacts between humans and wild fauna, reporting diseases found locally, and especially reporting known hazards and avoidance measures.

Local control efforts are likely to produce more problems than solutions. As in so many other situations, disease threats can be reduced by quick cleanup and removal of disease sources… the more pathogenic, the more the speed, location, and amount of response is needed. "High ecology" reins dominant in disease discussions; simple transmission is clearly a means to disease spread. Killing "spreaders" is as meaningful as "provide more research funds in gaining acceptable control of all wild faunal human-cases of human disease."

Trends will change, for the human populations of the USA are moving to cities! Where will be seen the wild fauna bearing disease in the future? Grogan et al. (2014) suggest a "new approach to detect emerging biodiversity diseases." We'll attempt work with their 6-point "aspects of an approach":

1. Integrate approaches, screenings, and sentinel animals to multifactor disease pathways.
2. Target broadly pathogens, hosts, and their homes for predictive modeling of outbreaks and their relations.
3. Honor species-groups present to prevent loss of taxonomic groups and small regions with data of-importance for future studies.
4. Focus on multiple biological levels (those of species and ecosystems).
5. Develop and study long-term baseline population changes resulting from impact of disease…with population data, impacts, detection variability, environmental data, roles of infectious disease, human environmental disturbance, and factors driving local population change.[72]

We describe, for referenced use, our current but likely-changing concept of "ecological" community wellness, and know that other conditions (natural and person-made) exist and are emerging. We are sensitive to claims, worldwide, of "mismanagement" —claims easily made and refuted with difficulty, partially because standards or conditions of before-and-after can rarely be well-addressed. An extreme field-observed condition may now appear, and Rural System may attempt to participate actively and precisely in official, critical claims and certifications of such conditions affecting Rural System managed lands and waters.

A claim of "changed condition" may be leveled as "ecosystem collapse."[73] We shall work for long-term records allowing such claims to be tested. An evident, significant loss in a leased rural ownership, forest or not, partial or not, often needs attention and response to stop any losses and prevent or impair future ones. We sketch our understanding and approach as we prepare to encounter a variety of ecosystems before, during, and after "collapse."

We shall usually start with part of an interior ownership, a nominal "natural" (as in nature) entity, e.g., forest, grassland, or shrubland. A collapse in such a land unit is an abrupt, long-lasting, widespread change that itself may cause and extend change or expansion elsewhere. Noteworthy causes of collapse include acid rain, nitrogen deposition, landscape (and habitat) fragmentation, rapid environmental change, undirected logging, recurrent fires, post-fire forest salvage, climate change, widespread clearcutting, and impaired road-water flow.

We emphasize the stability and dynamics of the above observations. We are in deep gratitude for access to data, and welcome interpretations of these data and their statistics. Staff will treat site-related information as "resource-value," and hold that it must be processed and potentially used to create things of value. We shall report on our unlikely and rare ecosystem collapse data. Rural System staff will work to observe and understand ecosystem collapse and to develop prognoses and early-warning procedures to predict collapse, and then to reduce the risks (and costs) of such occurrence.

The Dynamic Endangered Species Plan

Rural System's Endangered Species Plan shall work to assist individuals, state and federal agencies, and Groups within Rural System in endangered species work, especially as it relates to Rural System objectives.

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[72] Grogan LF, Berger L, Rose K, Grillo V, Cashins SD, Skerratt LF. 2014. Surveillance for emerging biodiversity diseases of wildlife. PLoS Pathog. 10(5):e1004015 doi: 10.a371/journal.ppat.1004015.

[73] Lindenmayer DC, Messier, Soto C. 2016. Avoiding ecosystem collapse in managed forest ecosystems. Frontiers in Ecology and the Environment. 14(10):561-568.

We shall study and report on local endangered species plants and animals, and relate, as best as we are able, the human benefits of these biota. We shall place our planned protections into the known areas of species reductions occurring. We shall describe the reported, conjectured financial importance of each species (and then all together).

We are clear to separate definition and context of named regional species and subspecies. We shall describe named "threatened" and "rare" species, and their genetics and context; we shall use "species-specific" designations. We shall collect and distribute related information from many sources.

Rural System workers tend to see sparse species that are declining, and reach for causes and change:

- Basic *resources* that may provide potential benefits
- Land surface – forests, fauna, thin soil layer, activity areas (recreation)
- Water surface and volume – lakes, streams, ground water
- Land volume – soundscapes, viewscapes, healthful air

Each of the above is the mappable site of human resource recognition, use, job creation, and benefit production.

Special conditions (e.g., threatened species loss, ground water depletion) lead resource managers to include in their actions and definitions: "population recovery of endangered species to a point at least to where their continued existence is no longer in doubt."[74] This may require at least an ecosystem to be preserved, upon which the species depends.

We anticipate little or no work with areas with endangered species, but we shall be aware of definitions and seek their protection following laws, regulations, and recent agreements. Our orientation is on intensive *rehabilitation, restoration*, and protection… and active engagement of the public at low cost, to experience the species and to learn of its past and of its potential future and loss to humans today. The costs can be high for each species, and probably will often be unavailable. We shall work *for* the species on our areas (e.g., enhance nesting areas) and plan to benefit creatively by our studies, endangered species presentations, and work with guests.

We are aware of past owners being protective of endangered species, and have reported related costs (to which we shall be sensitive, actively avoiding and arranging for compensation as easily as possible). These costs (as we plan) are likely to include:

- Timber harvesting options (more expensive), delays and job losses;
- Reforestation;
- Required "leave areas" or micro-wildernesses;
- Monitoring and reports;
- Meetings with officials and local groups;
- Survey costs;
- Loss of access to some lands;
- Legal action over false claims or unavoidable natural events (e.g., forest fire);
- Federal permits, licenses, grants in aid; and
- Administrative costs, particularly if clusters of Rural System lands are managed together for a species.

[74] Chafee JH. 1999. Endangered Species Recovery Act: Congressional Hearings. DIANE Publishing.

We shall report the costs and our investments in species, as we impair further endangerment. We are sensitive to high cost and the perceived benefits of species or their losses. Extinction is a normal event, observed in the past. We shall do modern accounting to reflect the costs of species protection and of preventing extinction.

We plan to address, within our limited resources, fiscal responsibility in wild floral and faunal management, geological loss evidence, human effects on animal endangerment, and the various concepts of "endangerment" and extinction. We shall undertake the complex valuation of human life, the value of the rare and very small animal or plant, considering accident rate costs and costs when considered over vast periods, compensation for related losses to animals, how we are now protecting a few species, and relevant data on local species or plants.

Forest Capital: Managing the Total Forest Resource

Much too much to describe, as we start and plan on creating Rural System, we have the experience of being "data rich," for we have access to data for forested areas throughout the multi-county region of western Virginia. We are pleasantly challenged to know of gross surface geology strata, land slope, aspect, elevation, and aquatic features for every Alpha Unit within the region!

We shall be able to ask VNodal for the existing conditions under a set of features of importance, or reverse the request to see what forest system would be specified if given the identified, hypothetical "functional requirements" of our system objectives. We shall be able to create new sets of information, make models of the most-suitable-soil for specific plants, and begin to combine "surface features" of probable climates, such as the dimensions of evapotranspiration. We see how to use additions of information on daily solar and lunar radiation, degree days, topographic shadow, distance from roads and streams, distance from oceanic salt spray, and distances from sources of toxic substances… all as we explain the past, list possibilities, and estimate the future for site-specific conditions. Computer-based, we'll probably have more abundant, more precise information on each site than available elsewhere.

We shall engage in formal, computer-aided gains over *uncertainty* in each forestry investment decision, using classical game theory concepts and developing software for such analyses. We intend to include soon: risk, uncertainty, and profit, and reach for characteristics of the general system. For example, we shall predict the future with "gains," and make present adjustments to fit the future conditions or likely "states of nature," assigning:

1. Uncertainty, the expressed probability
2. Estimated exact quantities of goods to be sold
3. Estimated demand to be satisfied
4. Documented local dangers, such as wind damage
5. Expenditures for such goods to be sold
6. Time periods likely required for each (i.e., planning and production periods)
7. Estimated profits for each product to be sold; likely profit set
8. Costs of production
9. Cost of movement of product toward market
10. Incomplete knowledge about markets, etc.
11. Uncertainties of the goals and objectives (term use)
12. Estimated coal-energy equivalent invested in market product

Each of the above shall be matched to a known past value or statistic. There is said to be several kinds of uncertainty: (1) that in the mind of analysts and decision makers; (2) that in nature, real future events; and (3) being uncertain, i.e., objectives, maximizing profits, the actual wood supply, security, extent of pride of ownership, labor supply and effectiveness. Financial risk or probable loss can be estimated for likely conditions (listed above).

A probable date for success or failure may be estimated (with cost/losses). The long growth periods in forestry can create major decision problems; provisions for adjustment or feedback are expected after planning and periodic reports, due to fire, weather, insects, labor issues, and leader's experience, knowledge and judgment (rank or expert probability level).

Plans are essential for old-aged trees, parts of forests, and include:

1. Financial support from owners, the public, and diverse markets;
2. Processing of the felled trees;
3. A salvage plan (to recover value from downed trees and to prevent other damage and avoid conflicts with species of concern); and
4. A damage plan, with estimated probability of loss combined with other assessments of cost/benefit.

Planned actions include removing severely-damaged timber as soon as possible. We plan to photograph damage for insurance, tax credits, and assistance that may become available. We shall wait to sell undamaged timber to benefit from probable local wood price increases after the likely slump (from surplus wood on market from damaged product). If managers have a plan with strict guidelines (e.g., riparian areas of endangered species) before a major disturbance, they can exempt areas where ecological values outweigh potential financial value from salvage logging.

We shall engage in expert-probability analysis. Conventional procedures by the pessimist decision-maker, called "**Minimax**" (by game theorists and others), attempt to minimize possible loss in a maximum-loss scenario. In a decision-making situation, guided by the computer, the most optimistic outcome is referred to as "**Minimin**" (minimization of the probability of minimum return), suggesting a decision for the weighted most-favorable outcomes or best consequences among the stated, weighted, and included options available. We'll explore **Minimax-Regret** strategies (taking measures to minimize maximum regret) relating to:

- significant increases in the mean global temperature;
- shifts in climatic zones;
- displacement in agriculture, forestry, and soil erosion control;
- changes in reservoir control; and
- changing high-cost studies of seasonal, annual, and atmospheric concentrations of carbon dioxide.

Questions are many and profound because of the Earth-size issues, the significant differences observed, and the changing observations among areas, past changes, and current massive change such as forest fires and regional land use. Forests are regional, under both ecological and economic forces.

Forests will be managed for landowners, but because they are viewed from a regional and corporation perspective, advantages may be gained in pooled buying and selling, reducing logging and transportation costs, sharing equipment, and in avoiding duplication of effort.

Owners of land may someday enroll all or parts of their ownerships under Rural System management (with forestry as a component, within a Conglomerate).

Rural System will engage in diverse activities *regionally* and eventually even *internationally.* The assumption is made that "perfect" forest management on one area within a poor, unhealthy, or dysfunctional region cannot be viewed as successful over many years. Staff have benefitted from the contributions of over 200 years of forestry work in wildfire protection, management knowledge, forest nurseries, genetic improvement, soils research, and more. Yet, few acres of forests are seen or managed by professional foresters, and so the benefits of their advice, grounded in work over this long period, are not experienced. (That is so very sad!) The same is true for pasture and some other farm operations, but the differences are not seen as great. Rural System can eventually bring needed change, with much land under modern, sophisticated regional management.

We have a set of operating principles or policies. One is that trees harvested are not income. *Forests are capital.* Only the amount taken in excess of that which Rural System will typically leave can be counted, and that would impact the capacity to produce the same amount in the future (not only of wood, but at least estimated annual profit from the land). Similarly, soil, clean water, clean air, coal seams, and annual animal populations are capital. Without them, there is nothing continually producing forest-based income. Few have an accounting system to keep track of natural capital, but Rural System, through VNodal, essentially seeks to do this.

When economic considerations are disregarded and physical principles are the strict basis for managing forests, the results are that the value of timber production is unnecessarily reduced and the potentials for an off-setting increase in non-timber benefits are not recognized. When land is allocated to deer or recreation, the owner may forego timber-based profit, thus experience an "opportunity cost." The reverse is common, i.e., ignoring the potential income from songbird study, hunting and trapping, other regional recreational uses, soil-quality gains, and alternative uses of other forest products—all for the sake of timber at a sub-optimum sale period!

When roads or ponds (etc.) are built, natural capital of one type is lost and replaced with another type of "capital." Progressively, "development" removes natural capital, preventing natural resource system capital gains from being sustained. Losses are replaced by "development" and other nominal resources (whether of equal value over time is unknown, but unlikely to be in the long term). We shall continue study to resolve or clarify the capital, the investments' results on the ownerships, and the real locations of investment results with appropriate present-discounting valuation over tree life-time and similar-source expectations.

Rural System will invest in increasing the productivity of natural capital, given that the land owner has and holds that capital. We shall use "sensitivity analyses" to find the most limiting factor in a project or subsystem, and find ways to invest to gain cost-effectiveness. Usually that factor which is limiting is natural capital, not labor or developed capital. For comparison: cut timber, for example, is limited by standing forests, not sawmills; fish catch is limited by fish populations, not just boats or anglers.

> Within the profession we are known as dirt foresters, and a great deal of our time in the woods is spent selecting and marking timber for harvest. Through the marking of timber, at least similar large tracts, we become a part of a natural system that can teach us how to live more fully and with greater awareness. Approached in this way, the task of putting paint on trees becomes a meditation, even as we acknowledge that cutting trees is at its heart an economic decision. Each decision involves factors such as age, size, health, soil, slope, aspect,

> economic value, competition, potential growth, wild faunal values and their functions, and more. The staff member calculates all these in his or her forestry-educated brain. You raise your paint gun to deliver the death sentence, and then something unnamable crawls up from your belly and asks: Is this the right thing to do?
>
> -Based on Southern Forests Network, October, 2008.

I knew well that gut feeling, but when the tree among hundreds has been under daily and "long-term" analysis, there is not a *death sentence*, but a forest renewal and improvement being made for animals and plant life, from tree tops to deep soils. That knowledge encourages investment in Rural System enterprise environments and beyond, within developing internal county markets.

We exist to serve the people and lands of our counties. We have to have some semblance of a policy for the common good. We struggle to articulate that as: "community-rooting of capital" (Herman Daly) and creating wealth.

Wood (tree-size) growth in the region now exceeds harvest by a changing, high ratio. Harvests can be increased, but the concerns are that quality growth is not occurring in superior trees of superior market value on productive sites, where access costs are reasonable and where other environmental impacts (erosion, compaction, etc.) are not extreme. There are too many "conditions." The problem is complex in the region, but especially so for the small-acreage landowner.

Staff of The Forest Group will have the means to solve these problems for the small- and large-unit landowner. The staff will be able to take the hassle out of problems for the out-of-state, absentee, or other owners that are busy with daily affairs and unaware of the complexity of forest-related decisions. The Forest Group will do what the owners want, but won't simply cut trees for immediate income. It may, however, work with the Wealth Management Group (Chapter 11), to alternatively assist in financial planning for college and other family-needs, even financial crisis management (forest banking) to prevent disastrous land impacts. The Forest Group can present a viable alternative to the rapid turnover in ownership of forestland (occurring on average every 12 years), by providing management, a steady flow of benefits, and reducing the harmful effects of a "cut-out-and-get-out," clear-cut before land sale tactic. The Forest Group even has plans for increasing the value of lands held in trust for banks.

Our *general* rules for achieving stable wood production and profit—as well as some of the frequently-used terms of "landscape amenities," "nature conservation," "cultural heritage," environmental protection," and "recreational resources" —are as follows:

1. Replant and assure a new stand of species as soon as possible on selected sites.
2. Tend the new stands and protect them well.
3. Thin during stand development to ensure production, reduce loss, and achieve timely profits.
4. Harvest at times that assure maximum, total-forest long-term profit.
5. Conduct operations to assure maximum number of natural (non-introduced, non-invasive) species within the ownership.
6. Harvest to achieve computer-informed age distribution among stands within each type.
7. Carefully manage the appearance of the harvest site and related forest for public viewers.
8. Announce and promote limited-access areas as reserves for use for wilderness values and studies (e.g., alternative productivity and carbon capture).

9. Manage intensively the valued, non-timber products of the site.
10. Remove harvested items as soon as possible to maximize profits, prevent loss in quality, and reduce losses to insects, pathogens, fire, theft, etc.
11. Protect, maintain, and improve the growing site. Maintain soil carbon and moisture in the forest floor, independent from stream-side sites.
12. Continue to express the essential needs locally met by a forest fishery.
13. Participate in well-estimated carbon-capture (perhaps studied carbon credits) and its dynamics for the site.
14. Report effects of Earth ice-cap melt on residences, management areas, forest sites, forest inventory, and forest projections, especially in coastal areas.

Forestry within Rural System is much more than a set of rules, but of processes and operations viewed as a total system by the captured intellect of many superior rural-area forest managers, operating within VNodal, and applied on the land by The Land Force. Such a system includes: reforesting and regenerating stands, studying decisions for rehabilitating marginal lands; providing protection; enhancing work that is cost effective; maintaining an inventory; conducting effective harvests; using proper storage, preservation, transportation, marketing, and processing; and emphasizing non-wood forest "goods and services"—all concentrating on adding stable value to wood products in the region, developing exports as appropriate, making genetic improvement, monitoring, and doing profit studies into all of the above. But *even this* is not the total money-producing system; this only focuses on the *forestry* part of the total "picture."

The look needs to be on the land platform, not just on the trees but on the productive Alpha Units and their nearby units. This was never before possible. It *is* now, with computer assistance. With that, international opportunities expand, such as in shaping public dialog about land management and including implications for domestic forest resource issues in harvests, uses, movement, trade, environmental vitality, and technology.

Rural System will seek to grow as an organization so positive that its influences will be felt throughout the region. It will display management of lands in the region: living, working, profitable areas, but also demonstration and studies areas. Such areas may be self-sustaining and provide desired employment opportunities for many local people. The financial gains will be made not only from trees and the work of foresters, but from the total, managed productivity of the land clusters under contract and actively-related Groups.

The Forest *Resource*

Land may be covered by trees. Land that was once covered by trees may have no trees, but may still be called "forest land," or the *forest resource*. We start with land as the fundamental unit, and then discuss whether it has trees (and of what size, age, and type). For legal and other reasons, forest land is defined as land area with a minimum size of one acre and 100 feet in width, which is at least 10 percent stocked with trees of any size.

We know that current estimates of local "forest conditions" tell that the state now grows more than it harvests. We continue to emphasize the un-measured, multi-listed benefits of each forest, and cannot resist adding all of the potential, un-exploited wood volume, wood quality, soil benefits, water storage, wild flora and fauna, stored-carbon, and esthetic benefits. Many of these forest resources never enter a "benefits list" for forest land… or avoid a net loss!

The Forest Group will quantify the mix of trees on each ownership, e.g., hardwoods and pine, species suitable for only the mountain-top, and some marshland species. Forest plans will

include these differences, now and for the future (with different values and expectations). Plans will outline forest management objectives, harvest rates, and reforestation techniques, measuring cumulative growth and changes in Alpha Units, ownership-wide.

Managing forested areas intensively, precisely, is important for all of the many well-recognized values of forests. Benefits being added, stabilized, or increased by Rural System management include soil stabilization to water and wind forces, cooling effects, noise attenuation, visual quality, landscape value, quality of life for employees, human recreation and education, and use by hundreds of wild flora and fauna species. Other products and services of forests have yet to be developed and recognized; benefits exist that will finally be marketed, not merely taken as "given" or as a "blessing."

The Forest Group knows how to grow trees and how to harvest them at peak profit, but especially knows how to assure a continuing forest that produces many desired benefits. By careful management, the forest within the ownership can provide financial benefits to the landowner over long periods. Only by careful, intensive, modern management can a full array of types and ages of stands be made available to produce the diversity of life forms, recently so-often expressed as the desire for "biodiversity."

The forests of a hypothetical area vary greatly and over different stands. The differences in forest type are caused, usually, by small differences in elevation, thus in site quality, related to water available in the rooting zone and to rates of soil deposition. (We shall study other options to those perceived limits on tree growth.) It is highly probable that each square meter of an ownership is unique.

Computer power and available databases now provide a potential to do prescription forestry, to avoid over-generalizing and to allow each unit to be treated uniquely. There will be a database for many stands, some of mixed species. GIS maps may be continuously improved by site-visits and field reports.

Applications of Silviculture

Operators of "silvicultural systems," by one definition, seek to regenerate forests, use intermediate operations to improve forests, and harvest trees effectively. The objectives vary greatly (maximizing profit, maximizing biomass, maximizing presence of desirable wild floral and faunal species, etc.). Objectives are often vaguely stated and poorly decided. We encounter: "no commercial tree species may be present except on its published optimum site!" and we modify that idiom of silviculture with: "unless higher profits over a similar decided period are very likely and timely, from trees and tree-products on sub-optimum sites on the ownership." The complexities have been dodged; it is time for computer action for the fields, forests, and Crescents!

Select parts of the area, no longer in active use, might be studied for reforesting. By on-site field decisions, these can be handled to avoid conflicts with regulations and guidelines about the height of vegetation within select areas and the amount of vegetation allowed around special areas. On the dry upland sites, pines are likely to be preferred. High deer numbers and their foraging will require protecting seedlings and making annual efforts at herd reduction.

Select stands need to be protected because of the occurrence of threatened or endangered species, and these stands will need special attention by The Forest Group. Typically, many rare plants or animals are those that occur in old, very-mature forests. Foraging deer populations now threaten the existence of some wild-plant species. Creating snags, doing improvement cuts (for

visual quality and later high-value), and on-the-contour grounds stabilization are all feasible operations to benefit the trees, the future forest, and its associates… to stabilize structure.

General guidelines for thinnings in bottomland hardwood stands include:

1. begin thinning early in the life of the stand;
2. favor the largest trees with well-developed crowns;
3. thin from below whenever possible to remove trees with inferior crowns;
4. use frequent, light thinnings instead of infrequent, heavy thinnings;
5. avoid excessive logging damage to residual trees; and
6. with The Deer Group, increase deer harvests to protect threatened plant species.

More specific guidelines are available. The general suggestion is to thin each hardwood stand given its characteristics, and modern practices include making alternative uses of the thinned wood (or compacting it into biochar for rapid soil improvement). Other partial cutting employed today in bottomland hardwood forests typically involves some form of crop-tree release, in which individual crop trees are selected early in the life of the stand and are periodically released from competition (surrounding trees) to promote maximum growth.

Dynamic Agroforestry

I have attended courses and conferences in **agroforestry**, studied the topic as it might be applied, and have seen examples of it in India, Nigeria, and Senegal. I approach the subject of agroforestry aware of an intended base of knowledge and the starting point for developing a special type of mixed-resource productivity on the rural lands under Rural System management and development.

The science and practice of agroforestry has advanced in the United States since the 1980s. In 1996, it was recognized that it still had not been institutionalized into USDA's concepts, philosophy, strategies, and programs. Taskforces in 1994, 1997, and 2000 struggled with the limited potentials of agroforestry for achieving agency goals and social goals.

Once called "silvopasture" work, the emphasis was on farm forests, livestock, and forages all growing together. It later included "alley-cropping" of annual crops in rows with high-valued trees and shrubs, then simply forest farming, where food, herbs (botanicals), and decorative products may be grown under the protection of a managed forest canopy. Well-aware of widely-related farmland activity and major local needs, windbreaks were added, as were waterways. Unlike others, within Rural System we include wetlands, streams, ponds—large and small—and Crescents. Using riparian forest buffers is an example of one such practice, helping reduce soil erosion and nutrient run-off.

The duration for alley-cropping product yield is long and the visual aesthetic is good. Travel-lane waste is minor, but needs to remain for finding the best models for superior sites for each of the plants, verifying the proper pairs, renting or gaining contracts for land for the first plantings (and show-trips, increasing economy-of-scale), and getting the plantings started. Agroforestry is planned as a mid-level or sub-system of Rural System, within which there will be crops, fisheries, forestry, and later livestock sub-systems.

We attempted an expanded phrase of "agro-pastoral-aqua-forestry," one closer to Rural System objectives than agroforestry, but rejected it as likely to push discussions and action away from our major Rural System objective of improving the total stability and prosperity of small rural communities in regions with diverse languages. (The work for Rural System is much broader than captured within a term-combination.) When purposes such as odor mitigation,

improving pollinator habitat, and trapping snow are added, the total seems very much like the planned subject matter of Rural System.

Agroforestry practices are asserted to result in improved water, soil, and air quality; forest profits; spatial and temporal diversity of farm produce and profits; and perhaps rural wealth. Such practices may play a role in forming and balancing food-secure regions in the face of global issues, such as climate change and a growing human population. Within Rural System, we shall work toward an index of success of such practices, minimally an annual profit index.

In Rural System, we use the word **agroforestry,** though carefully and sparingly. One working definition of agroforestry has been published by the USDA National Agroforestry Center:[75]

> Agroforestry is intentionally mixing and combining tree and shrub systems into crop and animal production systems to create land and water systems producing environmental, economic, and social system benefits.

We shall do studies and encourage research in agroforestry, and integrate it with our prescriptions for land use. We are interested in and are prepared to produce the big F's: food, feed, fiber, fun, and fuel (renewable energy). Many areas with trees are not now stable—not to be sustained—and we do not wish undesirable conditions to be sustained … even though they may certainly be sustained for years… before becoming a ghost town.

"Conserve" has little meaning any longer either. We shall typically communicate our agroforestry work as analyzing, prescribing for, restoring, protecting, and managing most of our adjacent and nearby forests (and other lands) for stable yields of profits—directly, simply—within Rural System over many years. We have many ways of creating productive, with profit, healthy farms, fisheries, ranches, woodlands, and communities, and retaining all that we desire. When we say "agroforestry," we emphasize trees—the right species of trees on the right sites—but only within our *total system*.

We have a metric for our success: annual corporate profit, unified with a human wellness index. We can demonstrate to individual land owners their profits (under contract) and suggest to them the likely changes and yields compared to their neighbors (a typical comparison). Our practices, and many of those of agroforestry proponents, have expected results, and we wish to engage the following for proven functions and long-term financial gains:

1. Protection for noteworthy, valuable topsoil, livestock, crops, and wildlife;
2. Protection for air, water, and soil resources, including moderate microclimate;
3. Productive sectors of farms, ranches, woodlands, and communities;
4. Diversity and landscape-level resilience to climate-change impacts;
5. Procedures for responding to emerging environmental markets (e.g., carbon, basic foods, high water quality);
6. Productive and valuable agricultural and horticultural crops;
7. Ecological services across rural, border, and urban lands and communities;
8. Biodiversity and landscape diversity;
9. Critical habitat for wild fauna, aquatic species, and pollinators, with preservation gardens and ponds;

[75] USDA National Agroforestry Center, United States Forest Service, and Natural Resources Conservation Service. What is Agroforestry? [Internet] [cited 2017 Apr 22]. Available from: http://nac.unl.edu/documents/workingtrees/infosheets/WhatIsAgroforestry07252014.pdf

10. Innovative and sustainable bioenergy production systems; and
11. Stable, profitable market systems reconnecting agriculture, people, and communities.

We learn from agroforestry that we should not over-estimate the results of applying agroforestry practices. Likely gains are limited in magnitude, as are land suitability, ready adoption, broad-scale sales, and financial and personnel resources. Agroforestry should not be over-promised. But, if it is integrated into individual farm operations and watersheds as planned in Rural System, agroforestry *can* create and enhance certain desirable functions and outcomes. Performance indicators, baselines, metrics, and targets will be developed to express agroforestry achievements and power for advantages in studies, proposals, and extensions.

We'll seek funding to increase the scientific underpinnings of agroforestry technologies. We hypothesize and will eventually test whether agroforestry is especially well-suited for modern community and rural cluster use, maintenance, and wealth development. We'll study and adapt interactive processes with feedback loops, involving staff and others from many disciplines and landowners and community people. Tetrad teams are likely to provide a rapid incorporation of on-the-ground findings and lead to further tool development and warnings (fire, injuries, pesticide risks). These teams may identify, assess, and prioritize local agroforestry science and technology needs and outcomes to improve the quality, relevancy, and performance of end-user products. As in other areas, we shall maintain reference resources or their access.

We now face changing roles within scientific and charitable organizations, for we are a for-profit Group, in significant competition, and knowledge gained from any source can reduce our risks of failure or of not achieving desired profitability of investments. We propose to develop and use agroforestry study results and technologies for our clients… and use successes to increase clientele. We shall further agroforestry-applications as needed, and as profitable and properly functional. We shall seek projects that display, for landowners, the benefits of agroforestry, and seek contracts for continued maintenance and improvement of such project areas.

We have (a few) major tasks ahead as we develop, test, and decide on the continuance of agroforestry emphases within Rural System:

1. Establish a team to frame priority issues that have been and can be addressed by agroforestry.
2. Gain and study the relevant information and data.
3. Simulate effects of significant improvement over the reported current successes. Use the results in deciding whether to continue engagement in agroforestry.
4. Build, if needed, subsystems to conduct life-cycle analyses of agroforestry systems.
5. Quantify the net economic and other benefits from agroforestry applications for comparison with those from other management systems.
6. Estimate the potential payoff(s) from establishing, measuring, inventorying, and monitoring annual agroforestry plantings and their impacts. Decide whether to continue or develop alternatives.
7. Develop further products and computer services to address the multiple issues of profitability and investment worthiness at multiple scales for targeted audiences.

Forests exist. They survive based on tolerance for change and on long-term, positive responses to great variability. It is too much to ask that they be like ponds or prairies, that there be universal laws and linking theories which can eventually be found after enough diligence. Forests are not systems, organisms, economies, or machines. They are large areas with trees,

each having a conspicuous life form. A recently "clear-cut" area is not a forest, although some will want to include its area within a tally for some socioeconomic concept of a forest. Trees, if present, need not be conspicuous. A recently-clear-cut forest is equivalent to a recently-abandoned agricultural field or pasture. There are relations within a forest, thousands of them, but few (if any) *interrelations*, a tenet contrary to a recurring theme in "ecology" texts. These relations may be conditional (e.g., if the pH is too acidic, the aluminum in the soil becomes toxic) or otherwise, but they are typically singular and occur at speeds with non-human time—time that is within the domain of the physical chemists (i.e., nanoseconds).

Relations in forests are sequential—like history book pages—just one thing right after another. The forest, being as big as it is defined, can have several things going on in sequence at the same time within a designated area. Thus, the conceptual is seen, and the computational and modeling difficulties of dealing with a big bunch of sequential events—stopping, starting, and slowing, all simultaneously. Rural System forests exist within a changing, multi-dimensional space.

Forests are not purposive. Tree and populations of other organisms may be, but not forests. *Humans* assign purpose, value, and risk. I doubt if species are purposive, but it is useful for teaching purposes to view them as "succeeding" or "trying to be fit" if they: (1) collect energy, (2) store energy, (3) tend wastes, (4) reproduce, and (5) make fundamental change (mutate or disperse), thereby achieving the fundamental biological laws of species survival.

A forest does not *seek to* or *attempt to* achieve some future status or size. It does not seek a steady state or desirable status. It may achieve such a condition, but it has no command that it must fulfill, no intrinsic or innate goal, no singular control. What people see, and to what they point and say "that is a forest," just happens—not randomly, but following rules in different combinations and permutations, largely a function of sequences of small initial events and deaths and decomposition of individual trees and associated plants… usually over a much longer period than elsewhere in nature or in acceptable (profitable or rewarding) human conditions.

Every forest is unique. They look alike, with "trees and things," because trees are perceptually dominant. No two are really exactly alike. The species mix is different as is the shape, spacing, ages, disease, animals, fungi, and understory plants... different in at least one of these, probably more. Teachers work hard to generalize for most forests; others must work very hard to understand *a single* forest.

Forests remain, often as forests. This condition does not mean they succeed or were predestined. It merely means that unique forest conditions, even with small, persistent changes, appear to humans to be similar enough to other things called "forests" to allow them to continue to be called "a forest" under the rules of local languages. Understanding the above is central to forest valuation.

Ideas and numbers used with timber are suggestive of value. They are not market estimates. They give owners and people of the region a feeling of land value, of dollars in the "nature bank." They also give to some people a feeling of sadness or frustration because they did not harvest those trees and put the money in the bank. Because the forest is so complex, this feeling can easily go away. If the game of: "what if...?" is played (as in: "what if I cut down the forest, sold the wood, and put the money in the bank?"), then the answer would be "keep going." Take the money and run. In considering the other consequences of such a ploy, besides "cash" and compounded interest in the bank account, you would have:

1. reduced carbon and energy collection;
2. reduced esthetic quality of the area, directly related to health costs and land value;

3. reduced historic value to some people, some buyers, and even some with prehistoric questions;
4. reduced opportunities for tapping into a billion-dollar industry related to wild-fauna watching;
5. reduced enterprise gains associated with Rural System;
6. increased costs of fisheries, including shellfish;
7. increased air conditioning and heating costs;
8. increased erosion and soil dredging costs;
9. increased health care costs (by several pathways);
10. increased water deficit and delivery costs;
11. threatened endangered and watch-list species, some having yet-unfound potentials (the lost opportunity value or "option value"); and
12. changed the spirit of place—it just would not be as nice (however you express such things).

The effect of these collected estimated values of the forest—now removed—need to be added, and then compared realistically to the often-low stumpage value of the forest. ("Stumpage value" is the worth of the wood when sold at the sawmill after all costs have been tallied.) Rarely do people tally the cost of growing the wood from seedling to harvest, or the net gain or loss in land value for 150 years in estimating stumpage value. The consequence of this comparison, if done realistically and in good faith, will suggest that there are few Eastern US forests that can supply direct, net, long-term financial value from wood sale that exceed the above, listed values.

The great potential value of forests is in other benefits, and most of these benefits are readily (if difficultly) expressed in expected financial terms. Their potential values increase greatly when they are seen in the context of coordinated work among landowners and the work of all Groups within Rural System over many years.

We hold strongly that the total ownership and its benefits and financial profits need to be the topic of interest. Rural System's vision is one of land under intensive contractual care, analogous to an excellent but less-limited lawn-care company. With detailed knowledge of the favored species, and control over their selection and their environment, in combination with knowledge of the potential uses and processes from the forest to the delivery site and regional marketing, we can retain the site benefits desired, as well as the wood values—some enhanced, as by tree thinning, pruning, and fertilization to achieve desired growth conditions within the tree bole.

Forests typically have more species of fauna (richness) than other land-use categories. If any land is left unattended (after farming, fire, etc.) in Virginia, it will probably become a forest. Different species are well-adapted for living in each stage of forest growth, but not to each site with trees. Cardinals, for example, are abundant in the early years; some warbler species are abundant in the older forest.

Timber management practices over a large area are the main influence on presence and abundance of wild plants and animals. Some practices favor young-age trees, others favor those that are old. Forest *age* is probably more significant than forest *type* in determining species present in an area. All aspects of forest *management* influence wild fauna species present, as well as their abundance and variety (diversity) and richness (species-count). Timber harvests, for example, let light reach to the forest floor and favor the understory plants, upon which many animals feed, including their predators. By careful harvests, considering area, timing, and

location, a stable overall forest condition can result to which diverse wild fauna, with diverse human values, will respond favorably (in summation, not singularly).

There are both federal and state laws protecting threatened and endangered species. It is reasonable to take at least preventative steps to avoid other species becoming listed, to retain minimum viable populations, or for Rural System to seek funding from human visitations to experience these organisms.

There are many other aspects of forest value, and we shall seek to gain benefits from each land ownership over time. Removing trees for whatever-claimed human purposes (building, road, airports, etc.) must someday include the costs to people surrounding the removal. They are real, accountable, and affect land and water needed now.

Intensive in our enthusiasm for tree growth, Rural System is especially anxious to advance markets for high-value forms, wooden tools, instruments, and garden forms, many related to charcoal (biochar) and its history in garden and crop productivity. In contrast to these will likely be our transitions to micro-wild areas—growing instruction in and enhancing values of the remaining, very old Eastern U.S. forests (some now within cemeteries).

It may be that profitable modern forestry, as suggested herein, is one of few means to reduce significant, undesirable land use changes, and to establish essential regional stability in the stressful years identified for Earth's future.

Troll: A Story about The Whole Thing

I've tried in many ways to tell different people about Rural System and have never felt successful. Here is another way I've told about it, as if it were real and functional.

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H. Rain Jacobson inherited land, and did not know what to do with it. Now, living in San Diego, she thought about selling. There was said to be a new option, Rural System, so she hired them to give it a try. After Rural System had been active for several months, she called Brother to check in. Brother knew nothing! He didn't know how he got the name Brother or what to do, much less why he had been excluded from owning 60 acres of mountain.

He did as was told, drove to the town near the Jacobson property and in a slit between two steep mountains, got a coke and searched the street for the Rural System office. He couldn't find it, but after talking to several locals, he discovered that everyone knew where it was: behind the red restaurant. That's where Brother met Joe, a representative of Rural System and not gloomy like the town. They went to an office nearby where Brother was shown maps, computers, files, books, and people working over keyboards. He was given a hat; the day was heating up.

They drove through a newly-built gate, like one from a Western ranch. They hit a bump in an otherwise smooth road, providing air bag pressure to a giant rotating wheel, producing some electrical energy for this end of the property. Joe explained that this unusual system was combined with the methane units, producing electricity and reducing year-around fuel and electrical costs.

"What's that white stuff? It looks like a baseball-field line," Brother asked, glossing past the bump in the road.

"It's the boundary of one of our management units, 10 meters by 10 meters. It's like the distance between football field lines. We usually ask visitors to guess about its size or what part of an acre it is."

"Who cares?" thought Brother, but it seemed harsh so he said nothing.

"There are about 40 of them in an acre and so there are 2,403 of those little devils, all unique, in Ms. Jacobson's land," Joe continued. "We use computers to tell them apart and try to treat them with personal respect."

Brother exclaimed, incredulous, "Surely that's asking too much!"

"It once was, but now with satellites and computer power, we know about 100 things about each of them. We have the power to restore them, enhance them, manage them, and predict their likely productivity. We can even attach local market prices to the produce from each." Joe shifted gears, and continued, "We have picked 8 spots for vegetable gardens based on soil type, soil richness, slope, nearness to roads, elevation, forest shade, aspect, past use, and wind patterns, all adjusted by the expected effects of climatic change. We have begun building the carbon structure in the soil by modest dragging after plowing, adding mulch from nearby forest stands, crop selection, crop rotation, and compost additions from legumes. Our Pest Force protects the crops, and we anticipate that crop harvests by our Land Force will put us in a profit stream for years to come."

Brother was almost dismissive, objecting, "That's far too complicated! I can't 'precisely manage' even a kid's basketball team." Joe simply smiled, used to peoples' amazement, sometimes skeptical and other times jubilant, when hearing about Rural System for the first time.

They turned a bend in the road. A covey of bob-white quail flushed. This field, full of triangular areas with brush borders, held more of these game birds than any other for miles around. Joe broke the silence again, explaining, “The Quail Group manages these fields, as well as hunting dogs available for rent. They work the patterns of the field for high insect numbers for quail chicks, and use a special technique to keep the stems of the grain the quail like to eat from falling over in the snow. Several hunters pay well for an opportunity to use their dogs with a known population of quail.

“Out of season, we have a great doggie play area within the fence. Visitors pay a small fee for each of their dogs to use the area. We are wary of diseases and do not compost dog waste material, but use it in our methane systems for electricity. You can see we have changed a conical “sink-hole” into a small amphitheater, and partial garden. The garden produces seasonal flowers for sale. We bring van loads of visitors here for our Group presentations, all with modest fees and our presentations of other opportunities here.”

Out of sound range, in a wooded grove, was a memorial area beside a giant rock face. This was provided to people wishing a beautiful, secluded place for placing the remains of family and friends. A perennial shade garden provided seating at one side, giant wooden benches built from thinned trees of the property.

Joe pulled over, parked the truck, and pointed: “The Rain Jacobson Place” was laser-carved into a large sign mounted in rock. He said, “These are made of wood from our forest, processed into desired shapes, and messages routed, burned, or laser-carved into them and then walnut-stained from our “waste” walnut shells. Our walnut groves are popular; our Walnut Vales Group produces nutmeats, shells for burnishing metal, wood for furniture, and dye. We anticipate using computer-selected areas for storing and drying cut walnut, some of which may be used within our Sculptor's Group.

After a drink from the truck cooler, Joe showed Brother a road-building guide, sent as a prescription from the VNodal software program. The two hiked off on a narrow, built trail. Flower patches that had been moved from the tread area diversified the trail sides. Designed for reduced erosion, the trail made the forest and fields open, available, easily seen by visitors and accessible to staff, the Land Force. One sunlit area here was a fragrant garden, another was a bee garden, there, down the trail, was a “xerosere,” an area with only dry-land-tolerant plants and rocks. A branch trail led to a road, a small parking area and a fireplace with stacked wood.

“Why is that fireplace there?” Brother asked.

Joe smiled, and said, “About once a month the Owls Group brings a bus of interested people from town at dark, walks them into the woods along that little trail, and plays a recording of real owl calls. The owls are well-studied here by students and they know what to expect. Everyone gets a tingly feeling, some are a little scared, and some rent night-vision equipment to see the owls called in. Afterwards they retreat to the fire place, hear a local guitarist, enjoy a drink and fireside fun, and are bussed back to town, all having had a unique experience in the deep-dark-forest of Rain Jacobson's Place.”

Around the bend, after looking at a vista, Joe and Brother almost hit some of the Land Force in the road. Half were talking, lounging on the road bank, and chewing on grass. One wore an elaborate safety emblem on his shirt. They looked “caught.” The others stood holding shovels and fire-rakes. They had been improving the rainwater flow off the road. “Hi, Troll!” said several.

Brother looked around. Joe yelled, “I'll be right there,” then told Brother to “check it out,” and handed him the tablet, adding, “we're at 3,300 feet.” Brother was thinking about the name, not the vista. Troll seemed an odd name, about as odd as “Brother.”

The Land Force gathered around and all talked at once. They were introduced and wanted to share their progress over a few days, including the poisonous snakes added to the database with the exact Alpha Unit where they were found. They moved up the mountain to an equivalent spot, marked the place for a new trail, and marked the places for three cultivated areas, each for different grains to attract song birds near to observers.

“Troll says resources are for people and just increasing birds or creatures up here has no known payoff. Our birds are not a resource unless we provide access. That's why we're up here today.”

Troll grinned approval.

“Where did you get that nickname, Joe... Troll?” asked Brother loudly. Everyone grinned.

A large woman, laughing a little, said, “I'll tell.

“Three of us drove up the north mountain side to the trout stream. We had put in a hydraulic ram for a sales demo near a road. We piped a little water from the stream to the ram, and the ram spewed it back up the hill into a marsh area, a ‘seep’ for the Wild Turkey Group. Suddenly, out from under a tumble of trees and limbs that had washed down into the stream from the upper banks crawled Joe. No one could believe it. He said that he was after a winter wren sighting. That sounded odd, but he insisted.

“Two days later we were weeding a north-facing winter-berry garden by a trail side and walked around the trail. Out of a tree-trunk came Joe, as if it was his home. He had been with The Bear Group the previous year and wanted to see if he fit where the tagged bear had been found. He’s just odd like that, our Troll.

“But the name came one day when we had a truck load of visitors. They had seen bear tracks, and had spent the morning in a blind in which people paid to observe their first-ever wild turkey to add to their bird life list. As our truck rounded a corner, we approached a bridge. Out from under the bridge came Joe, sweaty, wet, dirty, and covered in lichens and algae. Someone in the truck called out, ‘My God it's a Troll!’ We’ve called him Troll ever since.”

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Let’s take a hard look at how Rural System works, based on the story. Income came from timber thinning, sales of equipment (such as the methane units), field guides and related books and photographs, guide services, special events (such as the Owls Group experience), birder life-list visits (turkey), back-country road design, and GIS services. High country coolness and mountain shade had cut potentials for commercial vegetable production.

Brother was not a rural person and did not understand Troll or the strange things that the men and women of the Land Force did. He was glad to get home. Rain decided to visit later and see her place for herself. In the meantime, she enjoyed a percentage of the annual profits being raised, and appreciated the increase in her land value, as well as a modest tax break.

Chapter Nine

Rural System's Ranging

Like other words, the word, "ranging," may be used as a verb, a noun, or an adjective, e.g., as in, "That's our ranging budget for *the whole group* next year."

As other units of Rural System, this chapter presents ranging as a proposed, large, diverse activity and enterprise, one that intends to help stabilize and improve the lands and waters of a region for high quality, diverse outdoor recreational and viewing activities. There is nothing special about a word like *ranging*, unless it can help make sense and suggest positive structure for the expansive areas of outdoor recreation, ecotourism, agri-tourism and related words and phrases for region-changing action.

"Ranging" in Rural System means engaging in one or more of a diverse set of outdoor or rural activities for health, recreation, study, appreciation, and adventure. The term may also encompass related enterprises that promote, support, and supply these activities and the areas and resources used. Ranging includes (but is not limited to) hiking, backpacking, camping, trekking, climbing, biking, trail riding, hunting, fishing, boating, touring, sightseeing, studying nature, and observing wild flora and fauna. It may later include triathlon events and their observation and support. In Rural System, ranging is the total system of activities that manages the land for people, and their need for increasingly diverse outdoor activities for the long run.

Rural System's **Ranging Program** will market the set of rich resources of the managed properties, create related sales and services of equipment, clothing, food, lodging, and supplies; offer guided tours and unique experiences; develop new organizations with lasting memberships; and attract gifts, bequests, and research projects. The tours will protect the land and owners' resources, and provide opportunities for students for work experience and education, funds for tuition, and graduate research opportunities.

Rural System's Ranging Program will develop and promote a wide array of outdoor activities for a region. The "catch," the colloquial difference emerging, is that for such a program to be very successful and pay off for the region, *the region* must be beautiful, safe, and carefully managed for the long-run. It is not easy to maintain such standards, but ranging may have great payoffs in human health, reduced costs and risks, employment, regional stability, and high quality of life.

Ranging has a major component of "outdoor recreation." Nationally, outdoor recreation is an economic powerhouse, generating $646 billion in consumer spending and 6.1 million direct jobs annually. In Virginia alone, the estimated consumer spending on outdoor recreation is $13.6 billion in spending, 138,000 jobs, $3.9 billion in wages, and $923 million in state and local tax revenue.[76]

Ranging is a proposed, new combination of diverse activities with nameable results that can be used to paint a region as "beautiful" to sightseers and guests, rich in outdoor activities of

[76] Outdoor Industry Association. 2013. The Outdoor Recreation Economy [Internet]. [cited 2017 Apr 22]. Available from: https://outdoorindustry.org/images/ore_reports/VA-virginia-outdoorrecreationeconomy-oia.pdf

many kinds, and a place for adventure, self-testing, exercise, and even self-discovery or quiet reflection.

A cost-effective ranging program implies enacting diverse, progressive ranging-related enterprises in a well-managed environment. The enterprise and collective resources will build over time, providing profits and associated benefits in employment and community stability.

Rural System is planned to begin in Southwest Virginia before expanding nationally, and eventually Earth-around. As an example of ranging potentials in Southwest Virginia, the New River watershed includes one of Virginia's 14 major rivers. The New River starts in North Carolina. Its waters flow northward toward the Missouri, then southward into the Gulf of Mexico. With fuzzy borders of the area, people in Virginia are within one day's drive from 50% of the U.S. population! The region is expanding for worldwide activity. Of course, the Internet and related e-commerce automatically achieve part of that work.

Land may be a forest today, but that can change tomorrow. Fields of tobacco, once planted, tomorrow will be another crop. Lands may be mined and flat today; tomorrow, formerly mined land may be the site of a booming economy. It may be where ideas and creative expression arise. Land can be covered by the deep water of a pond, a camp site, a corn crop, or a shopping center. While certain things may not be suitable for a tract of land, trees are rarely the only thing for which any tract in uniquely suitable. Trees are thus a decision. Trees have no intrinsic “right” to an acre. Ranging land can be considered to exist as a mappable, working platform, and Rural System will promote the best possible uses for each Alpha Unit.

What's the Deal?

While not competing with existing enterprises, Rural System is likely to increase the markets and profitability of existing recreation, sport, and outdoor-related enterprises. All of these require a high-quality environment, conditions that attract people and please them enough to inspire a return or to share discussions about their positive experiences. Some sports require special conditions, but they all benefit from a beautiful regional experience, pleasant interactions with people, and reasonable services.

There's been much state and federal agency work on large and small public areas, foundation support, and enormous amounts of volunteer effort and time spent to preserve and manage public natural recreation areas. That work and thought underlies the planned actions of each ranging program. Public agency work has been essential, but is now uncoordinated, piecemeal, and adrift within public challenges for greater private use, lower expenditures, and other limitations.

Rural System plans to launch related business enterprises, such as clothing and equipment for ranging activities. Proponents of outdoor recreation and its economic impacts list supportive fields and count their full contribution to the production of income. Sources range from matches to motors, beer to binoculars. Changes in economics, agencies, and policies in the U.S., indeed the world, indicate that alternative strategies may be worth discussing… even necessary.

Current conditions suggest reduced tax support for natural resource agencies, loss of experienced staff, increasing environmental problems for which there are no apparent solutions and only long-term maintenance costs, new public awareness (but poorly informed) about human dependence upon a healthful environment, and new demands for “cleaning up” after past misdeeds. There are increasing *urban* populations, most having little understanding of changing

rural conditions, practices, or limitations. Farming conditions and the employment in rural regions today change daily, influenced by globalization, urbanization, family relations, emigration, and technology. People are leaving rural areas, in part due to this instability, and the support and service structures are disappearing. Ranging staff can help slow and reverse those trends, and tend-well innovations for the remaining rural land.

Ranging is not just a bunch of activities but a dynamic system that can be analyzed, designed, operated, and maintained for the long run. “For the good of the environment,” or, “for the good of the animals,” are essential concepts, but foremost is, “for the good of people and their region.” When a system is designed, and operated for the good of people into perpetuity, all of nature must be included and tended with great care to assure that the desired future conditions occur. Ranging can unify outdoor recreational activity with superior modern land and natural resource management to achieve lasting stability.

We suggest caution, however, and have prepared notes on tourism limits. There are mixed messages and caution flags in developing ranging as a singular line of investment. It can “work,” but only with very careful planning and skillful implementation, concentrating on full costs. We strongly support limited, careful efforts and enhancement of the activities now underway, but suggest time and effort be devoted to a diverse, inclusive set of activities, those most consistently profitable. We study “scale,” because a baseball game does not create a stadium. A large, diverse effort will attract ranging potential and regional success.

There are many ways to express profits, ways to move past the economic margins, and new ways to gain synergism or team benefits. Cost-effective strategies can be developed and the effects of decisions simulated before they are made. Optimum locations can be computer-selected for things that are *line-like* (e.g., utility corridors), *point-like* (e.g., offices, factories, plantings), and *area-like* (e.g., effects of a tax or policy).

Although Rural System staff are prone to wish to protect or save the region's natural resources, we are more prone to concentrate on *managing* those resources because some now need restoration, then enhancement. Improved human food supplies and water quality are repeating topics within this book. They are the essence of our beautiful rural landscape. Of the areas we do protect, there are ways to make profits from them still, and these are a part of Rural System tactics for the long-run.

Just Imagine with Us

Please reflect on the current regions of Virginia and those of adjacent states, potentially seen from highways. Think of all those diverse forests and rangelands, with fishing, hiking, and related activities throughout the region for tourists and visitors, citizens, land owners, and the overall wellbeing of the people of the region and neighbors.

Also, imagine:

- productive pastures and forests as scenery;
- people discussing Rural System Ranging as *a single destination* of diverse activities and experiences;
- publications, Internet units, and banners that tout things included that are ***new*** in the area;
- the region itself taking on a sense of newness, becoming the total system like a historic birthplace: that of Ranging;
- quality outdoor activities in a vital, improving region, with a new 150-year plan;

- becoming a member of Rural System, sharing profits from 30 or more ranging-related small businesses, managed by a for-profit alliance of existing and new private enterprises; and
- podcasts about new ranging opportunities and YouTube presentations of developments and challenges, successes in wild fauna management, seasonal wildflower trips, and local pasture beauty.

The Ranging Program advertises the region itself, along with its activities, as it seeks to make profit from all enterprises. By working together, enterprises achieve scale, scope, sequence, central services, and synergism, overcoming hundreds of recreation business losses in the past.

None of the enterprises suggested for Rural System, Inc. are more important than any other. All, by design, are related and supportive and benefitting. They perform together as a single, carefully-managed system, prepared for the often-needed rural recovery, resilience, and confidence-building.

Individual participants, with their lands and waters within Rural System's Ranging Program, might reasonably expect:

- A measurable increase in the budgets of at least 10, select, related businesses;
- National and state promotion;
- Two annual season fairs;
- An increasing regional Visual Quality score;
- Noteworthy improved farmland members;
- Increased avian diversity; and
- Abundant local school presentations and contests.

General, related activities include:

- Gaining controlled access to natural resource areas;
- Improving communication among local environmental and conservation groups;
- Building a local information system for participants;
- Describing and promoting a land-use ethic;
- Directing charitable funds toward local studies and research;
- Improving services, safety, security and deliveries to visitors in various lengths of stay;
- Demonstrably valuing cultural diversity;
- Managing access to small, remote designated “wild” areas;
- Predicting public interests, and expanding activities and opportunities;
- Studying and gaining improved, computer-based human health indices;
- Describing and reporting changes in visual differences in landscapes; and
- Actively matching human interests with available resources.

Rural System will provide cost-effectiveness for all Groups, and stability for some activities that are seasonal and affected by storms, fires, etc. (even skating on ponds). It directs the work that is designed to provide strong financial incentives for superior, long-term, private rural land management.

What's new? Why “Ranging”?

The needs for Rural System seem clear and, while the ideas herein are not new, the purposefully *combined and integrated* applications suggested *are* new. The advantages for a state or region are evident as problems are addressed within a single system, an entire region working together for its own good and for the future. New today, the innovations, discoveries, and applications that will arise from the exciting, changing interplay of the proposed enterprises and activities will themselves provide the motive to see and experience, "that dynamic, creative *ranging place*."

The modest objective of creating Ranging within Rural System is to benefit the people of the region for at least a 150-year planning horizon, shifting forward one year each year. To do that, the objective is to create and operate a for-profit enterprise that will set standards of excellence in resource management in the region, increase employment, stabilize communities, and increase benefits to landowners and citizens… then expand widely. A proportion of the profits will be devoted to key improvements on private rural lands. The sketched results sought include:

- Employment of about 150 people;
- Products, profits, and taxes from 30-50 small businesses;
- Modern Crescent management;
- Innovative, diverse ecotourism with memberships in new organizations, new nature "sports," and new educational events;
- Integrated deer damage management dealing with auto-strikes, threats to endangered plants, and crop-loss;
- Computer-based land management games and educational units;
- Various housing and services for visitors;
- A modern, complex, total fishery; and
- Specialized product sales and branding within the Rural System **Marketing Group**.

Over 50 components of the Ranging Program together result in a new, dynamic, public-private partnership for rural regions, first in Southwest Virginia.

Southwest Virginia, as many other rural areas, is beset with problems and needs in an ever-changing political environment. Pressures increase from an increasing, new set of diverse users whose interests, values, knowledge, and wish for outdoor experience is now very great. There has always been uncertainty about rural land management and what complete naturalness (a hands-off concept) may mean when contrasted to various levels of manipulation, control, intervention, or even restoration to achieve some previous state. The region is beset with these and other problems, for set-aside lands now need management. Rural beauty is seen in some pastures and unless these are carefully grazed, pastures become eroded or revert to forest-sameness. Southwest Virginia is probably already experiencing problems of the types and magnitudes likely to be experienced by other national rural communities in the near future.

The region and its people need help now to stop or slow the loss of farm families, assure a tax base for local children, provide quality conditions for tourists, offer jobs, and assure local people lasting advantages from investing in the region. The region may capitalize on demonstrating its successes with a modern high-technology solution to pressing regional problems, receiving recognition nationally or even worldwide. Others, elsewhere, are in the same boat and can benefit from the lessons learned and practices employed.

People have expressed a fresh spirit of need for less-public and more-private involvement in life. Often expressed as reduced public agency employment and reduced funds for established

agencies, the perceived spirit can have profound effects on the land and on its users and managers, especially as public land use increases while funds for protection and management decrease. There is no singular solution, but the full program of Ranging can provide major assistance.

Committed to using research results from past public investments, Rural System is also committed to rapid increases in studies for namable gains. Though the U.S. has an international reputation for scientific research, the National Science Foundation reports that citizens of the U.S. have turned against supporting research. Drastic cuts and reorganizations have occurred. Many areas of research in universities have been cut and costs have increased. Rural System seeks new ways to continue to produce research results, to maintain momentum for needed solutions (Chapters 5 and 6).

It has been difficult to sustain necessarily long-term studies of slow-moving natural systems. The needs for ecological knowledge, for understanding biodiversity and its proper care, for reducing wild fauna damage, for protecting rare species, for assuring human enjoyment without losses to the wilds... are all very real, and we have worked with graduate students prepared to learn new approaches to meeting them. Rural System can make use of the past progress of faculty and students of Virginia Tech, and other colleges and universities. The union of three—the region, Rural System, and the universities—in a unique effort, can bring new benefits to citizens at low tax costs, and can move new research findings from on-the-shelf to in-practice. Ranging will be central for rural area research and productive studies, attracting a large number of visitors hoping to experience recreational novelty, action, invention, and the vigor of a revitalized area and its people.

Stoneworms

I walked stretches of the Appalachian Trail in Maine, Virginia, and Georgia (in Ranger training), and did trail work with a team of five near Oakridge, Oregon, Mule Mountain lookout access, in 1965.

I worked with a small trail crew, opening an old trail with many cross-trail large logs. On that trail, I was surprised to slide downward, met my Pulaski tool along the way, gashed my thumb, and was pleased to walk with the stock back to trucks and surgery the next day, living "happily ever after," well-cautioned about sliding soil, tools "with a mind of their own," and a new respect for the potential dangers and return-to-base costs and losses of the Western USA national forest.

Years later, I collected and studied books on trail-building. On Rural System lands I proposed intensive, modern trail building based on US Forest Service and National Park trail analyses, and active use by the procedures developed.

We plan to create extensive trail systems, well-marked and with electronic markers for users during the day and at night. We'll create several trail types, such as total ownership access, views, wild-plant sites, and Crescent management access and demonstrations. We plan diverse trail types, well-constructed to avoid erosion, and easily maintained (smoothed, shaped, and with water bars).

Stoneworms is the proposed trail-building and maintenance Group within Rural System. It will study and develop trails, perfecting its own work. It will also be a demonstration and educational Group. It will get trail work done in demonstrations, tests, and contests. Stoneworms will enhance the potentials of forestry, fire crews, recreation, research, game harvests, and

fishery enterprises. Trails convert land into resources, and thus to potential benefits through the well-known economic concept of *access.*

Many miles of trails are needed, as are returns to cover costs. It would be unfair (and ineffective) to require Stoneworms to bear the full burden of a positive income-to-cost of operation. Trails provide a form of insurance against fire losses. They reduce forestry costs, challenge soil terrace creation and roles, and provide inspection access and security aids. They add beauty and increase property value.

Guides are needed in Stoneworms for guests of many types. Carefully selected, the Guides will wear noteworthy clothing, provide commentary and instructions, sell products as available (trail-building, hiking, camping, nature appreciation, exercise, safety and first-aid, woodland survival, etc.), and help bring urban visitors and trail users into harmony with their new rural surrounds. Trail Guides will gain tips as well as salaries, and engage each other in perfecting outdoor skills and knowledge of Rural System areas and waters for many types of visitors (some international, some with special needs).

Safety and Security

Safety and Security, the Rural System Group with the longer-than-usual name, has a large task on each ownership or cluster in communicating—to staff and guests—rural, outdoor, hiking, camping, and boating safety, along with occupational safety within composite fields known for unsafe, accident-prone conditions.

We plan to work toward international prominence in safety as we encounter a full range of often-unsafe conditions, and staff with prior education in safety (on which we plan to capitalize). As we work to gain new profits, we shall reduce costs and losses from accidents and lack of knowledge of danger and hidden personal costs.

We emphasize (minimally) hunting and angling and outdoor-life safety categories. Human/wild fauna relations are part of an on-site message as we encounter diseases, poisons, allergies, and typical camping-related accidents and temperature stress-conditions. We intend to implement a system of wild fauna law violation, prevention, and apprehension procedures.[77]

Safety in fearfulness, and information on unsafe expected behaviors of guests, will be gained as we come to understand international tensions and real threats to life within the regions with which we work. We anticipate fires, theft, and food destruction by many means, as well as water and food disease involvements. We'll employ ecosystem risk analyses (within VNodal), as suggested by Swartzman and Kaluzny.[78] We discuss direct links among our safety and security costs, time and health losses, and reduced life expectancy—displayed in our computer-produced indices to group successes (system branding as "healthy" for guests, employees, and affiliates).

We seek additional advice and tactics on protecting markets, crops, water supplies, and livestock. We respect cleanliness and advice for achieving it, especially in disease deterrence/avoidance. We welcome advice for avoiding specific rural threats.

Modern Hunter Safety

There's emerging need for a profitable school for hunters within Rural System, to get new hunters licensed, and experienced ones attuned to needs and responsibilities of hunters on

[77] Giles RH. 1978. Wildlife management. San Francisco (CA): W.H. Freeman, Co.

[78] Swartzman, Kaluzny SP. 1987. Ecological simulation primer. London: Macmillan Publishers.

Rural System lands. The school will teach safety practices to reduce accidents, increase the quality of every hunt, increase hunting success, and reduce negative public attitudes toward hunting. By attending the class, hunters will also gain useful Rural System connections, and pride and local awareness.

The classes will be conducted on 2-5 training areas (progressively developed) on contract land, typically within a natural amphitheater. Participants will receive certificates, Rural System literature, emblems, and equipment access. We shall seek state-parallel approval for adequate hunter knowledge and skills. Some presentations will be shared on a Rural System blog.

The presentations will include:

- Statistics describing hunter safety problems, and therefore why the class is important;
- The typical personal problems of unsafe action or non-action;
- An answer to the question: "whose problem is it?";
- Demonstration of accidents about to happen, and how to control them—what to do; and
- The benefits of hunting safety.

Emphasis will be on:

- Different equipment, hunts, experiences, and practice—leading to Rural System ranges and courses, personal equipment, and dress;
- Special details for hunting on Rural System lands (and usually others)—what we expect and how participants get a Rural System certificate of having completed the course, as well as a general one;
- Serious students, for maximum behavioral change in time for permits and awards; and
- How participation of hunters in the class helps land owners, Rural System staff, and the people of the area. We shall invest some percent of funds in improved hunter education: places, experts, equipment, publications, training aids, blog posts, and insurance.

Rural System's ***Challenge Course*** will allow hunters to practice what they have learned on a few, carefully-selected sites. The annual program will be conducted for state agency administrators to see the latest Rural System developments in the field, the likely changes, and the electronic media being produced.

Rural System may later create a memorial area, a special forest location to commemorate people known to have been killed in hunting-related accidents. We will also track accidents—where and how they occurred—to build a model of relative safety and needed safety actions for Rural System hunters. We will someday make GIS maps of areas known to be safer than others, and areas that are relatively more dangerous. Hunters, biologists, and managers need to know if such areas exist. We know areas exist and can be mapped for where more animals are shot and killed. We have planned, mapped soundscapes (Chapter 2) for law enforcement agents—aids to reference when out-of-season, or in "no-hunting" areas, to detect the presence of poachers.

Every three years we shall invite state hunter safety leaders to a conference near one of our education areas. We shall exchange ideas for improvements and for encouraging solutions to the main problems observed. Also, occasionally, we shall report on our estimates for future hunting production, and our current plans to address it (i.e., harvesting devices, probable species and areas, and hunter sex and age classes).

For example, we believe that hunters' willingness to hunt (and trap, as our data show) declines with age. We can model that and estimate the future of hunting on Rural System lands due to population demographics. We can simulate effects in changing prices, changing travel

costs, willingness to consume, and willingness to add game trophies to the home décor. This information may then inform marketing actions to stabilize hunting on Rural System lands, and therefore contribute to stable corporate profits.

We believe that Rural System can profit from several books on hunter safety, timed for release in the pre-hunting season. A safety-oriented bibliography and glossary will continuously be built. We shall compare carefully, before and after education effort, to estimate change in behavior for the money/time spent. The Marketing Group can suggest an award for Rural System units on lives saved, reported decline of unsafe practices, and not-crippled-animals.

Flora and Fauna

As elsewhere, this is not the place to quibble over terms, but readers may gain from my past, small efforts with the public and workers for likely significant benefits from discussing wild *fauna,* specifically, and not merging flora and fauna in every not-very-thoughtful use of *"wildlife."* Enforcement of rules and regulations differ significantly, as do conversation about "biological diversity." Vague uses now influence agency names and university departments … *and* decisions about "proper" budgeting, staffing, and major allocations.

Within Rural System, we have management descriptions for deer, bear, ruffed-grouse, foxes, turkey, raccoons, bob-white quail, and other wild fauna, and will implement plans for these on approved, leased lands as soon as feasible. The emphasis here is basic diversification, bringing income stability. The Owls Group (Chapter 10) is a diverse, special Group, but it presents expansion options in field studies, dinners, fireside entertainment … and trips for people searching for additions to their bird-watching life-lists. The Foxes Group, more-so than other species, will require special attention to human recreational viewing as well as diverse alternative uses in pest control, hunting and trapping, rabies outbreaks, and as predators in ecosystems.

We rarely mention individual plant species to be managed on private ownerships, but we plan active work within Nature Folks, a Group with some focus on species protection and management (e.g., ginseng), and forestry-related efforts with tree species and special sites for groups of tree species (i.e., arboreta and cemetery-trees) and agroforestry, with their linear fruit-producing shrub lanes. We'll explore insect and terrestrial snail populations and their roles throughout our areas, and surely someday we'll study the use of insects as food for pets, now eaten by some people.

Deer Herd Management: The Concept and Rural System Plan

Deer are a prized element of the wild fauna throughout the region, and likely in expanding regions of the planned Rural System. We may someday provide a program equivalent to bird life-listing, as we travel around the world to see and learn about deer and add new species to our personal life-lists or tally official "sightings." Thousands are harvested annually by hunters. In additional to their appeal to sportsmen, deer are beautiful animals with great appeal to many citizens and visitors.

However, they can be harmful to forest regeneration, crops, and occasionally to motorists. Deer herd management is necessary to achieve the right number of deer both for land owners, and general public welfare. Management is essential. Fortunately, more is known about the management of deer than any other wild animal, and major known elements are included in Rural System's modern general systems approach.

With several related objectives, Rural System will concentrate on lasting, net financial benefits from white-tailed deer populations within managed areas. Some owners of areas will specify more precise objectives, such as tourism; other owners will specify travel economies; and still others will emphasize reduced cropland and tree damage. The quest will become increasingly more difficult as questions are raised about "balancing" landscaping-plant damage from deer, stabilizing motel and hunting-camp attendance, or about changing popular quests for superior antlers vs. numbers of deer to harvest. These questions must take into account changing demographics, as numbers of hunters and license sales decrease, safety concerns increase, populations of people become more urban, hunters with less practice, and as fawn and coyote dynamics create uncertainties.

Our emphasis for the near future is on net human gains from the deer resource, over many areas, and over longer time during the year (while significantly reducing the likely losses from the growing resource). Active Rural System deer management will present deer herd history; work with reducing deer herd damage; relate deer weights to forage requirements; appreciate the importance of cover and energy ("saved" vs. lost); quantify herd increases; conduct deer tours on Rural System lands; implement new hunter success scoring procedures; promote local deer resource clubs; promote related art and photography of deer and their habitats; promote safe deer carcass butchering, roasts, and recipes; and sponsor youth deer track-casting contests, with related "trail findings." **The Deer Group's** public element will sponsor roadside deer-crossing signs and electronic signals at major crossings to reduce auto-strikes. (There's work ahead!)

Setting hunting seasons is a major management act. If hunters or land owners can help set proper seasons, then they will likely observe an improved deer herd on their land as well as surrounding areas. The proper combination considers (1) the opening of the season, (2) the length of the season, (3) the sexes that can be harvested, (4) the cost of the license, (5) the weapons used, (6) the timing throughout, (7) the number and types of permits issued, (8) and a predetermined number of deer that may be taken each year. The predetermined number is a very complicated calculation, done by sophisticated wildlife biologists and typically using a computer. The calculations involved are more than possible to review here.

The main points are to:

1. Encourage detailed processing and reporting, including how well the season achieved the pre-stated objectives;
2. Support The Deer Group's efforts to obtain regional and state-limited seasons, and other factors designed to achieve calculated harvests; and
3. Encourage studies geared to improve such calculations and to determine means to more closely harvest computed, specific deer… all safely.

There are good reasons why lands are posted against hunting. Nevertheless, in order to achieve the harvests needed (to prevent loss of surplus deer production and damage associated with overpopulation), hunting is needed. Yet, people are leaving rural lands, creating new problems related to land owners, hunting effectiveness, hunting laws and knowledge about them, and deer harvest estimates for the future. The Deer Group provides an alternative to posted lands—a way to post and yet gain the desired harvests.

There are many new ways that people can obtain benefits from deer. Provisions for hunters—like trails, lodges, and other facilities—can enhance the character of the hunt or

observation period. Rural System plans to offer select opportunities and programs for hunters to significantly increase deer hunting experiences and benefits.

Efforts to reduce crippling losses can reduce the displeasures associated with some hunts. Only by allowing certain weapons, providing areas for sighting-in, practicing with weapons before hunting, and using skilled trackers can we reduce such losses. A Rural System **"Trackers and Trails"** program is being developed for outfitters, trail guides, and helpers.

Deer have a peculiar behavior. The average deer stays within about one square mile in its lifetime. It's possible to have too many in one area, too few close by. Deer are also greatly influenced by their environment. The richness of the soil and the abundance of food influences many deer characteristics. The better the habitat, the greater the diameter of the antler beam, the greater the body-weight, the more kidney fat, and the more tines or points on the antler. Better habitat also leads to greater number of ova produced, a greater chance of does producing twins, and a greater proportion of young in the population. These are indicators of how well a manager has gotten and kept a deer population healthy.

A large, healthy population is hard to achieve. Doing so is a balancing act among select options and conditions:

- If there are many deer, they eat much forage, otherwise available for growing trophy antlers on bucks.
- If many bucks are removed, the available food goes into extra fawn production by the does.
- Young populations are most vigorous in reproducing.
- Old populations have larger antlers and greater sporting quality; they remain reproductive.
- The smaller animals require, relative to the larger ones, more food per pound of body weight (you can feed more pounds of big animals on a limited range than you can small animals—but fewer animals).

Thus, the percent of bucks and does and the ages of young deer are critical since that determines how big they are and thus how much food the population requires. Only very local, long-term, sophisticated analyses, as provided by Rural System's Deer Group, can achieve this balancing act.

Deer rarely live past eight years. Thus, it's feasible to remove animals skillfully by hunter harvests. Typically, between 20 and 40% of a population can be harvested each year, and landowners may yet have the same number of deer next year due to natural reproduction. As other animals, deer have maximum density limits. One per 20 acres seems, in a local population, to be about the upper limit. Limited food supplies and overcrowding, or "density stress," operate to keep this limit. Staff and assistants will make deer "droppings" and track counts, and correlate them with deer numbers and other factors of the environment.

Stocking deer is unlikely to be needed in any of the regions under management. Predator control is unwanted, except for much more stringent control of free-running or unleashed dogs. Spotlighting of deer must be stopped by increasing enforcement activity and increasing effectiveness, projects, and landowner cooperation with state game law enforcement agents. (Limited, announced spotlighting by staff for counts may yield useful data.)

Rural System's Deer Group can provide a timber-rotation schedule that will attempt to achieve an owner's desired deer production through balancing many system factors. As trees grow out of the reach of deer and shade the forest floor, available foods decrease. A system of

diverse species rotation is needed so that about the same number of acres of productive capacity is producing needed foods. Deer readily use the mast or nut production in fall and winter (as do competing mammals and birds), but mature forests rarely sustain the year-round production required for a large number of deer. High mast production (energy and nutrients) is planned for superior deer production areas.

Water is rarely limiting for deer though they will use it where it occurs. They can get most of their needs from succulent foods. With climate change, deep-water and flowing-water sources now seem needed for deer and other fauna. Salt is taken in the spring, but does not seem to be a limiting factor for deer. As Olaus Murie said for elk: "a salt block is like a beer fountain might be for a town—much used, but not necessary."

Deer management can produce abundant, diverse, year-around benefits to urban people with increasing interest in and gains from the wild deer resource. Deer, when abundant, become farm and urban-border pests. Newly available, Internet-based observations will be offered of deer herds—sharing, as never before, all aspects of their environments, lives, and difficulties.

The Quail Group

The Quail Group will focus on managing bob-white quail *(Colinus virginianus)* for profit, and is expected to expand rapidly among rural home-owners, following recent "lows," with herein-recommended management. Quail, a little bird, needs so much attention in so many ways. People often do only one or two of the management actions listed below, and so experience little success; no one knows exactly what is wrong in every case, and sometimes a diversity of variables are not right for healthy quail populations. We believe that a manager, doing most of the whole list of actions, will be able to maintain viable populations of quail on rural lands.

Quail fly moderate distances, flushed from quiet repose in groups known as "coveys." Season-specific food management is needed—literally year-around seed and insect production and management of small, ground-level insect abundance and diversity of predators. Large areas are needed year-round for covey escapes, with open trees for flights from diverse potential enemies.

Where a few quail still exist:

1. With Rural System staff and The Quail Group, list the desired benefits for whom, where, over what period, and within what seasons the system objectives will be sought:
    i. Family pleasure from calls and sightings
    ii. Family health
    iii. Harmful insect reduction
    iv. Hunting sport gains
    v. Nature photography
    vi. Bird watcher attraction
    vii. Photographer attraction
    viii. Dog kennels, training, trials, shows, contests
    ix. Partial game preserve unit (natural quail)
    x. Studies (profit-oriented)
    xi. Falconry
    xii. Organization

xiii. Publications
xiv. Consulting base (demonstration of procedures)
xv. Equipment and clothing sales
xvi. Land visitation permit sales
xvii. Predator-related work (Remove hawk-owl perches)
xviii. Horses and horse use and trails (sightings, flushes)

2. Keep an account of all costs.
3. Use crowing posts to record birds seen, locations, and covey density. Place whistle (the "bob white" notes) (5-6') posts at numbered corners of all 1/3 acre triangles.
4. Develop triangular hedge rows throughout the area. Use a portable electric fence within select areas. Graze the interior triangles on a 4-6-year rotation.
5. Vary the hedge vegetation in soft-mast-producing shrubs: privet, viburnum, crataegus, rose, honeysuckle, elderberry, blackberry, raspberry. Make some hedges of conifers. Use low-growing types: mugo pine, Fitzer juniper, or be sure to prune to keep dense low-form for winter cover.
6. Work for diverse, high insect populations in spring.
7. Provide water sources, 1/acre, for special periods.
8. Provide poultry grit, one spot per 2/3 acre.
9. Provide superior, non-toxic dusting areas, one spot per 2/3 acre.
10. Mow hunter- and observer-pathways or trails throughout the area.
11. Develop pyramidal brush piles in the "hedgerows."
12. Place old fence and brush in pyramidal form in "waste areas."
13. Develop one "snow shelter" (any type) per 1/3 acre (e.g., at the corners of all triangles).
14. Plant each triangular "quail field" into a different crop and rotate them: millet, corn, ladino clover, fallow, low-cost grain (wheat, oats, barley, etc.)
15. Fertilize and lime inside each field in strips to avoid an even pattern to increase insects.
16. Have one of every 6 triangles in fields with high-grass nest-cover. Mow pathways in these areas in spring.
17. Study regional densities: keep records of sightings, especially cumulative maximum.
18. Create a permanent census route for trend studies (e.g., modified King method).
19. Weigh all recovered birds; record weights and watch trends. Try to devise tactics to improve weights.
20. Observe sex ratios; calculate chi-square to detect when significant differences occur.
21. Remove key quail predators, especially feral cats, also crows.
22. Encourage large mammal trapping nearby and within protected areas.
23. Develop wire-covered standing-grain areas.
24. Develop emergency feeding "roofed" areas near roads (easy access by jeep, etc.) for severe-winter supplementary feeding.
25. Develop horse trails (for diverse sightings and secondary benefits).
26. Develop fire breaks.
27. Use cool-soil burns in small select areas if hedge rows are not to be used. Rotate burns every 4-6 years.
28. Avoid pesticide use.

29. Fertilize and lime fruit trees (e.g., cherry) in hedgerows.
30. Develop paths for bird watchers. Develop a guide service to gain benefits from population success.
31. Develop a kennel for visitors' dogs.
32. Develop a stable; use tethered horses for grazing regulation of vegetation in triangles.
33. Reduce groundhogs (*Marmota monax*) that build dens for predators.
34. Build blinds for photographers.
35. Improve soil conditions of all types; eliminate erosion; add organic matter to 'scalds.' Areas that "will not produce anything" will not produce quail; such areas increase the divisor in "Quail/Area." Map and subtract their area.
36. Join or develop a quail-related organization with fees, newsletter, blog, etc.
37. Take quail samples to a veterinarian or lab to get a base-line condition on health and disease. Collect liver, brain, and fat samples annually on harvested birds as baseline in the event of radical change in populations.
38. Put snow fence in sparse hedge rows for wind protection.
39. Conduct spring call-count routes to establish trends and population change/$ invested.
40. Invite press coverage, share blog contacts and images.
41. Sponsor studies for quail genetics, potential relationships between/among local quail and purchased quail from several sources.
42. Determine the exact spot of each quail kill; the quail can become the "monitoring species" (location and date) for analyses of radio-active nuclide presence, starting with a very-low level late in 2017, rising thereafter with reported reaches toward "nuclear warfare" and test actions within North Korea.

Wild quail populations, easily lost from the convergence of many land use factors, can probably be regained, and major, diverse benefits, such as the "bob-white call," can be cost-effectively gained for many people… or lost.

The Wild Turkey Group

Like Rural System's Deer Group, **The Wild Turkey Group** provides a departure from past wild faunal management. A symbol of regional Thanksgiving, the turkey feast is well-known, perhaps a part of Pilgrim life in Virginia. The wild turkey is a link to state and federal funding within wild animal management. It is sensitive to and harmed by land use changes toward urban conditions.

The popular wild turkey *(Meleagris gallopavo silvestris)* has been restored in Virginia and elsewhere; Dr. Henry Mosby was highly influential in accomplishing this. The "turkey" is one name, but that word names two distinctly different birds requiring different conditions, thus two types of active management: **poults** and **adults.** They require attention for different periods in different faunal space. They require many environments, including grass/forbs, edge/shrub, and mature forest of at least two different ages each ... thus 24 separate considerations and action programs. "Managing for turkeys" is said to be for all species; if their 24 conditions are met, many needs of many other species are likely met too.

The turkey requires forests, but its young also require cleared areas (primarily for nesting at edges, and for insect foraging). How forests are managed influences turkeys and the complex resource system grown up around the bird. Scientists have intensely studied how to manage

turkeys. Optimum forest management for the turkey may not result in maximum financial returns from the forest. The difference—the net losses and potential gains—are of great interest.

The Wild Turkey Group represents a major, alternative natural resource strategy. It is similar to that proposed for The Deer Group and other faunal enterprises of Rural System. It will account for the unique nature of animals, denying that all animals are 'wildlife' subject to the same over-generalizations. It demands *applied,* superior managerial skills and knowledge. Perhaps more than any other game animal, managerial efforts to increase turkey populations benefit many other game animals, and tend to hold or increase biodiversity. These can only be tallied as secondary gains, largely unaccountable from the singular indexed task of *lasting regular profits.*

From one perspective, the Wild Turkey Group is a large, agribusiness management firm. It will manage land for profits related to the "crop" —all marketable entities associated with the turkey. The Wild Turkey Group will be developed cautiously, but rapidly to achieve a diverse, sustainable enterprise that brings clientele to the wildlands, assures stable use in the hunting season as well as other times, and operates to assist other landowners in achieving positive gains from their turkey resource. The approach and actions are:

- A systems approach to single-species management of wild turkey for maximum benefits over time;
- Forest and wildland taxation advice for owners, and perhaps access to a foundation or relating to an educational and research group that provides tax incentives for progressive investment in turkeys;
- Improved forest land value assessment for long-term valuation, and land and water banking;
- Publications and other media related to the wild turkey;
- Fees for full-service turkey hunting on Rural System lands;
- Special shows, workshops, social media, and educational events on topics related to wild turkey management;
- Special advertising of Rural System wild turkey work to assure maximum public relations benefits from investments in the resource;
- Ornithology tours for people to add the wild turkey to their life list;
- Several major hunting lodges;
- Prescribed burning and wild fire management services;
- Detailed turkey management plans for each area; and
- Rented blinds for turkey flock observation by tourists and bird watchers.

The Wild Turkey Group's novel contribution is its scale, diversity, resource value enhancement, and monetary emphasis. Turkeys are a function of the land but also of humans. The turkey population is a resource; the manager usually seeks to maximize total net benefits from all of the uses of the population. General objectives of a biological nature are to maximize poult production, increase forage, provide adequate water, and sustain a viable breeding population.

The wild turkey is the largest game bird in the United States and probably the most difficult of all to bag. "Gobblers" (males) may attain a length of 48 inches and a weight of 16-18 pounds, whereas hens rarely exceed 36 inches in length and 10 pounds in weight. Weights in excess of 30 pounds have been reported, but birds larger than 20-21 pounds are a rarity. A gobbler can usually be distinguished from a hen by a tuft of coarse feathers on its breast, called a

“beard,” and an upwardly curved spur on the inside lower part of each leg. Hens occasionally have beards and in some instances beards do not develop on gobblers, but these cases are rare.

Turkeys are polygamous breeders, with one gobbler mating with several hens during the mating season. The male comes of breeding age at two years, while females take only one year. The male attempts to attract as many hens as possible by making gobbling sounds during the mating season, which usually begins in late February or early March, depending on the severity of the weather. The hen lays from 8 to 15 eggs in a well-hidden nest on the ground. Incubation of the eggs takes 28 days. Turkeys have only one brood per year, but following unsuccessful attempts they will continue nesting attempts until success is achieved.

The preferred habitat for turkeys is an all-aged woodland of mixed hardwoods and pines. Although oaks are of primary importance for turkeys, a variety of hardwood species is desirable in case of acorn failure. Turkeys need openings in the forest for insects and plant seeds, both of which are important in their diet. Turkeys drink water daily, so abundant free water, well-distributed over the range, is a desirable resource for birds. Since turkeys depend on their eyesight for protection and escape, woodland cover should be fairly open. Turkeys roost in trees, usually the tallest ones.

Turkeys eat a wide variety of food, depending upon the season of the year and what is available. The diet of adult wild turkeys is comprised of about 85% plant matter and 15% insect matter. This percentage is reversed for poults under six weeks of age. Although young turkeys eat a great variety of insects, grasshoppers, crickets, and cicadas probably comprise the bulk of their diet. Choice fall and winter foods for adult turkeys include acorns, chinquapins, beechnuts, dogwood berries, wild grapes, chufas, corn, barley, clover oats, rye, and winter wheat. Some favorite spring and summer foods are huckleberries, blackberries, mulberries, browntop millet, cowpeas, peanuts, grain sorgums, soybeans, bahia grass, yellow-eyed grass, carpet grass, and insects. Salamanders, toads, and small snakes and frogs are probably under-reported as a turkey food source.

Management for wild turkeys can be quite complicated due to their variable productivity rates and extensive habitat requirements. However, a few things that can be done to ensure suitable turkey populations: (1) produce more food in wooded and open areas, (2) provide suitable drinking water throughout the range, (3) maintain favorable cover and roosting areas, (4) protect turkeys from the often-significant losses from poaching, and (5) ensure against the spread of specific parasites and disease.

Food production in the forest can be provided by leaving a variety of mast- and fruit-producing trees. For optimum range conditions, at least 25% of the forested area should be mast-producing hardwoods, especially diverse oaks. Oaks at least 6 inches in diameter and over 30 feet high are the most valuable for acorn production. Prescribed burning is also an excellent turkey management tool, as it increases production of native grasses and legumes. Prescribed burning should be done no later than February 15, so that nesting won't be disturbed.

If drinking water becomes critical during droughts, turkeys will leave the range. Therefore, it is essential to have a year-round source of drinking water. Ponds and wells with hydraulic rams are means of assuring a supply of water.

Although the adult wild gobbler is alleged to be the keenest of all game birds, hens and young poults are highly susceptible to poaching. To avoid unlawful trespassing and poaching, posted signs and locked gates on entry roads should be installed.

Turkeys are plagued by a large number of parasites and diseases. This is probably due to their flocking nature, which facilitates rapid spread. The most serious disease affecting turkeys is

blackhead, which often causes 100% mortality in flocks. The following practices are recommended to keep infectious diseases and parasites to a minimum: (1) food patches should be kept small and should be rotated every year, (2) free-ranging domestic turkeys and chickens should be curtailed, (3) fields should not be fertilized with droppings from domestic poultry, and (4) pen-raised wild turkey should not be released.

Within The Wild Turkey Group, we know what to do to increase, maintain, and manage-well a large population of wild turkeys. The following list is that of named actions, but they are only meaningful within the proper scale, relations, and, of course, timing and cost-effectiveness:

1. Increased hard-mast production and GPS-located wild grapes, which seem to influence movements during the hunting season.
2. Reduced non-specific insecticide use in surrounding areas.
3. Mowing patterns in grassy areas and clover fields to increase insect accessibility for poults. Poults have difficulty getting to their diverse food-creatures in dense grass, mowing can be very beneficial. It needs to be done in the spring to produce changing, variable habitats for insects for poults, and easy access for them at the edges of each mown swath. Poults need abundant insects supplying the needed oils and proteins to maintain body temperature and grow bones, muscles, and feathers.
4. Increased low-shrub cover for nesting.
5. Maintained patches of grains that remain upright in winter snows.
6. Reduced turkey predators, and especially human poachers.
7. Reduced disturbances of all types (logging, recreation, feral dogs and cats, etc.) during nesting.
8. Maintained, small, dense stands of conifers for thermal cover.
9. Prescribed burning to achieve growth of various desirable forbs and special-function areas (plants, fruits, insects, etc.).
10. Increased farm hedgerow lengths (avoid “hawk alleys” harmful to hens and nestlings).
11. Select forest road and trail sides to produce desired grasses and forbs. Leave similar areas to produce native seeds and organisms, and to achieve other benefits of “day-lighting” forest roads.
12. Where field or forest clearings are developed primarily for turkeys, develop and mow the centers (described above), and manage a complex border of nut and fruit trees, vines, shrubs, conifer wind barriers, and native preferred-seeds.
13. A variety of mast-producing (nuts and seeds) shrubs, vines, and trees in sunlit areas in a plan for food production per unit time, based on prescriptions using transition curves.
14. Operate an effective wild faunal law enforcement program.
15. Carefully study the increasing abundance of the Eastern coyote in the region, and its likely effects on wild turkey nests and adults. (Abnormal, relatively new, predation is highly likely in areas producing abundant populations of the bird, and damage control may be part of the managerial costs.)

Monitoring turkeys is done by a combination of the following (using weighted well-sequenced results):

- Hunter reports of sightings will be made by each participant, with date, location, and statistics on the birds seen and taken. Such reports will be confidential, and only for analyses for modeling. They will likely include number of gobblers heard and number of gobblers “worked,” or called up or followed by staff. Hunters derive great pleasure in

hearing birds gobble and having them respond to calls. While "getting a bird" is the primary goal, being in the woods with active birds keeps the hunter "in the game." Other variables influencing satisfaction will be recorded, such as interaction with other hunters, the environment, and the presence of trespassers (non-members who have not received education or made pledges about maintaining high-quality hunting).

- Checking station reports of turkey kills, misses, and cripples.
- Making springtime gobbling counts (over regular annual vehicle trips).
- Making spring brood counts (and GIS mapping occurrence) for monitoring gross annual changes in the population.
- Making dropping (feces) counts made along a standard stretch of road.
- Making counts of birds coming to bait stations at a set time in a year.
- Monitoring (with a vacuum device) insect biomass along foraging area transects.

As a comprehensive wild turkey system is planned, the information needed from past and local sources can be considered. Studies, with hypothesis testing—minimum comparisons at least—are needed, even though comparable situations, populations, or conditions are almost impossible to achieve. We shall make changes, measure outcomes (especially those hypothesized, such as fruit production per unit area), and apply feedback. Data will be studied together from all areas and Groups.

The Wild Turkey Group will develop a local history of the bird, but also of the managerial actions that tended to lead to the present managerial knowledge—the Wild Turkey Group will prepare plans for the near future.

The Raccoon Group

One Rural System Group will speak loudly about the potentials and relationships within forests and forestry, and will emphasize linkages active throughout Rural System. The Raccoon Group will involve local, highly synthetic activity, linking ecological transition in all communities and types to the many species commonly known as furbearers. Even if no furs are ever taken or sold, many large, difficult-to-see, top-of-the-food-web animals are very important to the ecology of the area, and will be mastered with benefits throughout the rodent-, predator-, grass-, deer-coyote system (with raccoons). The Raccoon Group is focused on a small, conspicuous system that needs knowledge and management.

Furbearers are animals with great appeal, with hardly-exploited financial potentials, and needing intensive management for diverse measures of success. A rich variety of these animals live in the region: raccoons, beavers, weasels, minks, bobcats, rabbits, and coyotes. Without management, they can compromise other land-use objectives, but with management they can be changed into one or several profitable enterprises. Much research has been done on furbearers, but much, much more is needed. Few people realize the complexity and relations of their ecosystem or benefits context.

The emphasis of a major part of our furbearer work is on the raccoon, *Procyon lotor* (the "washer," named after seeing it apparently washing its food). The raccoon is one among several species with great appeal and with unexploited financial potentials from lands with trees, if managed as suggested within Rural System. The raccoon's status as an omnivore presents interesting rabies-specific, parasitological, and nutritional questions, potentially related to understanding human food consumption and health.

Raccoons' main food—invertebrates and amphibians—will be provided naturally in the streams or in shallow marshes and ponds, which will be created or enhanced (Chapter 7). Mast (tree nuts and fruits) are used for fall and winter food, and fruits and berries in the summer. Other fall food will be provided by the shrubs and grasses, planned to be planted. Year-around food supply is the often-forgotten requirement for robust raccoon populations. Raccoons will take advantage of corn in nearby cornfields, when available, potentially stimulating work for the Rural System Pest Force to keep the raccoons' action out of Rural System corn, or managed at a cost-effective local population level.

Extensive research results can be brought to showing a superior, total resource system for one species—a system related not only to furs, but also several types of hunting. Profits within Rural System from a fur enterprise are a primary interest. The strategies include marketing of furs, strategic buying, poultry-loss reduction, improvements in trapper success and humane taking, improved care of the pelts, fur storage, local cutting and trimming, alternative uses of partials, and alternative uses of the entire carcass. Fur markets seem to fluctuate due to style preferences and other phenomena. We propose to work with the fur industry, seek diversified marketing strategies, avoid public confrontations, retain a private-for-profit stance, and demonstrate the potentials of storage to achieve sale when prices are high.

Raccoon Group work will include sophisticated studies (expected to attract visitors and students), furbearer workshops for state and federal biologists, trapper schools, legal conditions, vertebrate pest damage manager schools, and fur-buyer schools. Software development will enhance some work, especially as it shows how ecological communities (that support each furbearer) change over time.

Research needs expand far beyond the biology of the animal alone (the past trend) but on to them as center of a total, profitable enterprise. Agencies have waited for funds, but none (to our knowledge) have stabilized an intensive management system including feedback and future predictions. The prospects are not for recreational trapping (strongly opposed by some), but for a viable, profitable enterprise utilizing one of the natural products of the Rural System leased lands ... in ways no one else has been able to sustain in the past.

Visitors and members may come to the area with the planned objective of seeing and photographing all of the furbearers present (as done with songbird life-list counts). A blog will announce the willing successful people, tell of research accomplishments, share in knowledge of the furbearers, and provide excellent photographs, poems, book suggestions, and natural history information. Close links will be built with **The Nature Folks Group** (Chapter 10).

The financial base of the system will come from schools, memberships, tours, individual guests on the area, volunteer work (in-kind salary equivalents), workshops, publications, photo opportunities (for a fee), art commissions, sale of harvested products (glands, bones, biological instruction kits), and new products and services of **The Pest Force**. Links will be made with the nighttime activities of **The Owls Group**.

Following computer analyses and field work by staff of the Raccoon Group, and indications of cost-effective work on a specific ownership, many procedures will be implemented. If specified by the RRx that either (1) more raccoons are needed, or (2) that greater population abundance stability is needed for the future, then faunal-space changes will be made.

One such space alteration (called imprecisely by others, "habitat manipulation") planned to be made is the **Raccoon copse**. Staff usually implement these, but recognized, authorized and "permitted" groups or members of The Raccoon Group, when supervised by staff, may be given a role without condition of future privilege. Each copse, on an ownership or cluster, will be

created and maintained to enhance or stabilize local raccoon populations ... and the financial benefits will be derived in multiple, some yet-unseen ways, from them. Following local and regional development, a competitive process may be implemented for copses with the greatest evidence of raccoon activity.

The Raccoon copse will be created within an area about the size of an Alpha Unit (recall, an Alpha Unit is 10m x 10m) with a few trees. They will usually be located at headwater streams (Chapter 7), below or close above forest logging-road stream-crossings, and have high soil moisture year-around (a "seep").

A copse is not static and undergoes expected transitions that need to be described. The maximum number of copses to be put on an ownership is one per 9 acres. We shall use GIS to determine optimum numbers of raccoons, based on suitable areas toward which we work over many years as we study population activity, market-demand, and claims by local people of pest action and fear of rabies.

As noted, raccoons are omnivorous and opportunistic. A variety of foods serve them well. This explains why they do well in areas with very different food conditions ... and makes the point that dens are more important for raccoons than food. The copse will actively involve 31 managerial considerations:

1. In each select area, Rural System will place 2 raccoon nest boxes high in trees to supplement any den present (more than two present will be wasted). These will be placed no more than 150 feet from wet areas or streams.
2. Given discovered competition and tolerance of the animals, the copses need to be about 1,100 feet apart (1.2 foot-ball-field lengths).
3. We shall retain red maple, elm, red and black oak, butternut, white oak, white ash, sugar maple, and sycamore that have dens or are likely to develop them within 50 years (trees of 23 inches dbh, diameter at breast height). These are among recognized den-trees, generally recommended in forest wild fauna work.
4. In the above tree species, where present, we shall saw off select limbs to get den openings started (callus tissue). We plan to use a large-bit hand-held power drill to start a hole at an angle downward to capture water and begin natural den-formation.
5. Where rock dens do not exist, we shall study whether rocks can be moved cost-effectively to create ground dens, and then act.
6. We shall study present or nearby ground-hog dens, and protect or enhance them for raccoon use. We shall work on a local ground-hog management strategy for dens, along with the tree-den tactic.
7. A copse is a high-intensity feeding area, and the gains are for the animals, but especially for human benefits from experiencing the animals nearby.
8. We shall select, for a copse, an area with soft-mast-producing trees ... making the sites difficult to find because of the pair-requirement. Active field workers will GPS-map sites when they are found.
9. Several hard-mast-producing trees are desirable, perhaps also containing den sites.
10. GIS maps will be made of the sites, and gaps in "coverage" will be sought over time.

11. Raccoon population production is that of crayfish and terrestrial mollusk management. We shall place regularly (often from nearby road patrols) small amounts of human and animal food waste (bones, meat-scraps, stable litter) beside the wet areas to increase crayfish.
12. We shall build trails near each copse to assist deposits, but also for protecting watersheds, caretaking, and for guided guest trips.
13. We shall provide a small blind at each copse for photographers and guests.
14. We shall try to maintain a sign at each copse, one that names and specifies Rural System publications and opportunities.
15. We shall select a few small trees and tightly wire them for increased hard-mast production.
16. We shall manage wild grapes. Grape vines will be fertilized, attached, and pruned and lighted (by cutting a dominant shading tree or tree top); new vines may be transplanted in areas where grapes now grow, and may be protected from deer by a wire "tube."
17. We shall post local raccoon hunting seasons.
18. We shall plant a garden plot of 5 hybrid blueberry shrubs within or near a copse.
19. Depending on the site, and especially if one or more apple trees are present (as in or near an old home-site), we shall plant and protect an apple tree pair.
20. These copses will be high-intensity food and reproduction-related sites, with a partial goal of high quality and quantity food at low maintenance cost.
21. After 3 years of implementing such sites, we shall study raccoon parasites and diseases and relations studies, and shall make changes in the program or design if needed to avoid now-unknown problems.
22. In the headwaters stream, or at the wet area edge, we shall place two 50-pound limestone rocks. The high-probability change in pH of the soil and slow-moving water will greatly diversify the often-unnamed biota of the copse, and will enhance the crayfish population.
23. In our copse, we shall respond, ownership-wide, to meeting a poorly-known raccoon population problem. Even with dens and diverse food, they must have abundant high-energy food in late summer and early fall to allow them to go into the winter in a healthy condition and for the females to bring off numerous, healthy kits in spring.
24. We shall meet one such protein need for raccoons by our managed population of woodland mice and shrews at one or more spots within each copse. (Typically, from a capped hay bale with nest litter placed on dry land and with protected runways, grain added, and wire protection from avian predators.) We shall often place a snag with the mouse-unit.
25. We shall engage bikers with help in surveillance of raccoons (their GPS locations), and from some we shall seek volunteers for copse-building and repairs.
26. Where feasible within the copse, we shall create a soil depression which holds water seasonally (a vernal pool) and that will enhance invertebrate conditions and provide special places for amphibian reproduction for other raccoon food.

27. We shall continue analyzing conflicts in using copse dens, those between opossum and raccoons. Tentatively, we hold that opossum needs are less specific, they are more opportunistic, their needs likely to be more abundantly met, and do not require the moist conditions reported for the raccoons. Furthermore, opossum fur values and recreational user values are lower than for the raccoon.
28. We shall block the likely view from the nearby road of the central raccoon feeding area of each copse. It will be blocked by foliage, rocks, or topography to prevent direct shots by road hunters/poachers.
29. We shall protect the copse and its animals from:
    - ground fires (that destroy logs, den entrances, and some food supplies)
    - grazing (that removes fruiting shrubs, acorns, and grapes)
    - disturbance from free ranging dogs
    - polluted waters
    - poachers and vandalism
    - excessive disturbance by hunters
30. Muddy water creates a nearly sterile condition and produces little food for raccoons. If food appears to be a limiting factor, corn can be planted in patches (protected from deer) near a watercourse, where animals naturally feed.
31. We shall also work to protect the copse from black bear destruction and food use, but most importantly we shall work for tight deer harvest regulations, because excessive deer remove much spring-time foods that underpin the new annual raccoon population.

Raccoon stocking will not take place on the area, since such programs are usually expensive and ineffective. Den boxes will be added to well-spaced, low-value den trees. Headwaters improvements and stabilization, and population protection will generally produce the desired results at low cost. Harvest and hunter control measures may be necessary, however, not only to prevent eliminating the animal in localized areas, but allowing for a natural increase in population.

Hunting dog contests and certifications, as well as new products and services of The Pest Force, may become available. Links with owners of raccoon-hunting dogs will be sought. Hunting and dog- training restrictions will be strictly enforced. Continual harassment by hunters and dogs will eventually result in the loss of part or all of the population through migration or death. The importance of den trees will be impressed upon hunters, and their destruction (e.g., for taking a treed raccoon) shall be strictly prohibited.

A membership organization will be created and managed related to maintaining high raccoon populations, great resource benefits to members and lasting, balanced human, raccoon, and regional resource benefits.

The Reach Group

As other Groups of Rural System, ***The Reach Group*** *is a set of ideas expressive of current thought about needs and potentials, first within Virginia, and expanding to other rural regions of Earth.*

We might see The Reach Group with *membership of all* within rural life, those who live and work there, including professionals, government officials, educators, farm workers, clergy, and residents who "share our concerns" and find our objectives meaningful. The Reach Group is planned to be within Rural System and will seek to strengthen the rural economy. "Rural" is a diverse economy dependent upon a range of industries, including manufacturing, services, government, and wholesale and retail trade.

Agriculture, which has traditionally been a key base of the rural economy, continues to record strong productivity gains. (Agriculture is highly competitive in international markets.) Rural America offers many opportunities, but also faces a number of infernal challenges, such as educational attainment that lags behind that of urban areas. Improvements in health status also have not kept pace, and access to doctors and health services has not met the challenges of rural people.

Work is needed to strengthen and diversify the rural economy, and to support rural workers and businesses. Many of these policies are already being implemented through the American Recovery and Reinvestment Act of 2009. Strengthening rural America is focused on growing businesses, expanding employment opportunities, and increasing support for small business lending. Rural System seeks to implement incentives to greatly expand biofuel production and renewable energy generation, sources which are often centered in rural areas. Wind generation may be proposed, as well as rural tourism and recreation for the local economy.

Improvements in rural infrastructure, roads, bridges, water projects, and telecommunications are needed to become fully integrated with the rest of the economy. Support and creative options are needed for rural infrastructure projects. Also needed are expansions of broadband internet access to rural areas and action for upgrading and improving the efficiency of rural water infrastructure.

We need to further open international markets to U.S. agricultural products, to propose reforms to better target farm support programs, and to urge a greater focus on local and regional food systems—Know Your Farmer, Know Your Food. Also, focus needs to be put on strengthening the labor force, and improving the quality of life in rural America by investing in education and health care, including rural broadband. Such investment will help make high-quality online courses available to rural areas.

We need investments in the health of rural America to increase the affordability and quality of health care, while bolstering the medical workforce and infrastructure to address the unique challenges that rural residents face. Such actions may include work on prenatal health, family health programs, accident reduction, local body sculpting with rewards, child care, first-aid and safety programs, fire prevention, family planning, automated health program access, access to health and wellness instruction and advice, and many other important measures. Rural System may provide special support for the rural medical workforce by expanding graduate medical education positions in rural teaching hospitals, and by supporting training for doctors and nurses in rural health care.

Chapter Ten

Tourism Groups in Rural System

Many of the diverse Groups planned to operate within Rural System are related to recreation or tourism on ownerships, generating profits and providing opportunities for people to enjoy the well-managed resources of lands and waters under Rural System management. In Chapter 9, we introduced the concept of ranging and covered topics related to hunting activities on ownerships under contract.

Ranging is not limited to hunting, however, and many ranging activities fall under the term "ecotourism," as explored widely by modern natural resource managers. Rural System ranging enterprises include diverse Groups, such as the Owls Group, and a new bird-watching sport invented by Giles, called "BirdGolf." We shall introduce several ranging-related Groups herein, as an example of the substantial opportunities for generating profits from rural regions while providing many benefits for humans.

The VA Touring Group

The increasing, urban human population, we suggest, has major needs—personal and for families—for learning about the rich natural resources of the Commonwealth's parks, forests, and state wildlife areas. (I think we can arrange this.) The new, proposed **VA Touring Group (VATG)** in Rural System will study the *existing* natural resource areas of the Commonwealth (called herein "parks"), develop relations with transportation and nearby lodging and food enterprises, and work to build a specialized, tourist-based industry in Virginia (later expanding elsewhere).

The VATG will map the rustic, walkable and drivable state park and ownership areas, and develop instructive and appreciation-enhancement aids, photos, and cost-effective, commercial bus-load, staff-guided tours of the resources of State-owned lands. Access and contracts will be developed for guests to enjoy nearby motels or related quarters.

VATG is planned to be an element of Rural System, with many similar objectives to "ecotourism," but adding education, and focusing on lands and waters "left behind" by emigrants to urban Virginia. VATG objectives are for superior jobs for local people, sale opportunities from growing regional markets, and knowledge of their historic areas. Well-aware of state investment in these park and forest areas, and separating people from them by high travel costs and limited access, the VATG will offer citizens and guests superior, often unique access to the history and natural resources potential of Virginia park lands.

Park visits and introductions will inform visitors of each nearby BirdGolf area, created by Rural System, as well as other Rural System bird opportunities, such as Owls Group tours—discussed later in this chapter. The bird-watching opportunities available on each park will be highlighted. Rural System will employ superior teachers, with high interest/enthusiasm for the area resources and local businesses. Special educators will be employed and will introduce

guests to special areas and resources. We plan to move to client-sensitive, non-TV sights and experiences, and to those available on tax-based state lands and waters.

Most visits will be on trails and prepared areas, as permitted. Officials may be invited, but no attendance will be requested or desired that may separate any of them from their work. VATG tours, by design, will not incur additional work of state or federal agents or staff. We shall be willing to submit a report on each visit, numbers and activities, and major sightings. (We shall also welcome access to state and federal reports and data as we prepare text and information for guests.)

Past ecotourism was interested in financing for local people and owners, as well as conservation. We plan, herein, for wages for Guides and staff participants, and for knowledge gained and stored on flora, fauna, and water resources. VATG, as planned, seeks to use public investments of the past to inform current urban dwellers about elements of that past … and so improve future decision-making and modern natural resource management guidance.

We plan to include safety instructions, including information about desired behavior on sites, and shall ask all to wear a supplied tracking-bracelet to avoid human losses. Transportation of guests will be by licensed, approved busses and other related vehicles, parked temporarily, where allowed, on or near public areas. Public toilets will be supplied, and meals will be arranged with local restaurants or approved suppliers. Adequate VATG staff will be needed to prevent lost people, allow full attention to the local sites, and deter personal accidents or property damage. Picture taking will be encouraged, as well as tweets, blog posts, and other reports of site visits and experiences.

International travel events will eventually be arranged and offered to guests for adventures to see wild fauna species, especially birds to add to their life lists.

Nature Folks

Nature Folks is a planned Group (for expansion statewide) that encourages guests of Rural System to take new opportunities to learn about nature and rural lands, especially the wildlands. Its objectives are to encourage study of nature and natural resources, to provide pleasant opportunities to learn, to contribute to knowledge about the ownerships and region, and to help achieve the objectives of Rural System. Nature study is usually a very private, personal activity, but occasionally it needs help, encouragement, or support. The Group will exist to help and encourage people who love nature and who study it. It will provide an organization, supplies, equipment, materials, a common site for visits, opportunities, and services to its members, clients, and friends.

As diverse as the interests of its likely members, some members may prefer solitary work and enjoy the newsletter and website; others may prefer more group-oriented work and topic-related social activities. The organization will be for anyone interested in nature; there will be no gender, age, race, nationality, or place-of-residence limits. The initial emphasis will be on a named region's rural wildlands and waters, and on their active, diverse, creative, and non-destructive uses.

Broad interest groups may be formed. Membership may often be held within several groups. Studies may result in individuals or groups gaining world-class “nature knowledge,” a resource that may be lost, shared, or passed on to future generations. Direct knowledge of Earth-organisms is needed and enjoyed—what they are, where they live, what they eat, how they are challenged, how they reproduce, behave, and die—all now seen as nearly vital to science and

society. Nature Folks will be neither an environmental nor an ecological activism or fund-raising Group. It will take no "stand"; it will not be a political Group. (There will likely be other individuals and organizations that may meet such needs.) In a related way, however, knowledge of a region can serve well in encouraging sound regional development, high quality of life, and diverse recreational and educational opportunities within the outdoors.

"What's out there!?" is the organization's question, and its answer.

Members will recognize the advantages of contacts made through and within Nature Folks with people of similar interests in proposed development and future projects within the region. The Group will affiliate with local museums, the North American Association for Environmental Education, and other enterprises and local groups with interest in, and programs/projects related to, nature.

Nature Folks will be created for people who do not already have major groups with which they can affiliate (such as the bird watching, fishing, or hunting groups). It is especially designed for people who may not have *special interests*, but who are generally interested in local nature, the outdoors, and the working of natural things. Nature Folks will be for individuals, but corporate or organizational involvement in special projects is welcomed and encouraged as well. It will engage in finding and listing flora, fauna, and other characteristics of Rural System leased lands—it will take pleasure in making, reporting, and storing information on discoveries of the local, rural natural world for the public good, general interest, and future needs.

Wise: The Owls Group?

The Owls Group is a new, planned enterprise, devoted to gaining optimum, long-term human benefits from the owl and raptor resources of the world. It will also seek to make profit (and related human employment) from such activity. Its initial emphasis will be on the owls of Central Appalachia.

The Owls Group holds that these birds are not being managed adequately or successfully. Certainly, their potential as an international modern resource has not been achieved. The Owls Group will seek to begin to meet perceived needs and to begin to improve resource use.

Designed as a system, the objectives of the Owls Group development are:

1. To maximize profits from an owl-based raptor resource management system;
2. To maximize research findings (conclusions) over a long period;
3. To minimize the time from research "discovery" to application;
4. To improve the status (abundance, distribution, community presence, and socioeconomic appreciation) of raptors and the raptor resource in the U.S.;
5. To increase knowledge of raptor management and predator foods and feeding;
6. To develop a comprehensive computer model representing owl abundance and dynamics within a major forest ecosystem over 150 years; and
7. To advance predator-prey theory—especially its application.

The Owls Group, like over 150 other Groups of Rural System, is a proposed, for-profit enterprise relating to all aspects of people's great interests in owls. The organization will sponsor "owl trips" as a primary activity, but it has a diverse set of other tactics, all aimed at improved, comprehensive, computer-aided faunal resource management. The Owls Group will be part of a strategy to increase jobs in the region and benefit from recreational visits.

There are 37 species and subspecies of owls in the Western U.S., and 12 (some the same) in the Eastern U.S. The spotted owl has been at the center of Western U.S. land-use controversies

for over a decade. Great interest in owls exists around the world; some are threatened, others are abundant and are important in ecosystems. Several occur in cities.

The potential activities, services, and products of The Owls Group are many, and include:

- Travel agent services for local field trips and tours;
- Field trips (catered, hotel, educational and recreational one-night "events");
- Photo sales and opportunities;
- Newsletters and publications on owls and their ecology, and on Owl Group activities;
- Sale/rental of night-observation and "calling" equipment;
- Art sales (painting, sculpture, and professional photographs);
- Product sales, such as screech owl nesting boxes and carvings; and
- Wilderness/remote area camping expeditions with observing owls as a major goal.

An evening owl trip or event will include a meal for 30 clients gathered at a contracted restaurant and/or motel. After introductions and a dinner, the group will hear a brief talk and see visuals of owls. Everyone will board a bus. During the 20-minute bus drive, a staff member of The Owls Group will describe the organization and its objectives, and give a wonderfully-crafted lecture on local owl species.

At the first stop, all will leave the bus, walk over a built trail to a quiet spot and an electronic device will be played, and barred owls will usually respond. Questions will be answered, and Guides would give further information about the owl. At another stop (the forests would be very dark) the group will huddle in the quiet, and other owls will be "called up." (This is said by some to be the thrill of a lifetime. *There is still magic in campfires.*)

The group will move to a campfire site, enjoy the fire, stories, refreshments, and live country music. Some might play new games with GlowOwl balls. Then, all will board the comfortable bus for the trip back to the motel or restaurant. Information on owl studies will be provided by Guides on the return trip. Those wishing to do so can later observe owl habitat and management activities during the day, perhaps soon after the evening tour.

The staff of the Owls Group will seek limited research grants to achieve some of the objectives, and to support and allow achievement of the others. The funds gained are expected to pay some salaries and wages for those conducting the research. Studies will be conducted in response to requests for proposals, when available, but the key pathways are those discovered by comprehensive models and sensitivity analyses.

A planned **Rural System Foundation** will accept money, gifts, lands, services, and equipment—all directed toward diverse Rural System goals, including those of The Owls Group. Named fellowships and properties (e.g., the A.B.C. Memorial Raptor Management Area) will be sought and utilized to meet the objectives of the program.

Though difficult and requiring innovation, activities described for The Owls Group do not seem impossible within the context of the entire, interdependent Rural System, with multiple funding sources and programmed assistance, computer aids, and benefits from past research. The Owls Group's success, as planned, will enhance the planned work of other Groups … and contribute to the land owners' income—those participating in the Rural System and its continual feedback, system-wide.

BirdGolf

BirdGolf is a proposed enterprise of Rural System, with plans for international franchises. It is a major activity with many new dimensions to popular bird watching, operating on land parcels designated as Rural System BirdGolf Courses.

I was brought up as a youth in scouting to love bird watching. My scout leader, Dr. Sam Guss, a veterinarian to whom I owe more than can ever be stated or repaid, was an amateur ornithologist (more than just a "bird watcher"), and loved to share his knowledge and zeal for a good daily bird count. (The maximum number of birds in an area or the count approaching that maximum is called "richness.") I raised homing pigeons, bantams, and in one year, ring-necked pheasants for release, so I was familiar with and enjoyed birds. He gave me a model and kept a "life list," which is a check sheet of each species he had seen during his life. He was always on the hunt for adding a new bird to his list, or to see and reconfirm a locally-rare species already checked on the list. I worked on a life list too, and enjoyed studying books and listening to records so that I could recognize species and perhaps make a "find" that would add to my list. Christmas Bird Counts, taken with local bird watchers, were always a pleasant seasonal event, and I usually added a bird or two to my life list on such days.

I bumped up the count of birds on my list (it seemed unfair to me) when I went from Virginia to work for the US Forest Service on a trail-building and fire-fighting crew in Oregon in the summer of 1952. I kept the field-guide book busy all summer, adding new species-sightings to my list. Years later, I suffered slightly among game management professionals, for I considered myself among them in my interests in grouse, turkey, quail, waterfowl, and crop-damaging birds, but also an outsider, for I was one of the so-called "dickey-bird watchers."

I took a course in ornithology—a cold, austere thing without a specimen or a field trip—in my Ph.D. program. My interest declined further as time slipped by and my hearing ability in the higher range of birdcalls declined. Yet, I continued reading about and studying birds, for they held a special place in my life. People around me increased their interest, but few seemed to know little more about their management than "feeders and bird houses." Funds here and there were released for a few studies of forest birds. I was paid to write the first "non-game bird" plan for the state wildlife agency. ("Non-game" has always been a non-word for me. Game birds were always "non-game" when the hunting season closed.) Peculiar claims were advanced about what birds needed, and what effects forest harvests had on them. The value of birds seemed to be in question, as if we could justify action on the forest… or not… with such numbers. We seriously discussed the possibilities of explicitly valuing pet-like creatures, as if the numbers would ever be used satisfactorily in public discussions.

I worked for several years on a paper on the "worth of a duck," after I learned of challenges which arose within the US Wildlife Refuge System. Duck losses to dams, powerlines, and other developments had to be mitigated, or at least factored into statements about impacts. Cost-benefit ratios had to be computed. Loss of birds was a cost, and if they had a monetary value, then they could be added into the cost column. My efforts were discouraging. Only "priceless" seemed to be of the right currency and magnitude for the potential loss of endangered species to be worth enough to slow or (rarely) stop a project.

I liked the economists' concept of "opportunity cost," which is approximately that something like a bird has to be worth at least as much to a person as the thing that was forgone to have it. If I know that a woodpecker depends on trees of a certain species and size, and I know that the trees will bring $3,000 if I cut them, but I do not do so in order to have the woodpeckers, then as a rational person, they must be worth at least $3,000 to me. Yet, there were several flaws

or uncertainties, and too many dimensions to discuss for this valuation to "sing" for me or for others.

Then along came my rediscovery of Shakespeare, my embarrassment at my sophomoric falling under Frost's small phrase, "rediscovery of the trite." As of yore, the pound of flesh cannot be valued alone. Many things are inseparable, valuable only when together—only when within a context. The presence of things that are meaningless or worthless when alone may give value to other things, when with them. The president's house is an attraction, and so "makes" the area a tourists' area. A building or natural feature is worth the trip to see it for the family or individual, but its value has to be tallied over time, as *all* of the net financial gains in commodities and services not available to a nearby, similar community. A wall that obscures ugly things adds value to observers and land on at least one side … but all walls have two sides, perhaps one that is valueless.

"They will not place the proposed corridor for the power line through that person's house!" is not a surprising statement. There are things so highly valued that they do not have to be *explicitly* valued; there is common knowledge that the costs of such action will be very high, and are likely to exceed the benefits. There is a value dimension to honor and respect, and so an alternative powerline corridor is selected… without computation.

I sought ways to assign value to wild fauna and other important natural resources, for they seemed to me to be under attack and, when close to the time for decision, it seemed that estimated monetary value was the determining topic. If they could not be convincingly valued, then they lost in each decision about whether to build or not, and *where* to build to avoid loss or impairment. I found over 20 ways to value wild faunal resources, but the key phrase for me was "*convincingly* valued."

One way that I had not found was the ***profitable enterprise*** argument. It was akin to the historic site or the congressman's-house value approach. The value of wildlife (i.e., wild fauna, or similar natural resource) depended on its value to an enterprise. The value of a wild fauna enterprise is expressible in terms of important things directly tied to and interdependent with it: employment, payrolls, a tax base, schools, and community services.

I began to imagine a wildlife activity so well-used, so much liked, producing so much employment and tax revenue, and providing so many environmental services that no one would consider destroying or impairing the wild faunal communities associated with that activity. Or, at least, without attempted computation of all of those values. I called it Avi, later AviGolf, and now "BirdGolf." It began emerging with Richard C. Rivera in Guatemala at Buen Aventura private nature reserve, where there were 186 species of birds available to be seen by guests.

In 1985, I began working with students on an imaginary project that might one day have a practical application (rather than some pointless make-work assignments). The learning objectives were scattered among analyses, design, presentation, writing, ornithology, and computer programming.

Waiting for a movie to open one evening, and telling a respected neighbor about the BirdGolf concept, he volunteered that a course in "the rough" of a standard existing course, developed as I had suggested, might really please his wife, who typically lounged in the golf-course club house and did not like any part of his conventional golf.

I had imagined separate, intensively-developed areas, rich in bird species, perhaps on select private lands, existing state wildlife lands, or various "refuges" —any land enhanced for bird species by a Rural System Group. My students were helpful. The challenges were simultaneous; no 1, 2, 3 sequence for solving them seemed possible. For success, we had to

imagine an increasing market, sources of income over time, diversification potentials, and mastering the ecology of the birds of a region so well, so precisely, that all of the conditions for maximum species richness could be brought into or cultivated rapidly, cost-effectively, in a relatively-small, useable area for some long period.

We worked on an imaginary, *new,* for-profit sport of bird watching on private, franchised, bird-watching courses. The sport had strong parallels to conventional golf. I thought it could be developed on an existing golf course, especially in the rough areas and surrounding trees and landscape. Early morning use would not detract from golfing on the course itself, and capital investment would be minor. Better, I imagined the course on an area already rich with bird species. Better still, and much more of a challenge with its creative demands, was the possibility of developing a business related to an area around a trail that would allow informed users to see more different local bird species year-around than in any other nearby areas.

The imagined BirdGolf course was a place where people, singly or in small groups, would pay a fee or show a membership card, enter data about themselves and past visits and the conditions of the day, and then follow the trail (aided or not) to see with binoculars or other aids many species of birds.

Of course, I knew of and had visited many areas on public lands where bird species are abundant. I enjoyed bird walks on private lands. The differences for BirdGolf were:

- Use of *our* "course" of intensively developed habitats would require fees;
- Users would see significantly more species on a course than within many miles;
- The course would be available year-around, and thus would require some vegetative manipulation (planting, pruning, protection);
- Seasonal differences (migratory and residential bird differences) would allow for different marketing;
- A 150-year planning horizon could be put in place as part of Rural System action; and
- Significant social and competitive dimensions may be added.

Semi-natural, the proposed BirdGolf courses would allow feeders, watering devices, nesting structures, and viewing structures. BirdGolf rules, most paralleling conventional but often intricate golf, would be in effect. There would be personal and group security within courses, group and membership appeals, and rewards, including a variety of competition options; additional services and benefits such as guides and assistants, memberships, codes of behavior, and communications between members would also be available.

Students were puzzled, and commonly voiced that for such areas there would be competition from public areas. There was the general feeling that birds can be seen anywhere. "Must everything be for money?" they asked.

I think that there is a major segment of society that has limited time, seeks special interests, enjoys being outdoors, and welcomes the peace, security, quiet, and beauty of the typical golf course. There are among them people who would like to be involved in things natural, intellectually challenging, with opportunities far beyond those of the conventional bird hike. There are people that are interested in birds who want to see places of excellence, places where the best current practices of stabilizing excellent bird faunal-space are at work—together—with a reward for a visit to a local outdoor "wonder," and potentially new experience.

I knew that public land and water resources were present, and that they could not and cannot meet all of the needs, tastes, and preferences of the human population using them. They do not meet the intense needs of visitors, local or international, for guided bird watching and life-

list building (e.g., a record of 1,530 species placing a person 149th in the world). Occasional sighting of birds on public lands is not the same as active bird watching—a purposeful and directed activity. Active bird watching, on which I was instructed as a youth, is not the same as participating in BirdGolf.

I knew that in 1999, birding was among the top five fastest growing activities among 25% of the population. The number was increasing faster than the population! There were millions of "wildlife watchers," and they seemed to be increasing, and among them the number of bird watchers had increased *4 times* in the 20 years before the turn of the century. In 2002, over 50,000 birdwatchers sent in their checklists of birds seen in their backyards to a national project requesting such lists. There is an interest, and it seems stalled, for there are no known new options. BirdGolf courses would provide fresh options for a perceived customer base.

I imagined a small group or individuals on the BirdGolf course during an early weekend morning.

The bird watchers are greeted by a receptionist (in a tent, cabin, or Golf-course office), pay a fee or show membership, and have their membership numbers entered. Rules are explained to the novice and a rulebook is available.

Each watcher receives a "handicap" for the day and time based on the season and the weather, receives a recent list of birds likely on the area, and is admitted to the course. The watchers identify and check off species seen. (Numbers seen are not counted, except for personal interests.) Dates of birds seen became part of their personal records, with emphasis on benefits from the memories of when the numbered sighting was made.

Afterwards, during Monday-morning office coffee-talk, like bragging about the weekend golf score, they might comment on having "gotten 67 birds." By now, coffee-colleagues would recognize that "having gotten" means "seeing and identifying with high certainty." He or she also has a reported score—in this case 81—a computer-cranked number that pulls together the goodness of the day, his or her past experiences, the date, time spent, and climatic conditions.

Each person, as desired, is grossly tested before beginning for hearing and sight to achieve a personal *calibration, a "handicap," that may be included in the par for the course for them on that day. Each bird species is assigned a daily bird-conspicuousness index, and extra points are awarded for having seen inconspicuous or rare birds.*

As in conventional golf, an honor system is at work. No one checks. Any paying person can use the course for any bird-related benefits that they desire…including casual walking and watching. Most players are expected to try to beat their prior score, or to best a score on the same chrono- and pheno-date as last year. Disturbing the birds, however, is discouraged.

BirdGolf participants, along with ecologists and bird watchers worldwide, would be likely to be more interested in *phenological* time than standard time. This means that they are interested in seasonal advances, somewhat like farmers' talk about "the corn being late this year." Phenology is the study of the occurrence of biological events (e.g., leaf fall, bud break, eggs hatching). Each BirdGolf course would have its own indicator plants for outdoor activity. Birds seen on a calendar date would be compared to those seen in other years on different dates, when the season was behind or advanced.

Of course, migration is related to conditions that affect these natural timing standards. Emergence of certain insects (a function of temperature, moisture, and photoperiod) will make some birds more conspicuous in some years than others. Some birding work is done consistently on the same date each year for these phenological reasons.

Players could keep their own life lists for birds seen anywhere, and a separate list for sightings on BirdGolf courses. Possibilities would increase as more courses become franchised. Players with exceptionally long lists could be featured on the Internet site for all participants. BirdGolf life-list builders could go from course to course, building a cumulative list.

The managers of the courses are recruited from among people recognized as the best avian ecologists in the world, who then recruit and train local guides and aids. Competition among experts adds new rungs to a potential career ladder as an ornithologist, and the awareness of these opportunities is like fresh air into a room where there were few opportunities other than teaching or a rare job meeting the diverse demands of engineering firms doing impact analyses. The expertise required is almost unimaginable—calling for mastery of bird ecology to keep wild species in an area year after year. As a result, BirdGolf ornithologists notice that their reputations have grown immeasurably.

Bird richness in a small, easily-walked area is more a function of the presence of water and the ages of plant species than of the ecological communities present. Thus, while some plants age and become beneficial to some species, others fall out of usefulness to species, or the probabilities of bird-use declines. Of course, yearly differences affect insects and moisture, and thus the manager must monitor and accommodate the birds' needs for these resources. Such knowledge and attention is required, because profits related to all BirdGolf activity are dependent upon high, sustained bird richness.

Players observe birds at their own pace along trails, and are typically trying to see all of the birds of the carefully-designed courses over many visits. They try to "max out" a course, to get the greatest number of life-list additions from each BirdGolf course. They walk through well-managed habitats, especially planned by wildlife managers to diversify the birds and to make sightings likely and pleasant. The players may enjoy each sighting, the ecological relations of the birds, or they may be trying to best their personal previous score or out-compete a friend.

The courses are simply wonderful places to stroll. "Step-asides" are provided for observers so that a bird can be watched for as long as liked. The rules of passing and sharing observations are as explicit as those of conventional golf. Small children are discouraged from admission, for they rarely have interests in the different birds. Some courses may later have play areas with minimum instruction to keep the courses attractive to families.

Observers go through different habitats seeking the birds that are common to each. They may use the blinds available, take a boardwalk high into the trees to see warblers, or may walk near a marsh or mud flat to get to other species. There are places to sit and places to stand, as others continue walking by. Most people use binoculars, but a few use telescopes. Collapsible speakers' pointers are commonly seen and used to point to birds and the direction of a call. A serving-line model is used to prevent bunching-up (to see closely a rare and very quiet bird), or to minimize disturbance or maximize privacy along the course.

Franchise courses would later become available, some in other countries. An international membership would be established with superior players announced. BirdGolf would work interactively with the Rural System **Tours Group**, **The Forest Group**, and **The Gardens Group**. Large **Alpha Earth** deposits made along courses would attract some birds. BirdGolf courses may exist alone, but the synergistic effects of many, closely-related Rural System enterprises can reduce the risks inherent in start-up operations, reduce costs and delays, and increase profitability and the probability of a satisfactory, memorable experience of all visitors and guests.

Rural System would market BirdGolf-specific rule books, books and CDs on bird watching, ornithology, and ecology, binoculars, specialized clothing, hiking staffs and pointers, listening aids, photographs, home bird feeders and houses, a lawn management service, avian pest management aids, and camera supplies. Night-course work would be available, with night-viewing equipment rentals.

Each week a report would be published online, naming the top 10-20 BirdGolf players on BirdGolf courses. A national list would also be presented. The best courses would be listed, based on all of the scores of all of the players. After a certain number, say 110, it would become harder to add a new species. Points would be awarded for these next-level advances.

Several Rural System ownerships in the region are the first places that this challenging new sport became a reality. Other courses in the Eastern and Western U.S., Mexico, Belize, Uganda, Guatemala, Senegal, India, and elsewhere are created as franchises. Confident of the financial potential, the natural resource knowledge challenges are exciting for perceptive staff. It seems likely that the courses can offer exceptional students of ecology, ornithology, and faunal system management high-paying jobs that challenge their intellect, creativity and synthetic abilities as they participate with high financial contributions within the Rural System Conglomerate. As areas are added to Rural System management, suitability and potentials for BirdGolf course inclusions are be evaluated, especially for urban and urban-border residents.

Black Bears! A Business?

Once a state wildlife biologist, I have had more than ample experiences with black bears. As a youth, I made plaster casts of their paw prints. As a graduate student, I fed the bear cubs of a fellow graduate student, Alan Stickley, experimental diets, and helped weigh them to follow their growth. I have been involved with investigating a bear having killed sheep, and later a bear-poaching event.

The animal and its population dynamics are complex (as learned by my colleague, Dr. Mike Vaughn, and his graduate students at Virginia Tech, over many years). Rural System's **Black Bear Group** will seek ways to continue that research of black bears,[79] and use the results as a revived resource.

There is great interest in the bear as a game animal, tourist attraction, livestock killer, bee hive and conifer pest, and an interesting component of the regional natural ecosystem. Black bears, like grizzly bears, work with their young for several years. In this behavior I perceive an important message for human families and youth needing care and instruction for many years in future society.

The Black Bear Group of Rural System will be formed to gather knowledge on the black bear resource, synthesize it, create powerful models, and use the results in all Groups for tourism, recreation, protection, and reduced costs from bear-related property damages. The Black Bear Group, as other Rural System Groups, will seek to stabilize regional jobs and provide protection from many types of losses.

The bear is an important part of the present system of natural resources in Virginia. Quite a large resource, it is now virtually unused by a mere several hundred bear hunters statewide, a few days a year. It is seen as an unexploited resource that can be preserved, stabilized, and

[79] IUCN. 1976. Bears, their biology and management. 3rd International Conference on Bear Research and Management. Morges (Switzerland).

managed for net gains. The Black Bear Group will likely do most of the following, and perhaps many other actions besides:

- Conduct hunts (legally—locally, nationally, and internationally);
- Process hides, flesh, bones, and body parts;
- Conduct tooth aging;
- Perform food habits analyses;
- Sponsor excellent taxidermy;
- Provide bear display sites, accompanied by an extensive blog and additional ongoing camera studies of behavior;
- Conduct wildlife law enforcement research;
- Prevent bear-related accidents and damages;
- Develop a GIS system relating to all aspects of their ecology and use;
- Create a world-class population model of black bears;
- Sponsor alternatives to bear parts in Asian medicine (to reduce and prevent exploitation of bears for their organs);
- Conduct prescribed burns for bear habitat production;
- Develop trails (with **Stoneworms**) into bear country;
- Conduct tours into bear country and bear dens;
- Encourage photography, and conduct a black bear photo contest with prize money;
- Sell quality, bear-related artwork;
- Provide memberships to an alternative organization of interest with newsletters and services;
- Hold periodic conferences on the black bear;
- Present a regional and national lecture series;
- Conduct bear-related studies;
- Provide a variety of consulting services;
- Market a bear-related educational game;
- Publish books on a variety of bear subjects (from folk tales to ecological compilations); and
- Market ecotourism, both locally and internationally, with participants seeking to see one of each species of all of the bears of the world.

The above list is long, and gains value and momentum as the units are combined. There are now many biologists that have studied bears. Their work is not well-known or integrated. We propose a series of in-depth interviews, then to recruit biologists/ecologists that are systems-oriented, and to develop a knowledge-based program on bears. We know of and appreciate the knowledge of bears among farmers and seek to gain from and benefit others with that knowledge, sharing in work together as we prepare for the great bear-related rural troubles ahead. No simple limits can be set, but a new, developing enterprise is expected to become a lasting operation with products, services, and opportunities made available by the Black Bear Group.

The following is a sample message from VNodal to a land owner, from a long set of prescriptions from within Rural System's RRx for consideration by an owner. The prescription is followed by working concepts of the proposed Black Bear Group:

> You may have black bear on or near your property. Your lands are large enough and have little disturbance so that black bear management is feasible. You have not indicated a high desire for such populations, but it is likely you will have a few on your area as a result of the natural productivity of the land.
>
> Our Rural System Bear Group emphasis is on developing and maintaining a long-term system designed to be profitable, to achieve for you, as a citizen, modest access to the benefits of the bear resource, as well as from research of great public interest (itself a resource); intensive, cost-effective faunal-space management; intensive tourist management; and close attention to net benefits for you and your surrounding community. We suggest an opportunity for extensive education, modern tourism, and potential relations with alternative tourism interests within Rural System in other regions of the state.
>
> Rural System holds an expanded list of potential benefits of *the bear resource*, those at the center of a large, dynamic area within your region. The benefit categories are:
>
> - Services,
> - Products,
> - Structures,
> - Events,
> - Opportunities,
> - Views,
> - Information,
> - Ideas,
> - Inspirations,
> - Memberships,
> - Time, and
> - Memories.

Few people understand large, diverse rural resource systems. Citizens inquire of agency leaders, "How are things going?" and, like members of a board of directors, are willing to leave details to the CEO and officers. They want a system performance measure—a general grade on the system. They want to see a graph, and expect a flat or increasing main line to suggest all is well, or that the system is improving.

Herein we advance a beginning mix of ideas and concepts that may be useful in developing the potentials of a bear-centered tourism entity ... and its function in shaping self-sustaining modern tourism, as well as wild faunal resource management.

New technology may enable new studies of the distribution and abundance of black bears in remote forested areas. Some of these studies will relate new concerns (and legislation) to "biodiversity." We propose a study of recreationists and others who will report the presence and location of observed bears via cell phones. These observations can be sent, recorded, and then mapped, and duplicates can be reduced by analysis of difference in time and location of reported observations. The information can be digitized, GIS-mapped, and then supervised processes can

be used to analyze potential or probable, desirable "seasonal faunal space" and abundance per unit type. Similarly, GPS equipment can be rented to recreationists with instructions for reporting bears observed.

A game animal, the bear is also a non-game species when the hunting season closes. We see a potential area for tourism development with the state, for pest damage management, and for extensive wild faunal management (related to Virginia tourism and adjacent public lands).

A **Bear Hunter Group** will some day gain name recognition for its care and treatment of dogs, full-scale use and development of all bear parts gained (after successful, legal hunts), farmer-protection investments in bear-related damage costs reduction (e.g., bees, sheep, pets), and supporting books, trips, studies, and counter-action and alternatives to *illegal* gathering and sale of "bear-parts" (hides, organs, skulls, claws, meat, and fat), some now sold illegally in international markets.

The Guides Group

The Guides is a planned Group of people who love the rural area and often have "family lands." They will be insured, certified, and gain special first-aid knowledge. The Guides will cater to the specific interests of clients (e.g., bird watching, plant collection, mountain scenery, special photographs, climbing trees, etc.) but will typically have select service routes and areas in which each "expert" will provide diverse services for fees. They will be advertised within one of the Rural System blogs, and locally in diverse ways.

The Guides will supply lunches and meals, and will work closely with the other outdoor Groups, such as BirdGolf, The Fishery, and The Plant People. They will be encouraged to work with writers and photographers. The major objective of most members of the Group will be to build memories.

Youth programs may be conducted by The Guides, working in teams. Special roles for old members of the community may be developed, e.g., **The Past 60 Group**. They may have special abilities for Appalachian Trail use by individuals or groups, perhaps introducing people to some sections of the Trail.

They may often lead tours conducted on modern farming practices, research results, problems in the food chain, pathways to future human food (including soil and range management), and stream and pond ecology.

The Guides, in recognized clothing, can create and build their own demand. For example, field trips are widely used within instruction in forestry. Individual forestry faculty go on conference-related field trips, or even conduct them. There may be unusual times when an entire faculty might experience "getting away," going to a field site and discussing together, observing, sharing knowledge and asking questions. In the "land health" analogy of Leopold, such expeditions amount to a team of physicians visiting a patient.

The Cemeteries Group

Throughout the land, landowners may discover burial markers and cemeteries. Such important sites are often abandoned. Rural System can help protect those found, learn from them, and in some cases, expand near them because they have embodied decisions of years past. Sites need markers, and our plan is to find and develop a caretaking and visitation strategy for these

areas. They may become attractive sites for hikers and visitors to the land. Care of them may reflect well on the "cultural and historic" dimensions of land use management.

The Cemeteries Group, along with **The Memorials Group** and **The Histories Group**, will develop a regional cemeteries file, as appropriate, with relevant historical, genealogical, legal, business-related, and ecological notes. (We search for meaning within their distribution in time and space.) The Cemeteries Group will map, photograph, and begin to redevelop failing cemeteries of the various properties under Rural System management. The Cemeteries Group will provide other Groups with cemetery information, and may ask **The Fence Group** for action, as needed, to fence-in sites to protect flora communities from human intrusions, floods, as well as from grazing and excessive "clean-up."

The Cemeteries Group will relate to **The Lands Group** for real-estate records and related technical access. Gaining family histories is only a minor part of the Group's role. The location, marking, and clean-up at a cemetery site, as needed, are perceived to be socially necessary, important, and of community interest as well as of great potential ecological interest and dedication to owners. Of course, such areas need to be protected and are actively limited in any proposed land use or restoration project. Each cemetery, existing or proposed, will be located within or near appropriate Rural System Alpha Units.

Cemeteries may offer a glimpse into original or early soils of an area (rarely not-plowed), with mowing and organic deposits. Some, with fences or walls, contain rare, original perennial plants (as suggested by Aldo Leopold). Fences may be needed to protect vegetation from grazers. The soil and algae mark on tombstones suggests the rate of erosion or soil loss within the height of soil splatter. A computer-based life-table approach to human population analysis based on the distribution of death dates on tombstones may suggest local periods of land use, human stress, disease, or wealth.

We shall work to complete such records and use them in historical and ecological analyses and projections, and make such documents a part of the history of each region, tract, or ownership. GIS analyses of cemetery criteria will likely allow us to find hidden spots of near-identical characteristics. The Cemeteries Group may ask for assistance in analyzing the areas and reporting on findings (necrogeography[80]).

With ownership permission, we shall investigate special garden spots nearby or within cemetery areas. (Our VNodal system may distribute site-specific information for success in such gardens.) **The Gardens and Yards Group** will select the plants (with relevant family advice where applicable). The presence of trees in Group lands is related to fruiting tree potentials, nearby arboreta (if any), and a potential role in a portion of the plot or placement of the ashes. A memorials strategy is suggested, including placement of pylons (from wood or more permanent materials).

"Are cemeteries an appropriate land use?" is discussed more and more frequently. Mausoleums may accommodate about 1,000 burials per acre, where one burial requires 0.001 acres. One acre can accommodate an average of 620 traditional burials (0.00161 acres per burial).[81] Cremation urns require one-eighth the space of a standard horizontal burial. For general computations of changing needs, the minimum burial plot size of 27 square feet can be used. As populations shift and operational land area per capita declines, attitudes toward burial may change. Travel costs and probabilities for site visits enter recent decisions. Yet, there will persist some needs for burial, site protection, ash disposal, conserving select elements, and for memorial

[80] Knitten F. 1967. Necrogeography in the United States. Geographical Review. 57:426-427.

[81] Anon. 1950. Cemeteries in the city plan. ASPO Planning advisory service information report No. 16.

sites. We plan to study the role of tree groves and arboreta areas as desirable sites for human ash disposal.

In McCaw vs. Harrison,[82] testimony indicated that potential cadaver-caused contaminants to the ground water supply would travel no more than 50 feet from the casket. In other cases, cemeteries have been found to be public nuisances, where they endangered public health as a potential source of water pollution, or where they disrupted traffic in the surrounding community. Goldstein (1952)[83] suggested cremation as an alternative to the extensive above-ground burials made necessary in New Orleans and regional valley floods by a high hydrostatic level. Extensive study of "scattered remains in urban areas" has been reported by Stanley et al. (2015).[84]

Researchers have found social stratification of the dead.[85] High ground and easy access were most prestigious, though there is no correlation between cremation and class. In 1971, cremation was the means for disposal of remains by 4.8% of those dying in the US.[86] Both Roman Catholic and Jewish faiths discourage cremation. The cremation rate in 1998 was 23%, and predictions at that time indicated that economic difficulties would shift burials to cremations.[87] In 2014, 46.7% of Americans chose cremation, and the Cremation Association of North America said more people are choosing cremation due to its affordability and customizability.[88]

A possible simulation and inquiry for decision-making about spaces needed for cemeteries should include:

- Number of people within the region of interest;
- Estimated yearly death rate;
- Estimated acres of land required in cemeteries, per person;
- Types of preferred burials, including the proportion needing horizontal burial vs. other types; and
- Changes in human population (migration, etc.).

The Cemeteries Group will work intensively with **The Lands, GIS/GPS, Fence, Gardens, Arboreta, Trails,** and **Marketing Groups**. The Land Force will develop the surface up-keep. When mature, The Cemeteries Group will coordinate with **The Studies** and **GIS/GPS Groups** to locate and record cemeteries, especially pre-settlement human sites and slave cemeteries.

Lest it be missed, Rural System has strong, often-dependent relations between and among many Groups. Each might be somewhat independent, but with common reliance on Corporate Service Groups (Chapter 2). Each Group will be diversified and augmented, as suggested here.

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[82] Beuscher JH, Wright RR. Cases and materials on land use. Minneapolis (MN): West Publishing Co.
[83] Goldstein LA. 1952. A crematorium, columbarium and chapel for New Orleans, Louisiana. Thesis for MS in Architecture. Blacksburg (VA): Virginia Tech.
[84] Stanley M.C. et al. 2015. *Emerging threats in urban ecosystems: a horizon scanning exercise.* Frontiers in Ecology and Environment. 13(10): 553-560.
[85] Boggs, A and R. P. Miller. 1975. Social stratification of the dead. Intellect 104: 110-112
[86] Lublin, J.S. 1973. As burial costs go up, so does the popularity of scattering ashes. Wall Street J. 182 (60):1
[87] Ibid.
[88] Cremation Association of North America. "U.S. Cremation Rate Nearly Doubles Over Past 15 years." PR Newswire: Press Release Distribution, Targeting, Monitoring, and Marketing. PR Newswire, 1 Oct. 2015. Web. 06 Jan. 2017 http://www.prnewswire.com/news-releases/us-cremation-rate-nearly-doubles-over-past-15-years-300152328.html

Each Group has likely very different income potentials and profits. *Multi-season* and *stability* will be key success components along with the many advantages of diversity, reliability, and shared income.

Embodied Energy

Embodied energy (H. Odum) is a profound concept addressing the total collection of energy present (visible and temporarily on-display) in an object, such as an animal, human, machine, furniture, vase, etc. It expresses the cost of existence to date within a subject of substance (loss, waste, decomposition, crushed). The plant or unit of livestock forage has embodied energy.

Such emphasis can be related to antique furniture found in the rural region. I think of the high-energy costs to produce a hand-made rocking chair, being viewed (realizing many had been destroyed, lost, discarded, and here, before me, was a sole survivor). I see ancient vases in museums, and reflect on the vast amounts of energy to collect superior material, mold it, and do the needed furnace work. I count the failed and broken identical vases over the years as they were engaged in energy-reduction and loss themselves... the ones viewed as especially valued for their embodied energy and ability to do useful work.

Similar, I see a plant and the individual animal as a wonder, a wonderful, potentially live object of embodied energy. The costs are very detailed, losses great, inefficiencies evident start-to-finish, and in a different coin, the kilocalorie. Ancient people highly valued certain objects that we now find in museums, the last of them, equal, but preserved and protected for their great, usually-functional value, but also beauty, the one on display a favorite among the remaining few, the one having experienced "care." There is real energy cost on display as beauty, results of careful treatment, being honored, at least given special caution and tending over abundant, though brief, periods. (Thus, I think beauty can be quantified.)

As fossil energy costs increase (the mix of them), embodied energy costs will become of conspicuously greater interest; it will become much better known in the new language of energetics. Broken, lost, worn out, place where "neither moth nor rust doth corrupt" ... are features of entropy, the on-going loss (of everything) to the cosmos. The natural resource manager's giant task is avoiding, slowing, and overcoming entropy... everywhere. Mastering and using that realm of physics and ecology will provide leadership.

Cemeteries and Links

"Cemeteries" you read, and I know you're probably thinking a question. I can imagine your face and position. I know your question, and I've already heard it: *"why in hell are you including a chapter on cemeteries in this book?"*

I once bought a cabin, and the owner gave me a cigar box of "Indian arrow heads." I learned from the enclosed "points" —their size, form, substance, and from identical ones found elsewhere, I learned their ages (thanks to radio-carbon dating). "My" arrow and spear points were from traveling, pre-settlement-people who once gained water from my spring—groups of these people, only a few hundred years off the ice-free edge of the East coast of the glacier on what is now the USA.

The stone points told me of the existence of the people, their actions, their work, and how the artistry and effectiveness of each must have changed over the duration of their use at my

spring, from which the owner had collected and saved the stones. They lay hidden in an imported, wooden cigar box in the cabin basement before I arrived.

My brilliant (now deceased) graduate student, Seth Diamond, had an unusual undergraduate background, and taught me much about the history of the vegetation, thus ecosystems of the region, and thus available plant food for pre-settlement people—the same people who had dropped the points on the land I would later buy. They lived a mere few thousand years ago.

Years ago, I treated "a century" as an abstract mental image, or "part-of-a-thousand" as "a thing in a text book." Now, at 83, nearly a century, time and its periods and history categories take on new and personal meaning.

I invite readers to join me as I imagine continental movement influencing early ecosystems—now our coal layers between giant earth erosion layers. I proceed eventually to glaciers, then to the cold climate they released at the now-Eastern-USA-edge, and finally I arrive at the ruffed grouse, *Bonasa umbellus,* as we now expect them—typically Northeastern or high-elevation forest birds. Ruffed grouse would have been common to pre-settlement people, but having left no trace among the aspen trees—not abundant, in their low, warm-elevation, southerly forest-fire edges. Much later, I studied ruffed grouse as a Boy Scout for my Eagle Award.

"Why write about cemeteries?" I hear, as I learn about soil splash at sides of my dad's gravestone. I pondered the rate of erosion, and likely history for his headstone, as I read of local, recently-discovered cemeteries speaking loudly of natural system rates of action—expected change over time. I now expect that Mom's ashes in a church-side grave site will be lost in "urban transition" …during community rebuilding, rapidly-changing urban-border population needs, and "the rich garden flat space" near the old church side-door.

Why a cemetery section in this book? It is like a flag, a physical manifestation of something aphysical, of something very human that often provokes questions… and maybe useful answers. Seth taught me through his diverse studies about the likely abundant use of box turtles in the migrant, pre-settlement (USA) people, and of our near-omission, in our studies of passenger pigeons and probable vegetation, of loss of the American chestnut—once a major annual food supply for US settlers and pre-settlement-people, and most of the then-wild fauna. We grappled with the needs and perils of food storage by migrant early people, forgetting chestnuts. The tree seeds fed deer, supplying the hides for energy-loss reduction (cover and clothing), and thus balancing the energy needs, which had been exceeding the energy of available foods—for pre-settlement peoples—in our calculations.

On the rock layer gap above the cabin, I found with others a stone hand-tool and spear-point, somehow left at a thin, suitable sleeping place for a hunter on the small floor of "space," with a stone roof, high on the mountain… adequate for a person in a thin, open cave. Dating indicated a post-glacial, pre-settlement person with a uniquely-shaped point—from just 7 or 8 centuries ago. He or she just left sculpted points in the sandy dust of the north-facing rock-layer with a roof. Down in the valley, a few hundred years later and below the resting place, a village would be built, with yet-unknown optimization in our questions about life *between* hunter-gatherers and villagers, or *among* people and their living volume on Earth.

I rarely can answer "why include cemeteries in a book about the rural future?" It takes time not usually available and it tends to question and enlighten the past more than the present, to find the past more than shape the future. In the past, form, function, and fauna were the problems; now we face similar problems with new technology and knowledge. The hard work

ahead is not so well-known, but is evident in leaders' influences, group results, and effective committees… using current technology and planning for the near future.

Cemeteries are attachments to the past, like museum pieces, and they'd better not be lost. They must be included in plans for physical changes for the future, and achieving, in part, one of the objectives of "museums." Cemeteries represent treasured history—the captured past, hints of the future that can be produced from them… and must be. In Rural System, **The Studies** and **PowerPlace Groups**, at least, will seek to discover and apply knowledge from them.

I wished, while writing, that parallels and connections within The Cemeteries Group and others of *Rural Future* would be made. I want readers to learn of things like the word "isomorphism," relating to things having the same structure, and to move past that word *to find and use the concept actively,* gaining efficiencies in managing nearly identical structures or forms in farmland, urban borders, and throughout life. Beyond "finding" same structures (and maybe functions too—a fun game), we can use them in potentially new, productive ways. I'd like that for the reader.

I'd also like for you to study, understand, and use **a systems approach** well and to find ways to practice its uses. (I practice it now, herein, setting my **objective** to "what I want readers to do" and using **feedback** as I face my inadequacy.) **Context:** I have no rights to expect, demand, even request such behavior. I resort to elements of **feedforward.** I fear that *Rural Future* may seem to be a dark book, full of bad news and excessive challenges. Some will understand its intentions as a book of hope, and a call to a pathway to suggested alternatives.

Far beyond the scale of giant trees and large islands with migrating birds were deep caverns, with small light-deprived bats that flew over future terrain and winter-land runoff. The cemeteries, symbolic of the past, may be *the* singular symbol of the future. They are mysterious past, pre-history, but with many messages of emerging society—people together, active and learning, migrating… and displaying the fundamental law of biology: *migrate, mutate, or die.* Some, while migrating, left arrow/spear points nearby my cabin. They left the gateway entrance to the *human, social component* of evident, current diverse rural resource management.

Owners and managers of rural lands, I believe, must study and display mastered knowledge of their lands and waters, to survive and achieve desired levels of success. They must engage all dimensions of society for the long-term—for the rural future… and they must grasp the major social dimensions of successful society *beyond* feeding and watering animals, fencing, fertilizing, plowing and seeding, harvesting, storing, weeding, marketing, and vaccinating. The human dimension needs emphasis. "Rural" is beyond "farm," and does not stop at the urban border.

"Rural" extends into the city office of the National Forest Ranger, a federal employee, one on a staff to manage each designated national forest. Perhaps within sight of, or even adjacent to, private rural land, that publicly-owned national forest land is under the control of a *large book* of definitions, rules, and regulations affecting use of the land… the "neighbor" to all adjacent owners, and what can be seen from them. The "public" land is part of the viewscape and landscape (and public water flows onto private land). The *private* owner may provide adjacent access to forest land for legal activity. Activity on the land of the forest is tightly controlled (timber harvests, managed burns, road building, clearings, plantations, etc.)—neighborly action—changing with changes in neighbors; "forest" names and designations; forest leaders, and their varied experience, education, age, and future plans; proximity to railroads or factories for wood sales; and the current public attitude (e.g., recent local forest fire impact, the roadside "ugly" timber and the "clearcut"). A message herein is that there is much more to the adjacent

public property (the national and state forests) than wood and pretty autumn leaves, sleepy streams, and big deer antlers.

Meeting social needs—said to be part of rural land management in some areas, and generalized and simplified to "education" in other areas—may have hidden purposes of *improved conditions* for people that will result from our teaching events. "Objectives-orientation" work, within a systems Context, emphasizes stated, desired change by specific people, resulting from using planned processes of teaching (intended behavioral change, ranging from scenic appreciation to safe campfire building).

We shall achieve some desired outcomes by direct, physical action on the lands or waters of ownerships… but also by changing surrounding private land and water (odors, noise, pollution, views, illegal energy and use), and nearby public land (often enhanced land value and taxation).

We shall work to improve the retail value of ownerships, and to improve markets. The thousands of acres of absentee rural lands, owned privately, can become a vast, splendidly-managed, profitable enterprise environment in the future, when the *human* dimension of the rural land and water bases are carefully, strategically managed as a system for *lasting,* long-term profit, fully-integrated among ownership clusters.

We can (and must) learn from the expectations of ancient post-glacial migrant survivalists, some from United Nations countries. We plan ahead, imagining being within a vast, Western Virginia region of scattered farms, left behind in family moves toward coastal Virginia (or within an imagined Earth region)—few people, aged farm clusters, and distant towns with abundant people, some congregating at urban borders. The picture is one of crowded, small groups of people within or nearby formerly "named" small cities, with travel "tentacles" to rural areas, residual clusters and work sites (e.g., orchards).

Seen from the city or urban border, the near future is not the remembered past. "Wishing" is not a "change-agent." The present rural areas, within a period of from 2030 AD to 2050 AD, unless managed by Rural System or its equivalent, will be occupied by sparse surviving people. There will be a few housing units on the landscape. Urban people will escape to low-rent, multi-level living quarters, each inhabitant with a small, dense "marketplace," more social than economic, most *thirsty* for abundant clean water and adequate food for their family, wounded, stressed, caring but with inadequate health, time, or trade to move past a claim of "destitute," or "just cold," standing beside a waste burner lighting the evening walls of 2-3 story buildings and pathways into the night where children never walk.

From Another Angle

"Just farmin', or more like a lawn service!? What's a Rural System? What's it about?"

About? It's now a planned, large, complex, dynamic business-like system to revitalize and hold well rural regions for human-kind, and the resources upon which they depend.

Many very bright people wrestle with the meaning of "rural," especially as it may differ from "urban," because this distinction influences where voters live and how funds delivered from public coffers seem to be allocated. In Rural System, I specify a dynamic **Border Group** working at the rural-urban border. The differences between hobby farms, some residential areas, and center-city cooperative gardens are usually very small and not worth a human half-life of discussion and statistical report. The Border Group will work with all of these and many other natural resource features at the rural-urban border.

Rural System is a slowly-evolving concept that will someday become real. It does not exist, so it cannot be quickly demonstrated. It is very much like a corporation producing diverse items. In the beginning, it will be regional, but it is designed to become franchised widely. It is planned to be a for-profit corporation, but it will often deal with social needs of populations and regions, much like existing socially-oriented enterprises. Part of the continuing confusion has been the adamant split in legal advisors between the corporation being "for profit" or "not-for-profit," and my foundation belief is that only a significant, evident profit will achieve the desired, long-term, fundamental aims for Rural System.

People have left rural lands for the cities. Thousands of people! They age; they grow ill; the emigration continues. Rural residents and those absent daily inherit rural lands. Many do not know what to do with them... other than pay real estate taxes on them and visit once a year for "old-times-sake," or for huntin' and fishin'.

The lands and residual resources are often unprotected, unused, unmanaged, and/or exploited. Forests, for example, may not be tended for minimal profit in harvests, restoration, carbon sequestration, and watershed revitalization, or even hunting and fishing at a minimum.

The designed, interior structure of Rural System has a **Safety and Security Group** to work with local law enforcement and modern tactics to prevent losses (fire, vandalism, restricted uses by guests, with added safety, and first aid). Safety and Security will just be one Group within the active Rural System working on one ownership. There will likely be from 3 to 10 such ownerships managed within a cluster.

The structure is given to specify what Rural System "looks like," but its ever-present functions will include reducing financial losses and damages (elements of a "lean strategy"), and providing jobs and funds for local people, a small community tax base, and a staff—all required/desired for making the areas profitable under contract.

Multiple Groups are evident, and will be independent, with strong leaders, employed local people, and local awards for measured monetary loss reductions (e.g., timber, or deer theft, vandalism, or trespass). One example Group is **Stills**, which will serve all photo-related interests. Another, to serve many, is **The Marketing Group**. **The Furbearer Group** will benefit from trail camera units, supplied by The Marketing Group. There are over 150 planned enterprises working together (listed in Appendix 1), and there will typically be 20 active on each ownership, even more within a cluster. The Groups will work—they will hire, produce, relate, and yet they will be interdependent, not just interactive—the Rural System **Swarm**.

Several ownerships within a small area (e.g., one-half of a county) will form a cluster and share major strengths of all Groups of the ownerships. Thus, they will automatically gain reliability, increased diversity of scope, scale, and resilience. They will utilize advantages of branding, economies from shared use of large equipment, software, related research reports, fencing, and drinking facilities for livestock (where appropriate).

Groups (like Safety and Security) may have a very typical public, non-profit role. That image can be changed. There are others, like **The Lands Group** (data- and map-based), that will largely be *supportive* within Rural System and linked to all Groups, but used by only a few. Safety and Security will be linked to all, but will put pressure on **The GIS/GPS Group** for many more services than other Groups.

All Groups will be linked by contract, and all together will benefit, proportional to total financial net benefits, as well as from additive Group benefits that will likely not be proportional. Though I resist the concept, some take pleasure in saying Rural System is "a business ecosystem." So very different from actual ecosystems, the analogy makes me think that descriptions of Rural System must have been very poor.

Each ownership will have detailed GIS maps and data, available to staff and fundamental to Rural System success. The GIS maps will describe the ownership with details about each Alpha Unit on the ownership. Data is available for all of Virginia, and connections for mapping analyses for Virginia and even, recently, for Earth!

The major uses of GIS will be performed by (and within) VNodal, the "brain" of the system. VNodal will specify jobs for The Land Force (the work force, mostly of recruited and trained local employees) each morning, sent to mobile devices in the field. These "prescriptions" will specify where each worker is to go on the property, and what actions to take (i.e., trail work, fence repair, planting, etc.) Data and observations will go directly to VNodal and be processed, results will be summarized, and actions will be listed to make needed changes to work to objectives. New prescriptions will specify means to keep production and profits within the bounds required for long-term system success. "Two low or too high" profits will typically require field action to correct. A major advantage of the great diversity of Groups is the assurance of full time, around-the-year, stable profits and work, unlike that on the average farm, with part-time laborers.

Some inherited properties in western Virginia, like elsewhere, seem like punishment rather than wonderful, treasured gifts. Steep cliffs over a river are hardly farmland. That is Rural System's non-secret basis for rural work. We are for farm *and* for non-farm, for lake and dry stream-bed... all together. Given that we "know" more than 100 factors about every Alpha Unit on a map of every piece of land in western Virginia, I think I can start a small Group list with at least 15 profitable things that can be done with such properties if contracted within Rural System. Not a "farm" by any definition I know, Rural System will respond to a tract of land needing great care and tending, all with careful use, restoration, enhancement, and continued, shifting planning and unique resources, all aided in their protection and distribution.

Such lands' pure real-estate issues need dynamic analysis; their relationship viewscapes and their values need precise, computer-map analyses. The role of Rural System may become one of denying the appropriateness of real-estate tax values on a property, while balancing potential land value gains from Rural System work and enhancements. Unrestricted, tax valuation can become deadly to property ownership and value. Enhanced land value can open doors to county and small rural community labor, an enhanced tax base, and balanced real-estate

taxation and community involvement in expanding land values... and critical protection in many areas.

"What is Rural System? Really! Just briefly now!"

Rural System will be explored for uses within India, then within peaceful parts of Africa. It's a planned, private enterprise that will provide new, hi-tech, long-term management of lands left by urban emigrants, achieving social and natural-resource objectives for people through the distant future.

If you must know, Rural System first requires VNodal development. That will be done while much of the above is solidified, but the data requirements are specific. VNodal requires abundant software access, collection, and unification (some by translation of results from one to inputs to another). With the aid of VNodal, Rural System will exponentiate the practical usefulness of data.

Rural System does not plan to do research within the first years, only to conduct less-intensive studies, and use available software with special recognition of known and discovered workers. Major databases, like that of the wild animals of Virginia, are needed for demonstrations, and use will incur some costs.

The "nodes " of VNodal are the junctions at which **results** from one computation about daily-gathered data become **inputs** to important models, for example, of fertilizer needs, plant growth, and expected yields per acre per unit time in GPS-numbered and GIS-selected plots. (For example, a unit of land was selected for growing "kale 237," because the market analysis said its price per unit harvested and packaged would be better than for "kale 176.")

Trivial differences for the small rural farm can become quite large for 80 acres selected by GIS, and scattered over 900 acres of contractor ownerships. Rural System will gain by working with scope, scale, market information, knowledge of degree days, harvest rates and timing, buying locations, beneficial waste production, and more—all helpfully processed to generate decision aids to progress toward stated objectives. Objectives include long-term, relatively stable, bounded, significant products and benefits, indexed by equivalent local human losses, and planned over 150 years—sliding forward a year annually.

"Again—what's Rural System?"

It a complex thing—a bunch of enterprise environments managed together in clusters and Collaboratives, with a Swarm of many linked Groups, to achieve long-term, sustained profits and all five objectives.

"More detail?"

Let's talk! I'm Delighted!

Chapter Eleven

A Plan for the Integrated Health of Land and People

There is little agreement over full meaning of "health" and "wellness," but we study them and seek approved definitions—ones that can become actively used among the people, land owners, and staff of Rural System. We have begun parallel discussions and criteria-setting explorations about the meaning of "forest health." We continue to study and learn to generalize Aldo Leopold's concept of "land health" for people and ecosystems, as we seek criteria for our success in future rural regions.

We work toward a health objective for rural land and waters following restoration, improvements, or maintenance, and we must face the potential, negative realities of bioterrorism, general malevolence, revenge acts, legal obstruction, genuine ignorance or mistakes, and the ever-present and potentially increasing climatic or Earth-force disruptions.

We add to this list our awareness of human disease, and we study dimensions of the One Health Initiative. Sherman Jack (2012) describes the One Health Initiative as, "a worldwide movement of physicians, veterinarians, and other scientists recognizing the fundamental links among people, wildlife, and the environment." [89] The movement champions an "integrated, interdisciplinary approach to health management…" as we do in Rural System.

Jack spoke of the need for increased cooperation to address new health concerns, e.g., human population encroachment into natural areas, and citizens unaware of many zoonoses (diseases that can be transmitted from animals to humans); the spread of disease following environmental change (e.g., malaria, related to temperature increase); and once-checked diseases now reappearing. We fully intend to develop and maintain healthy rural environments, but we are eager to recognize, identify, and work with the counter-forces that impede or prevent Rural System's lasting success.

Jack suggested an overly simplistic diagram, with three overlapping circles related to health, of (1) humans, (2) domestic animals, and (3) wildlife. We suggest these are the objectives of a subsystem prioritizing at least generalized management of the diverse, changing environment. Simplistic diagrams help a little, but they must quickly promote *systems thinking* about other connections and relations, leading to objectives, such as those of *people* … and quickly to those of the *flora and fauna* upon which they depend. The persistent question needing to be asked and answered is: what is the positive, physical reality of a "relationship" in the forest, deserted farm, or urban border?

I find a few useful, named relationships, real or likely, starting with the letter **"R": Respect, Recover, Reuse, Repair, Restore, Recycle, and Redesign** … that seem especially dominant in cooperative work, essential throughout Rural System.

Respect seemed an outlier at first, but now seems closely related to embodied energy—the perceived or actual energy cost of gaining and holding an object (tool, vase, machine), or the personal ability to do useful work—i.e., physical power. The other side of such power is reduced

[89] Jack SW. 2012. One Health: More than Just a Catch Phrase! Journal of Human-Wildlife Interactions. 6(1):5-6.

physical power (disease or injury)—as stated, the inability to do useful, meaningful work. Physical power, as used here, is related to speed, quality, ease of repair, probable life, ease of use, safety in use, pleasing appearance, and long depreciation rate.

In the spirit of the One Health Initiative, we explore, for further meaning, parallels in human and domestic animal literature and management actions. Herein, we begin at the border between urban and rural, and then introduce Rural System's plans for more robust Collaboratives and vital communities in the rural regions within which Rural System works.

A Sight from the Urban Window

Rural System has, as its foundation, general systems theory and diverse texts and computer systems. It draws an imaginary line between the urban border and the rural region. Urban areas, cities, will have resources and pressures, and "infrastructure" in hand, with vast engineering, architectural, financial, and related system resources. Rural regions may lack many of these resources, but are home to indispensable natural resources.

The scale is evidently different between rural and urban: high human density and sparse areas in cities, served by and dependent upon dispersed elderly people and vast, often-despoiled rural acres and volumes of water. I concentrate on rural, know the urban, and know well the mid-ground—the residential areas or zones. The border land can be seen at the map-edge of lands labeled "urban." They are essential together—and if we do not self-destruct beforehand, there will come a beautiful union of the rural and urban. I work toward that in Rural System's **Border Group.**

I know that people stand in the urban window and look to the lands loved, to real home, where life was good, where challenges were known and overcome with help of neighbors. Everything was different then. That is the look of so many people. I work to create vital, productive rural regions that are beautiful from the urban window, but where people may see hosts of guests from the cities, enjoying the rural regions in all of their diversity and novel changes; rural has lasting roots for all of us.

There are special needs, conditions, and opportunities within the border, and within Rural System we plan and design The Border Group to meet them. Sadly, it is now a place of growing conflict and difficult problems. As homes and shopping malls proliferate, the United States loses about 6,000 acres of open space every day, four acres per minute, and most of it in the urban border zone. Border area development in the US (along with rural loss and urban change) is among the highest in the world.

Few people know—and have no reason to see and comprehend—what the consequences will be, from 7 out of 10 people living in cities by 2050 AD. The borders will have to expand... into rural areas, the sources of so many basic and yet not-judged-to-be-basic resources. Borders will be challenged by connecting routes between communities, as now, and between areas within cities. People will need to adopt higher densities and diverse housing for city dwellers, return to restructured rural areas, or reduce population size.

Of course, the border is a place for people... where many things happen as they move into towns and cities, and then outward again, back into the rural landscape. Resource managers at the border (the wildland-urban interface) are challenged by the homes and activities that present needs and obstacles to what they can do as managers. Paved surfaces change the flow of rainwater, roads and road barriers intersect animals' areas, curbs present barriers to small amphibians and reptiles, and free-ranging pets create special problems for birds and small

animals. Well-meant, bird feeders may also attract some unwanted animals and their behaviors. The border zone is a challenging area where the cities and towns are encroaching on the rural area, and the rural area with its noises, odors, and unplanned conditions are infringing on urban quality of life.

Sprawling encroachment will expand on important farmlands, increasingly prized in value for growing food, and not only for structure-space. Urban problems will continue to push remaining middle-class people to the border, and put stresses on the lands and waters there as central cities decay. While there is continued conversion of rural lands to urban uses, Rural System seeks to improve the food productivity of those remaining lands and their central "support services," economies, and communities.

Within these remaining communities and active farms there must be capital, human skills, technology, and supporting systems. Few appreciate the costs of urban crime, school quality, housing finance and rehabilitation, transportation, and taxation within the average urban maze. At the urban border, conflicts are likely to arise between abundance and shortages between urban and rural area people, before and after looming changes… especially without adequate planning, and structural and social components. Somehow, planners must address the abundant, heart-felt expressions of the mutual needs for unique, irreplaceable natural resources, some space, and a "common heritage" within border lands, among other needs.

There are over 150 suggested Groups now within Rural System (Appendix 1). The Border Group will become one of the most important and will use the talents and software of many, many other Groups, some forestry-evident and others related to waterfowl, gardens, recreational trails, and legal hunting. Working with The Border Group, we propose full, sensitive development of the lands and waters left behind—the result of the rural emigration of a dozen years. We propose to work with absentee owners to make money for them, enhancing their land values and their visits for the future. Their lands, ponds, streams, and especially forests will take on extra meaning from the context within which they are located. Staff ecologists will work at the edges (with well-known "edge effect" phenomena, scattered within the ecology text books).

Proximity matters. Some forests are near processing industries and others are distant; resource proximity to uses influences the value of forest products. Forests harbor potential threats to crop fields in the form of pests. The nearby presence of cropland changes the transition probability for a forest-acre to field-acre. Forests increase some land value; residential, urban land, and roadways increase the probability of wildfire in forests. Some forest flora and fauna are enhanced by proximity to forest edges, while other wildlife is reduced. The quality of recreational sites, and experiences on them, are influenced by nearby forests.

Urban parks may reduce the heat island effect on the city, and Rural System can integrate such conditions within its models to enhance desirable effects and reduce others, such as from forest winds. Rural System will have access to GIS data for each region of work, integrating winds over forests with energy conservation of buildings, both within the border and throughout rural regions.

The border of the city is the "overlap area" for people of the city and those incoming from the rural areas. It is the wide but only generally-defined area at the outer urban edge, where residual interests, activities, hobbies, and wishes converge. There, the dynamic—perhaps locally unique—of a very busy, somewhat-urban forest is often found … about which questions and unusual, unified city-forest problems emerge.

Urban and urban-border tree canopies are already well-known for social services, such as:

- Reducing the urban heat-island effect,
- Saving energy in housing,
- Reducing some storm effects (e.g., wind),
- Improving air quality,
- Providing homes for birds,
- Adding to human "livability" indices (including psychological benefits), and
- Helping to control storm water.

We think that many urban dwellers realize how precious and vulnerable their street, park, and yard trees are. Some observers suggest that forest changes may be coming, related to unplanned, harmful insect introductions, as well as from changes in precipitation and temperature.

Studies continue, and the Rural System forestry staff will watch area-wide changes, rural and urban. Philadelphia, for example, has 16,884 acres of existing tree canopy (large and small). An Urban Tree Canopy (UTC) assessment helps prioritize planting areas, project long-term needs, and strengthen a city or border collective capacity for serving citizens. Zoning codes need to be studied to assure responses to late-stage problems.

Elves, Inc.

We imagine **Elves, Inc.** will become a Group of Rural System, to manage the urban and urban-border forests. The forests of rural towns, small cities, and their borders are a topic of immense importance. They are, as so many other modern topics, on the cusp among disciplines.

At once forestry and parkland management, the work of Elves, Inc. is so far interlaced with poorly-defined terms like urban ecology, urban forestry, community forestry, social forestry, vertebrate pest control, outdoor life, nature study, ecotourism, and viewscape management. Part of the entrepreneurial development for the region, Rural System will probably develop Elves, Inc. in collaboration with existing enterprises to establish a modern, sophisticated program for creating, restoring, and managing scenic, healthful, nature- and tree-dominant communities near and within rural-area towns.

There is no single word or phrase now associated with the vast topics the Group will address now. We call that total system simply Elves, Inc. (small creatures, small forests, with marketing appeal and potentials). Elves, Inc., continuing job expansions, will address the natural managed spaces of trees and shrubs, landscaped spots, streamsides, stormwater gardens, ponds and their borders, and viewscapes into and out from the town/city edges.

Elves, Inc. will provide a response to a growing need for community forestry and related work, for giving land an appearance of being under care. It will seek to attract and to retain the attention of visitors and tourists, and to help manage the outdoor appearance of small towns and villages throughout the forest region. All small rural towns now suffer financial difficulties, and "forests" are far down most lists of needs and budget lines. We believe that Elves, Inc. serves for more than personal town cosmetics. It is for the results of what government was once intended, that is, for beneficial projects that individuals can rarely do alone. Elves, Inc. will be a regional Group, achieving economies of scale and allowing superior natural resource work for rural towns, independent developments, corporation lands, and communities, to produce a variety of wood and tree-based urban benefits.

Elves, Inc. can play a vital, diversifying role for Rural System. The system will serve under contract with towns and communities throughout private lands (and recreational and

roadside areas). It, however, will also be involved in the management and uses of the underlying and surrounding lands and waters, human health and safety near trees and their areas, pest issues, noise attenuation, carbon capture, economy of tree leaves, energy conservation, nature-beauty, and related lawn and plant communities. As throughout Rural System, Elves, Inc. will exhibit direct marketing and exploratory contacts for other Groups, such as **Nature Folks** and its songbirds unit, **The Pest Force**, and **The Sculptors Group**, using removed woods for potential uses in carvings.

The Modern Community: The Recent Human Environment as Context

The well-known "small farm" cannot likely be recreated now as a food base; a food-export source; a community financial base; or as a safe, healthy, well-educated, lasting-family home. Widespread, water quality and quantity are now threatened. Absentee owners have little information about agricultural agencies or their services. An estimated 63% of absentee owners have never been farmers.

Fewer than 2 percent of Americans farm for a living today[90]; only 17 percent of Americans now live in rural areas.[91] People now leave farms in Virginia. Some are aging, infirm, and rural medical and assisted-living services are inadequate. Transportation is sparse. Agriculture is within the topmost-dangerous occupations. Rapid access to affordable health and medical services and centers must be stabilized as regional needs increase. In 2012, the average age of a principal farm operator was 58.3 years, up 1.2 years since 2007, and continuing a 30-year trend of steady increase[92] in age and rural-area-life difficulty.

Farms cover 8.3 million acres, or about 32% of Virginia's total land area.[93] Much of the rest of Virginia's land is covered by buildings, highways, and airports. Absentee landowners own an estimated 45 percent of agricultural acreage in Virginia. Nearby where I write within Western Virginia, there are more than 300,000 acres (variable criteria throughout) of absentee farm land, an estimated initial market for Rural System services. Current average farm size is 180 acres.[94] Small farms and ownerships in Virginia are marginal (family income is below the poverty line) and "success" is tallied by some as related to international trade conditions. Eight percent of farms account for 85% of farm sales.[95]

Rural housing quality declines. The absence of broadband for high-speed internet work now limits business and education growth for the region. Threats of fossil energy shortages and local limitations abound; critical knowledge is absent… that agriculture is highly energy-dependent. Active strategies to respond to harmful shifts in climatic temperatures and growing seasons are only slowly forming.

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[90] USDA. 2014. 2012 Census Highlights [Internet]. Census of Agriculture. [cited 2017 Apr 23]. Available from: https://www.agcensus.usda.gov/Publications/2012/Online_Resources/Highlights/Farm_Demographics/.
[91] Council of Economic Advisors. Strengthening the Rural Economy - The Current State of Rural America [Internet]. The White House. [cited 2017 Apr 23]. Available from: https://obamawhitehouse.archives.gov/administration/eop/cea/factsheets-reports/strengthening-the-rural-economy/the-current-state-of-rural-america.
[92] Ibid.
[93] USDA. 2012 Census Volume 1, Chapter 1: State Level Data—Virginia [Internet]. Census of Agriculture. [cited 2017 Apr 23]. Available from: https://agcensus.usda.gov/Publications/2012/#full_report.
[94] Ibid.
[95] Ibid.

We may assist the region in meeting part of those needs with an alternative strategy, integrating sophisticated, diverse, computer-aided land use, conducted by a Conglomerate of for-profit businesses. "For-profit" is held by Rural System and believed to be the base of a strategy that provides the only consistent major motive and opportunities for society to gain sustained protection, restoration (as needed), and science-based management of rural lands and waters—partially meeting human needs.

We continue to ask for reflection on our objectives, no one of which is "maximum profit." We have consistently said that Rural System is not a high-yield, high-rate-of-return enterprise, and thus typical angel investors have not been interested. Rates of return are ponderous… less than to send shrub fruits to market? The evidence is in: traditional farmers fail and are moving elsewhere. Superior and extended work without salary, little innovation, unavailable (off-farm) family workers, and land inheritance issues together destabilize farm life. We see new ways to success, and to modest, stable, bounded profitability for the system while it achieves its other, closely-related and interdependent objectives.

There is an alternative to the present, rapidly-forming, very troublesome conditions: a well-developed Rural System, existing within the same lands and waters of the present, but differing in many ways by their great diversity, emphases, productivity, resilience, reliability, and gainful linkages. All parts of Rural System will work toward common, long-lasting financial gains, rewarding participants and society by making many desirable social and natural-resource improvements.

The Rural System's Cooperatives, Collaboratives, and a Conglomerate

In 2013, I was delighted to learn of the book *Make No Small Plans: A Cooperative Revival for Rural America*, by Lee Egerstrom.[96] He described the changes in rural conditions after the Great Depression as "very bad," and as "continuing to get worse since then." There has been a flight from rural areas along with school closures, hospitals, and changing government aid. The needs, then and now, are seen, and local involvement of farmer groups—cooperatives—seems like one way to meet them. Egerstrom wrote that the time has come to find creative thinking for new structures for the ownership of production facilities, to build job security through equity stakes in plants, to engage community development programs, to range widely for cooperative action in rural areas, and to gain more favorable trade agreements.

Now we see that technology provides benefits in some areas but subtracts them in others. Fewer people are now needed in areas where large machines can do their work of producing food and fiber (or mining coal). The declining needs for more workers shift human needs and resources for schools, hospitals, and retail space and service. Egerstrom observed that awareness of the difficulties ahead must be motivational. A new form of social action is needed for the people of the rural regions—all of them—those ready to leave, those returning, and those who have already left for the cities. Egerstrom further wrote that, "*cooperatives* are the most efficient vehicles for developing value-added business ideas and raising community capital to turn ideas into action. These businesses raise the value of area raw materials …They also provide jobs and gainful employment in rural communities for people no longer associated with the land" (1994:13). Within Rural System, I work toward a way to integrate the best elements of past

[96] Egerstrom L. 1994. Make no small plans, a cooperative revival for rural America. Rochester (MN): Lone Oak Press.

cooperative ventures, programs, inventions, and unique functions for the future society of rural lands and waters.

The migrants have left behind (and continue leaving) their small, un-economical farms. Egerstrom observed that the new land owners were stressed by their understanding of communism, and therefore the seeming affronts of cooperatives to individual farm ownership and management. There were genuine concerns and issues with communism that hampered cooperative developments, including those of intensive livestock production and practices, pollution management, and other projects. The absence of cooperation led to diverse, uncertain agendas, inadequate return on investment, uncertain regional and international commodity prices for uncertain produce, and regionally uncertain bank credit.

Within Rural System it seems essential to continue the process of encouraging the cooperative agrarians. People now in cities just do not know the language, the sources of food, the costs, the risks, the rapid changes, and the danger of the over-elaborate county scene. There is no sacred adapted mission, just that the successful large farm is a substantial *business* and a substantial *investment*. As other businesses, they seek net gains. Modern arithmetic in urban schools will likely not address the personal costs of the taxes that are behind the subsidized foods on urban plates. Egerstrom (1994:64), listing major changes, said that "rural Americans must start over—just as their ancestors, the pioneers, did—to give their farms and towns reasons to survive and prosper in the next century." We must work "collaboratively" in the new high-tech society to improve our collective standards of living.

I wonder, sad, about a culture change, unsure of the new spirit of work, the need for thinking like pioneers and entrepreneurs, acting as if on a moon mission, skeptical of international unity, challenged by "natural surprise" alerts received daily from the internet, unsure of "place" within the new Earth or epistemology.

Egerstrom, quoting Mr. Joe Famalette, said "farmers have to ask themselves if they want to just be farmers or if they want to be farmer-business-people. If they want to stay a farmer, they will be growing crops under contract for someone else. If they decide to be a farmer-business person, they will be growing things for themselves (their cooperatives)" (1994:143). We suspect that people cannot stay farmers and continue to grow crops without major change and cooperative effort, and will continue leaving for rational reasons related to family finance.

Herein is our premise that a farmer, successful and still rural, *must* be a business person, a Rural System person. In our proposed **Conglomerate** of Groups, people involved will be growing and working for themselves and their customers—perhaps worldwide. Major parts and processes of cooperative systems can be held, enhanced, and continued, but, now surrounded by change, they must be guided toward acceptable *rates* of change and future possibilities.

Hope remains, among:

1. a few historically-strong, large farms holding forth—well-capitalized, family-dependent, and actively engaged in markets, with some local labor and using public resources; or
2. the Rural System Conglomerate, including diverse, abundant, related Groups, with some national and state agency aid, niche markets, strategic alliances, and dispersed clusters.

From analysis of the needs for integrated systems to fill existing voids emerges the imagined and under-design **Rural System Collaborative**, avoiding pitfalls identified by experts on cooperatives, making modifications, and extending into the new enterprise environments. The Collaborative will apply GIS, GPS, and computer-aided decision-making with simulation, and with diverse electronic media for advertising and marketing from in and around Rural System

enterprise environments. Clusters of ownerships, unified within a Swarm of Groups, will be the new Rural System Collaborative.

Not just another marketing approach, the Collaborative will be seeking great efficiencies—better deals—for buyers, but also wellness, along with other objectives the members may wish to achieve together for the common good. We can imagine the emergence of leaders, male and female, with ideas for great differences in produce and sale areas, climates, and access. But we see how to overcome problems *together* for people now and for the future … we are not dependent upon phlegmatic people, the ardent leader…. or the occasional monoculture-payoff. Rural people will be better served by the effective, diverse *Collaborative*.

Lee Egerstrom wrote that, "A new rural America is starting to take shape, rising from the ruins of communities that were no longer needed to serve the needs of traditional agriculture." He just did not realize the *pace,* having said in 1974 that he had campaigned for Congress in towns sick, "if not dying." "Schools have closed or, at best, consolidated beyond recognition," and, he noted, "...needless to say things have gotten worse." (1994:7) Even in 1994, he called for "America to take back control of [the forces of change]," and suggested "a golden age ahead for agriculture and for all of rural America."

Readers may call some of the work of the planned Collaborative misdirected. However, as suggested in our text for employees' "Decent Work" (Appendix 3), it will actively engage and display social responsibility, respecting and valuing employees, the community, and the visual environment. We believe this ethic will influence long-term Collaborative profits. The Collaborative is planned to operate off a modified, enlightened self-interest proclamation of the once-Senator, Hubert Humphrey: hunger, thirst, ignorance, illness, today-centered thought, and inefficiencies represent lost Earth-markets.

Warned by Egerstrom, we know there is now no known likely set of farm policies that can restore or sustain large populations of farming people around current cities. People have left; others leave. High productivity is a conservative goal, as regional needs are estimated to grow and peak in 2050 AD. The options are few, the time is short, even for young people… between now and the year that Earth-populations will meet and begin exceeding food and water supplies.

From my analysis of national needs, narrowed to state needs, and then to what I knew best, the potentials and needs of Western Virginia became evident. The needs mirrored the plight of communities throughout the US and international communities that I had visited. I realized that I had found a solution for "home-town use," one isomorphic, and with broad, lasting benefits. The private lands of Virginia (and especially those vast lands of absentee landowners) may now become the centralized test and demonstration areas for rural resource management… now. Past natural resource management has not worked well, sufficiently, and shows little sign of preparation for the looming changes and limits.

I now write of a concept within Rural System: Conglomerate structure. My working hypothesis is that *abundant, rich food and abundant, clean water can now only be achieved at the massive scale needed via profit motives, and working in tandem.* Profit is needed for large numbers of people, with much land to assure that the computer-optimization effort approximates *lasting* optimization… production within bounds or "limits."

The Vital Community

Human community stability is one of the major objectives of Rural System, and that stability becomes increasingly valuable as we see the potentials of the "now" community

becoming the "next" or, for Rural System, the *new vital community*—re-shaped, and in touch with the changes all around. We see dimly that communities within rural areas are highly stressed by excessive demands. People in rural areas now need new technologies (with high costs), for older tools and methods to be replaced or repaired, and a new awareness of the enormous future needs for rural products as well as social amenities. Herein, we discuss standback and feedforward, essential parts of the modern general system (Chapter 2), relating specifically to our community objective.

Rural System itself is seen as a human community. We are not in the old, challenged business of "farming" but in that of a new, expansive corporate community, a Conglomerate—computer-aided and technologically active—with business centers and housing for diverse enterprises such as ranging (Chapter 9) and modern wealth management. The Rural System Conglomerate—a mixture of businesses, housing, farm clusters, and modernized agricultural cooperatives (Collaboratives)—will create communities, new social forms.

A community is not just a mapped area; we know that. It is composed of people relating well to each other, providing stability, reliance, and common interests and helpfulness, and we know well the differences between groups of people. Some we admire and others... not so much. Along with high employment, we shall strive for functional, vital families that make good use of the funds gained resulting from employment, and are proud in doing meaningful work, engaged in continuing learning, and healthy. We aspire for areas of regions with low crime rates, few people in poverty, and most people unlikely to overuse alcohol or drugs. There will likely be a working medical treatment center, and few teen-aged pregnancies.

As others, we face "the rural problem" but see "problems"—many, not one—defined as being within a gap between where we are now, and where we intend to be. We are eager to become involved with citizens as we come to understand and operate on closing that gap... which requires understanding the present and the desired future (and knowing how to quantify or express them so that we can tell when we are achieving the specific, desired results of our collective efforts).

Our Rural System strategies for stabilizing small rural communities, such as those found in Central Appalachia, are to attack and reverse the following observed limitations or problems:

- High tax burden per person;
- High maintenance costs;
- Uncertain payoffs;
- Few employees in the area;
- Uncertain public services for local groups of people;
- Little income available for starting and building profitable markets;
- Not enough use of waste and composting;
- Storm water problems, flooding, and need for water capture; and
- Unmitigated crime and drug use.

As part of our work in responding to these problems, we shall attempt to gain local employment that stays close within a region. We shall work for employment opportunities, educational spaces and opportunities, and for satisfied, happy citizens who stay and have their personal objectives well-met within the region. We intend to develop an escape from the boom-and-bust of typical farm and mining communities—a strategy we call *planned, bounded profits* (Chapter 12).

We learn from John Schultz's book, *Boomtown USA*,[97] that people are, "moving to small towns, primarily for quality of life issues." We are aware that they are moving *from* cities for these same reasons, and some may move *to* work in new cities, clusters of farms, and innovative additions to small rural communities, potential "roots for individual success." We recognize the coined "agurb," a rural town having experienced growth in population and employment from 1990 to 2000, and having a per capita income growth of more than 2% per year from 1998 to 1999. However, as Schultz observed, "Not all small towns are prospering."

He wrote that more than half of the 15,800 small towns in the US have lost population, and the trend seems likely to continue. All small towns are in a fight to survive, and most are losing. Rural System is developing a mixed strategy for all involved, planning to attract urban youth to border and rural areas; increase electronic communications among rural residents; diversify Rural System enterprises and their marketing efforts; make use of housing spaces of leased lands and at-home computer workplaces; provide diverse resources for young families; engage in outdoor recreation; and attempt to use creative solutions for quality-of-life issues, beyond restoring and enhancing the lands of current owners.

Rural System will work to build improving and enduring economies, vibrant communities, and regions stronger than in the past, largely by helping low-income people get ahead, but also through growing the stock of evolving, multiple regional rural assets, providing the base for a prosperous future. Within our well-related Groups, we shall work on specific needs such as improving community involvement against crime, and for youth development and related environmental justice programs. We propose to consider and advance green infrastructure for most buildings and their areas for communities, as well as Rural System farm structures.

It is very difficult to unscramble the statistics and use them convincingly, especially in the cross-currents of economic and political forces... For example, only about 20-25% of the US population is currently called "rural"... but an even smaller 1.9% of the population is actually on farms. We'll not get into "family farm" discussions, but we see changes coming with an improved communication system, dispersed work from computers, occasional business group meetings, and greater dependence upon commercial exporters (both short- and long-distance) than ever before. We shall move toward land ownership clusters as communities, and hope to see some of these emerge as unique Collaboratives.

Rural System has designed many intensive solutions to revitalize rural communities after large-scale departures. We plan to:

- Develop a superior, repeatable community development strategy;
- Develop a sound energy policy and relevant program, including at least energy-efficient mortgages, passive energy retrofits, using utility incentive programs, and personal energy efficiencies;
- Develop small gathering places within or near a community center (or merge with a nearby community) for local topic discussions, presentations, concerts, dances, art displays, and celebrations of community successes;
- Create a committee or organization for action, with social networking for community-wide participation;
- Develop a studies unit (e.g., history, population, economics, health care, problems, select resources) with easy access for citizens and scientists;

[97] Schultz JM. 2004. Boomtown USA: The 7 1/2 Keys to Big Success in Small Towns. Herndon (VA): National Association of Industrial and Office Properties.

- Enhance or create a library and information center;
- Develop special units of integrated work to increase employment opportunities for minorities, youths, elderly, handicapped, and economically disadvantaged individuals;
- Develop community service action programs with the courts, as well as adult social groups (e.g., beautification, waste disposal, highway clean up);
- Work within Rural System for education, leadership, and work-force development;
- Provide reports on the likely effects of regional, state, national, and international economic and natural resource changes on communities;
- Provide specialized youth workforce development (e.g., chemistry, carpentry, welding, programming);
- Provide diverse children's programs (e.g., recreation, service, and advocacy); and
- Develop a Rural System **Brown-Bag Group**, providing nutritious, quick lunches for the local workforce as a community alternative to fast food.

The preliminary **Vital Communities Strategy** will have within it, and have related to it:

- Abundant data and modern maps about the community, its history, ownerships, and leaders;
- Local museums to preserve cultural heritage and history;
- Internet materials and documents describing our objectives and processes;
- Speeches and publications for community members about our activities and intentions;
- Local field trips to planned Rural System work sites and demonstration sites;
- Reports of contributions to the local tax budgets;
- Published success stories and ongoing visits from community members;
- Consultations with off-site community experts;
- Meetings with county/local representatives to discuss Rural System activities;
- Annual financial reports with current lists of local Rural System employees and affiliates;
- Reports from citizens on likely effects of Rural System activities on family well-being; and
- Specialized training and services for community members.

Many authors describe how modern communities are being tested—people interacting online, creating anew the conceptual and functional elements that relate them. Rural communities will be inspired to find, for themselves, new online sources for entertainment, business, research, recreation, medical help, and other needs. They will create a community dialog, one now directed at needs, availability, shared objectives, and timely opportunities (food, sales, equipment, sites for work or service, warnings and risks, etc.).

The Internet is the new playing field where adaptive social processes can evade, settle, or surmount conflicts. It can show special needs or techniques, store past knowledge and retrieve it for timely decision-making. There are opportunities for communicating sound as well as images, words as well as voices, the past as well as sketches of the likely future... at reasonable costs for every rural community member. Markets are now worldwide, not just “down the road.” Whether they are realistic or not will depend on fossil fuel or other energy availability, and new modes of transporting *physical* things.

Many strong communities start and build around special environmental phenomena, such as ancient trail and road crossings, railroad crossings or centers, waterholes, and stream and river

crossings. Some develop near mines and factories. If these latter features close, or the resource is fully removed, the financial support and the reason for being for the community disappear. Yet, to abandon a mine site is part of the initial financial calculus of the land owner or large corporation. We see new opportunities in restoring formerly-mined lands for intensified food production, with secondary advantages of community diversification, food quality, and local tax advantages.

Quality of Life

Just what is a reasonable objective for rural communities? We think it's a stable, vital community that has conditions agreed upon by a few knowledgeable people to be adaptable, linked with others, resilient, and with reserves (resources for the future). Such stability for the citizens and businesses need not be official, but merely an area easily bounded by sketches on a map, agreed to by 5 out of 10 citizens of the community. The community is not necessarily a legal town or city, just a recognized place within which many people together will describe that it and its people as different than its surroundings. For example, Donoghue et al. (2006) wrote that, "The concept of community is a sociological phenomenon that continues to be shaped by differing interpretations of social structures, processes, relations, actions, and change related to human groupings."[98]

Discussions of community often include a high quality of life, and we continue work toward quantifying that expression and condition. There are many dimensions to achieving and maintaining it. "I live in a society of serious conflict," said Emmanuel Etomi of the Royal Dutch Shell Company, speaking in 2003 about Nigeria.[99] "This is being fed by corruption, poverty, and high unemployment among youth in a region where little of the wealth has been returned to the people." I have heard this said about many areas of the world... the coalfields of Virginia, West Virginia, and Tennessee; Senegal; former tobacco areas; US rice fields; and Native American lands. Rural System recognizes that such conflicts are real.

A part of the Rural System strategic intent is to reduce regional conflicts. We know that much conflict is massive, diverse, long-standing, and has already been the subject of past corrective efforts. We shall continue, optimistically, with our particular efforts and a plan to understand how our activities are affected by, and may contribute to, regional conflicts. Conflicts will probably make it difficult for us to operate safely and with integrity, and we may inadvertently feed the conflict. We know unmitigated conflict may reduce the achievements and impacts of our community stability and development objective.

We're not following a "borrowing trouble" basis for developing our strategy but just the opposite; we're using partially an "avoiding it" strategy, trying to be upbeat and trouble-free, then creative. We rarely emphasize conflict and instead shall work toward the desired conditions. We know that conflicts and issues arise between communities and corporations. We also know that most of these can be prevented and that some will not be resolved quickly... but we shall move always toward progress from our work together.

We know that there are various levels of quality of life. Most people aspire to a "high" level, others just to a *higher* quality than they now have. Quality of life differs by neighborhoods,

[98] Donoghue EM, Lynnae SN, Haynes RW. 2006. Considering Communities in Forest Management Planning in Western Oregon. USDA Rep. no. PNW-GTR-693.

[99] Tran M. 2004. Shell 'may have to leave Nigeria' [Internet]. The Guardian. [cited 2017 Mar 17]. Available from: https://www.theguardian.com/business/2004/jun/11/oilandpetrol.money

and is influenced by many dimensions, such as prenatal and early childhood care, general happiness, socioeconomic status, and high school graduation rates. Communities can rank and weigh these and other dimensions (like open space, scenic views, wild animals present, and back-to-nature atmosphere) according to their relative importance in *their* quality of life.

We have a special awareness of modern communities; they are strongly affected by images and realities of the past. Buildings, dams, roads, mines, and even forests set a pattern on the land, and while communities are social, they are strongly affected by space, structures, and past actions, including zoning and related decisions. Donoghue et al. (2006) [100] recognized that human communities are inseparable from surrounding ecosystems: "The past two decades have seen an evolution of concepts used to depict communities and their connections to forest resources and their management. The evolution of concepts shows a growing emphasis on the complex, dynamic, and interrelated aspects of rural communities and the natural resources that surround them." The result is an emerging social form, a modern, diversely-Internet-linked community, concerned with quality of life over the long-run.

We must face for the present that we have lost, recognizably, a level of human community. In the loss is the very definition of what we mean and feel when we use the term. In families, there are now two job holders; it seems that everyone is "working." There is little time or opportunity for meeting, exchanging ideas, casual conversation, or time together. There is little "moving up" from one neighborhood to another.

Even the messengers or connectors are rare—the milk man, newspaper boy, laundry or dry-cleaner delivery people … now even the postman. Relatives, unlike the past, now live far away. Grandchildren are almost unknown by many grandparents. Stores are too big or too far away from former communities to have people we know with which to pass more than the time of day. These stores usually have owners living outside the communities, and thus poorly attuned to interior sentiments of any form.

People are, more often than in the past, called *individuals,* and groups with names have multiple personalities. There are few groups, just individuals accustomed to private cars and solitary TVs. Entertainment is rarely social; people once went out to movies, played games, sang songs together, and listened little to pop singers. Maybe we have learned an artificial indoor culture and image of rightness from watching so much TV. We now see inside neighbors' homes, where conditions reflect on those living there. We know little of neighbors' values, thrift, manners, or courtesies.

The potential growth of tourism, urbanization, and large construction projects can put increasing pressure on the preservation of the cultural heritage of a region. Especially if the indigenous needs and interests towards local heritage are under-addressed, no effective steps can be set towards preserving the cultural heritage of the region through management and planning.

Studies of people are common, and we recognize their limits, but also their usefulness. Professionally-developed, the studies can express *well* "people overall," people over very large areas. We shall study these and use them carefully to make a point, draw conclusions (as sharply as possible, quickly, and at reasonable costs and benefits) about people of the region. The information will be used within a computer simulation of what things would look like if these values were real and were actively used, and may be an able influence on plans, marketing, and future budgets. Individual or group uses are likely to be different, and that difference—discussed and resolved—might be worth the cost of having the analysis "in-hand" on decisions to be made.

[100] Ibid.

We know quality of life is often quantified for study, and some use, with it, human life expectancy. We compute savings efficiencies in "years of work-time lost" (in classes of age 18-58, if needed, and of units of 4.5 family members), based on the variables of reduced falls, smoking, diet, heart limits, diabetes, child birth and care, first-aid safety at work and at home, driving safety, air pollution, water quality, noise, and exercise.

We have developed a long list of the factors for a desirable human environment. They may be considered human objectives in systems. We know that thoughtful people can and will express personal, relative value for objects or criteria in a list. These are human expressions—timely, changing, approximate—probably producing satisfactions or satisfying creative needs.

Rural System staff members have experience with profit indices, as are used in many industries. We can also use an index to appropriately weigh, and relate intrinsic and aesthetics values to measurable, relevant rural forms and functions. Most mathematicians, appraisers, and managers struggle to assign numeric value to these phenomena, and yet we all accept that intrinsic value and aesthetics not only exist but truly influence our choices.

We shall work toward significantly reducing family health and welfare costs. We shall add sickness and other losses to the annual "net cost" summation ... then display results annually, and study correlations and effects of such an index on the profit index. Within our results, we shall stabilize our financial gains as bounded values, and present with it a paired value, a graphed quality of life index, Q*. Now, with computer assistance, we will be able to use Q* reports in daily decisions made on estimates of differences in relative goodness, or simple "betterment."

Rural System's primary planned work is with diverse natural resources, and these activities are for bringing economic advantages to the towns and business places, directly and through employment. Diversification within the community is seen as very important, and we plan to diversify business-related activities for employees, the nearby residents, and the natural resources upon which they and others depend. Failure will be in thinking Rural System is a proposal *only* for increasing the profitability of soil, water, forestry, and agriculture. It's much more than that; Rural System is a proposal to improve quality of regional and expanding human life for the future.

We do not plan to meet our community objective and improve Q* by giving money to small rural communities. We shall hire people, provide living wages, and logically expect that to flow into local businesses, household improvement investments, health improvement, and local tax benefits, parallel with Q* gains. We shall work for communities in rural towns and areas of rural Virginia by doing "citizen work," meaning we shall work to build family health, average individual longevity; wealth management with living-wage adjustment; new, quality living space; and financially-supportive work centers.

Rural System's Human Health Hypothesis

Eager to maintain and increase the health of humans within our areas, Rural System staff recognize human wellness as a significant objective (integral with Q*), and readily see the financial dimensions to it, well-related with the other activities and objectives of Rural System work. The Q* annual index for residents may become used throughout each region of ownerships. We may display the index along with the financial index, minimally suggestive of the relationship of the two, and eventually build toward a net index—the hypothesized, desirable interaction of the reported Rural System profits and benefits of the family health and wellness indices.

We support and see means to participate actively toward gaining wellness for employees of Rural System. The behaviors and closely-related activities of employees can be examined within wellness programs, and modified if need be to achieve reduced family health costs and losses, and therefore higher *net* annual budgets for employees and for Rural System. We plan to develop an active health analysis and prescription Group for caregivers and participants, related to testing a developing hypothesis:

*A greater median annual financial **family-health index** (expressing the costs of wellness and health) will be achieved by participating family residents than from **monetary gains** from the well-related lands under intensive Rural System management.*

As part of our health project, we shall inquire about Community Supported Agriculture (CSA) programs to allow Rural System staff to develop deep and long-lasting relationships with local communities. CSA or other options may produce foods throughout the growing season for cash. We can expect customers to become long-term investors in our lands to make significant developments. We shall implement recommended, site-specific field procedures to develop whole-food production, storage, and marketing subsystems with opportunities for local families, and attention to food, water, and nutrition security.

We shall seek to use resources of the Ford Foundation and others to engage in regional public health. That is a massive task with obscure borders, but we find it essential to achieve our objectives, especially as we see challenges emerging in nutrition, diseases and pandemics, energy and food quality threats, addiction, and the changing conditions at the urban border. We shall study and press for research on disease dynamics with GIS software, innovate new roles for people with addictions, and manage realistic ecotourism concerns relating to diseases. We shall address the human concerns of lands undergoing reduced coal mining, increased emigration, and requiring revitalization.

We may improve local food and nutrition gains by:

- Supporting networks of civil society organizations to gain accountability and realization of food security;
- Supporting small-scale producers' organizations to increase their production of highly nutritious foods, and improve their access to local markets;
- Increasing citizen knowledge on well-designed, resilient and reliable food systems, whole systems including marketing and a view of the future;
- Reducing food losses, wastes, and inefficiencies;
- Improving the availability of nutritious food supplies in households, addressing food security in the long-term;
- Assuring foods of high quality, stimulating production for diverse, nutritious diets, combined with education for full-range nutrition; and
- Facilitating developing strong and proactive, local, multi-stakeholder forums on the "Right to Food," and demonstrating their effects on local people.

Within **PowerPlace,** our educational Group (to be discussed next), we shall have strong economic, nutrition, and population health components. We learn from reports of school room behavior that modified diets can result in profound, positive behavior changes—i.e., "poor" diets changed to recognizably healthy and improved diets (fresh vegetables and fruits, whole grain bread, and salads). The changes are notably reduced vandalism, litter, and security challenges;

greater calmness; and reduced fights and general bad behavior. Behavior change is expected, knowing the brain uses 20% of peoples' energy.

We have information from a few sources, quite believable, about the poor diets within families in poverty. We shall work toward nutritious meals… and have an active supplements program to fill in a few of the gaps when nutritious meals are not available. We shall work toward balanced meals, partially to mitigate harmful body weight and its results on activity… and general health. *Food affects behavior.*

MIT economists established a Poverty Action Lab in 2003, and we hope to use their idea and studies to respond to the thousands of people in poverty at the corner of three states—Virginia, West Virginia, and Tennessee. They have selected one way to identify "extreme poverty" —difficult among several ways—as living with a budget of a dollar per day. We work with State and Federal "poverty criteria," but we suspect the list to be incomplete. We list a "general lack of income," but hold and examine whether that condition is due to inherited conditions, e.g., determined based on sex, age, and race, access to adequate educational sequence, and good health.

We shall take standardized "wellness indices" and modifications under study for estimated improvements. We'll follow (experimentally) behavioral change and poverty-status, with additions of measured meal-supplements from Rural System gardens—notably lentils, and other nitrogen-high meals—for education-score improvements. Our working hypothesis is that improving health may be cost-effective within rural system performance.

Treating Addiction in Rural America

I've learned of the thousands of people with alcohol and drug addictions within the region where I am hopeful to start Rural System, and I can imagine the high costs likely to occur, even the failure of Groups or the entire system due to this now-rampant "learning disorder,"[101] or chronic brain disease.[102] I appreciate herein the support and noted work of Laurel Sindewald and Anne Giles. I write here to share my understanding of addiction, and to gain a base for creative aids to provide addictions treatment for people in the region, suffering the effects of coal-mine closures.

I appreciate the many thoughtful current efforts, well-intended toward reducing addiction and/or its harmful social effects and outcomes. There appears to be no singular cause or treatment for such a complex condition,[103] within so many people of diverse form and function, experience and expectation. I struggle to learn more. For now, I simplify studies and seek alternatives to overcoming the following collective fundamental causes. These now appear to be *centers for analysis* and treatment, many within the field of Rural System operations:

1. **Disaffiliation:** failures to connect within relatively stable communities, small (marriage; family) to very large (military units); the loss or failure to gain group-unity (**community-less**).

[101] Szalavitz M. 2016. Unbroken Brain: A Revolutionary New Way of Understanding Addiction. New York (NY): St. Martin's Press.
[102] NIDA. The science of drug abuse and addiction: the basics [Internet]. [cited 2017 Apr 23]. Available from: https://www.drugabuse.gov/publications/media-guide/science-drug-abuse-addiction-basics.
[103] Sindewald L. 2017. Complex and Interacting Factors Predispose People to Addiction [Internet]. Handshake Media, Inc. [cited 2017 Apr 23]. Available from: http://www.handshakemediainc.com/2017/04/15/complex-and-interacting-factors-predispose-people-to-addiction/

2. An effect of #1 – **Lost reliance**, increased risks, loss of team or membership status, loss of past affiliation (e.g., family, employment, high group status thus reduced confidence, rare synergism).
3. An effect of #1 – **Lost resilience**, increased risks over time, reduced permanence and confidence, survivability, and life expectancy.
4. **Helplessness:** experiencing or believing personal shortage of resources, knowledge, skills, physical abilities, actionable-beliefs in a higher power, or the diverse consequences of disappointed belief in national power.
5. **Hopelessness:** perception of being without alternatives, without assistance sources, and in the face of extreme risks to be encountered.
6. **Worthlessness:** shortage or absence of action… or delayed action, resulting in judging one's self as not being praiseworthy; being without rewards, other-noted success, appreciation, or name recognition
7. **Purposelessness:** without needed, high-level, durable, socially-relevant and recognized, *lasting* goals or objectives—whether planned or undergoing action.
8. **Trauma:** about half of people with trauma develop addiction, and over half of people with addiction have a history of trauma. Research suggests the relationship is causal.[104]
9. **Co-occurring disorders:** people with addiction also commonly have co-occurring mental disorders or personality disorders, which often pre-date and contribute to the development of addiction.

Becoming aware of one or more of these centers can help us all understand each other, and begin actions to help individuals or groups understand addiction, its causes, and targets for relief and wellness. This will be a preliminary basis for work with staff and others, replacing it with rapidly-developing knowledge as it advances, and providing action for people throughout the rural environment. Tentatively-planned actions, believed to be responsive to the needs of people within Rural System and its environments, are being explored among messages to everyone within Rural System, especially those sensitive to the items listed above.

Given the above dimensions of our understanding of addiction, we now think that *addiction* needs consistent and repeated definitions in order to sharpen discussions and measurements of specific topics within the realm of past uses of the word. The most recent definition for addiction comes from the National Institute on Drug Abuse (NIDA),[105] as: "a chronic, relapsing brain disease that is characterized by compulsive drug seeking and use, despite harmful consequences." For this reason, and given research on the cost-effectiveness of treatment over incarceration,[106] we recognize that imprisonment and other negative consequences are unlikely to be effective in reducing addiction rates or severity in the future.

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[104] Sindewald L. 2016. Trauma and Addiction: Common Origins and Integrated Treatment [Internet]. Handshake Media, Inc. [cited 2017 Mar 19]. Available from: http://www.handshakemediainc.com/2016/09/06/trauma-and-addiction-common-origins-and-integrated-treatment/.

[105] [NIDA] National Institute on Drug Abuse. 2016. The Science of Drug Abuse and Addiction: The Basics [Internet]. [cited 2017 Mar 19]. Available from: https://www.drugabuse.gov/publications/media-guide/science-drug-abuse-addiction-basics

[106] Sindewald L. 2014. 10 Facts on How Addictions Treatment vs. Incarceration Cuts Costs for Taxpayers [Internet]. Handshake Media, Inc. [cited 2017 Mar 19]. Available from: http://www.handshake20.com/2014/03/10-facts-on-how-addictions-treatment-vs-incarceration-cuts-costs-for-taxpayers.html

We believe that meaningful, gainful employment may be substantially helpful for supporting the recovery of people with addiction, and to that end we have planned **Advance Group** within Rural System. Advance is imagined to be a small Group within Rural System that assists the public local courts and affiliates in achieving supervised community service work for individuals—work that is required and is constructive, meaningful, and planned in the region.

Advance will supervise workers, plan projects, set priorities, provide transportation, and attempt to attach individuals to their *personal* work on the land (e.g., planting "their" tree; building "their" stone wall) for the good of the land and all people. The Group will conspicuously attempt to overcome, with participants, helplessness and hopelessness. Advance will be quick to clarify and advance *purposefulness*, and to build Tetrads, or groups of four people, to provide mutual support as they learn new skills in Advance work.

Advance will introduce participants to areas of work of Rural System, especially that of **The Land Force**, and will serve as a rural, usually-outdoor job market, especially for youth and healthful exercise. Where feasible, jobs available within the Groups of Rural System will be announced, and additional educational programs within **PowerPlace** will be encouraged for people entering court probation or seeking to re-enter the workforce after time in prison. PowerPlace may also serve well the staff and students of **StairSteps**.

Another *employment-oriented* Group, StairSteps will work from an office in a rural community. It will maintain a private, for-profit employment service for people with special talents and abilities who seek part-time work. Their model is somewhat like that of Uber. The members will choose to work whenever they want, and for as many hours as they want, and there will be no need to ask anyone for vacation. All members will be carefully selected, and opt in or out as they decide and at their leisure. Members of StairSteps will be a new type of consultant, often with *many* skills and talents (as is common within rural settings), and a willingness to work alone or within small groups.

Members of StairSteps will have priorities in response to requests and to messages on an on-going blog, to be developed. The new business will depend upon computer-accessed talent, timely responses to local need, and mutual personal needs for brief jobs. StairSteps will require additional team and enterprise development, access to talents and needs within almost all Rural System Groups, realistic scheduling to meet local travel costs and challenges, and will need to provide support for the region through community centers. There may be an option for individuals or small teams to work at home.

But employment is not expected to be sufficient for supporting recovery from addiction. The centers of action for addiction are paralleled by a more general observation of human nature made by Sebastian Junger in his book, *Tribe,*[107] that to form human communities is natural, mammalian, and probably genetically controlled. Summary evidence allows a working hypothesis that forming into groups (tribes) has survival value for species, including humans.

Junger (2016:15) observed that because of "basic freedoms" of American Indians, "they tended to be exceedingly loyal." "It was a simple ethos that promoted loyalty and courage over all other virtues akin to preservation of the tribe." He listed comfort and protection from hardship as appealing characteristics of tribal groups, as well as a strong emphasis on "sharing," frequency of moving, and minimum accumulation of surplus. He observed that the more individualistic the common choices about life, the more diminished are group efforts toward a common good.

He also noted that modern society – despite nearly miraculous advances in medicine and other areas, has the highest rates of depression, schizophrenia, poor health, anxiety, and chronic

[107] Junger S. 2016. Tribe: On Homecoming and Belonging. New York (NY): Hachette Book Group.

loneliness in human history (Junger 2016:19). People who are poor are forced to *share* their time and resources more than wealthy people, thus "live in closer communities" (Junger 2016:21). We examine the "community" concept, known to have many meanings but to be singular enough in use and meaning to identify a human concept, perhaps one found to be similar in other life forms.

Our community concept, enlightened by *Tribe*, is that alcohol and drug addiction is influenced by community, and thus treatable by bringing diagnosed individuals into measurably large, long-term roles in communities—those socially recognized as having beneficial purpose. (Addiction-specific mutual-help groups like AA may be helpful, but really any community support will do.[108])

We agree with Junger that, "poverty is more natural than affluence," (Junger 2016:21) and reflect on its certainty and potential, perhaps universal truth. We glance at animal populations and see fewer affluent reproducers with access to resources than offspring (in a poverty-like struggling condition of shortages and limits). We learn that financial independence leads to personal isolation, the non-community, and then to risk of depression and suicide.

The maximum benefits of community may be found in the large-scale disasters or crises (Junger 2016:52-53).[109] A message about the disaster or threat of food and water shortages (and perhaps of war) may emerge in energy devoted to the community, rather than to individuals.

As elsewhere in this book I welcome advice and input on ideas within this chapter. Implicit within the above, we continue to study addiction and its treatment. We investigate broken personal linkages as a cause of addiction, study the impermanence of linkages, and ponder whether the cure may involve near-permanent human linkage.

Employment and Rural System's PowerPlace

Rural System's major concept of *community* is directly related to our role in increasing jobs, engaging in meaningful work, and holding fast to workers. The employment we propose and prepare to provide contributes to community social benefits, in part by stimulating the local economy. Rural System jobs will also help by contributing to a tax base for the community, providing citizen services.

The Land Force, led by **System Central** and Group leaders, will train and employ local people. We will hire superior workers, both full- and part-time, who will seek to implement the objectives of their Groups on enterprise environments. We'll recruit and educate leaders for many Groups to get each started as soon as possible and provide marketing advice for each from the first days of employment. We're in a buyers' market for staff.

The Land Force will work daily on prescriptions from VNodal, read in the field on mobile devices. They will move in field vehicles to ownerships and hike to GPS-specific sites to complete daily work. Their work may include forest thinning, trail building and repair, sign placement, visitor center creation, faunal-sighting reports, and stream improvement.

[108] Sindewald L. 2016. Addiction Recovery with Others is Easier than Recovery Alone [Internet]. Handshake Media, Inc. [cited 2017 Mar 19]. Available from: http://www.handshakemediainc.com/2016/09/27/addiction-recovery-with-others-is-easier-than-recovery-alone/

[109] Ibid.

Rural System is very thoughtful about the needs of Hispanics in the US and other recent migrants to the region. A map from the USDA's Economic Research Service,[110] provided by The Daily Yonder, shows the growth of Hispanic populations in rural counties, which has led to higher rural incomes. Dennis Coates and T. H. Gindling[111] found that this demographic change has benefited rural America. I believe that can and should continue.

Young Americans have been moving out of rural areas and small towns, leaving behind smaller and older populations. That trend of declining population has slowed and in some cases reversed, largely as the result of growth in the Hispanic population in these rural areas. This growth in rural areas is also changing the age structure of the population, making it younger. For this reason, young families are at the center of Rural System community thought, planning, and system developments in those areas, with a special focus on language, and financial, health, and social resources.

We see needs for assisting Hispanics in revitalizing parts of communities, gaining education and language skills, and benefitting from wages that we intend to offer for performing the diverse, prescribed work of the Rural System Groups. We envision Didactron-like[112] educational space developments, the PowerPlace, with rapid development of safety materials in Spanish, and translations of resource and Group-related materials developed by each Group.

We now believe that Rural System needs to have a system to teach *about itself,* and to share our thoughts, hopeful for stimulating new clarity in education and planned desirable changes for the people of the system. We plan significant advances in local education and job training, along with responding to the many needs and talents of emigrants to our regions. Together, these will comprise a modest, carefully-regulated, for-profit enterprise, one of the Rural System Groups.

Called PowerPlace, the Group will be more than a fancy name for the "same old schools," or locations. It will be an institution providing electronic education, and will present ideas and knowledge as multi-dimensional—thought systems—and students as masters of needed, practical change. It will bring the world—as in some TV work—into a teaching center. PowerPlace's objective is to cause behaviors to change, cost-effectively, to behaviors that improve life quality and allow individuals, families, and Groups to prosper financially. PowerPlace will teach concepts and applications for meeting the stresses ahead in 2030 and 2050 AD.

Symbolically, PowerPlace will be in the minds and bodies of world citizens, together. It will begin and end with concepts of certified achievements—a system designed to give people sufficient power over their environment and social conditions to allow them to reach, and then hold, high quality of life. PowerPlace is based on individuals or small groups (like families) being profitable. It will be directed toward reducing costs and losses as much as toward "making money," but will aim to become a profitable Group, with collective income from:

1. Fees for educational units and programs;
2. Fees for proctoring exams;
3. Rentals (room and board) during educational stays and outings;

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[110] Coates D, Gindling TH. 2013. Hispanic Growth, Higher Rural Incomes [Internet]. The Daily Yonder. [cited 2017 Apr 23]. Available from: http://www.dailyyonder.com/hispanic-growth-higher-rural-incomes/2013/02/12/5652.

[111] Coates D, Gindling TH. 2012. Is Hispanic Population Dispersion into Rural Counties Contributing to Local Economic Growth? Contemporary Economic Policy. 31(4):649-668. doi: 10.1111/j.1465-7287.2012.00334.x

[112] Giles RH. 2012. The Didactron. Blacksburg (VA): Handshake Media, Incorporated.

4. Publications, software, and media sales;
5. Conferences, tours, field trips, and experiences;
6. Equivalent worth, hours of labor (trading);
7. Innovations and project results;
8. Fees for automated evaluations; and
9. Shared profits of the Rural System Conglomerate.

PowerPlace, as planned, will have a large financial incentive to connect its graduates with well-paying employment. Rural public schools, unable to stop their drop-out rates and unable to resolve conflicting social interests and wars in athletics, busses, religion, etc., are ignored and are "gone around" by us to offer a reasonable, advanced, private educational system to willing individuals. PowerPlace's broad view is that it will move willing people, or those that can be motivated, into an optimized, objectives-oriented life system with measured behavioral objectives, with fairly clear financial costs of achieving them.

We need one special, physical PowerPlace, then many derivatives, with high technology education for potential landowners and others. While we know individuals who give their lives teaching, we contemplate the immediate needs for superior teaching of many people in small groups, with field experiences. Simultaneously, we need to implement now-available media sources, and thus present alternatives to large, interior classroom experiences (i.e., virtual reality). We need some units for teachers and advanced students. We may offer experiences within courses as part of professional development or for doing effective work with Groups. PowerPlace will emerge as a Group with places and technology for educating employees and citizens of the region.

I learned of a 1963 premise that "*educating*," means "causing desired, changed behavior." Our message: we achieve *desired behaviors, cost-effectively*. Local people can become valuable to their employers with fresh insights and exploring new opportunities, gaining skills needed to advance or change their careers. PowerPlace will help staff and guests pursue personal and professional goals, discover opportunities within Rural System, and possibly find, get, and hold jobs. They may discover a future work opportunity—their specialty for life—and explore that specialty internationally.

The maker of fine furniture does not belabor the saw, the hammer, the smooth surface, the imported wood, the stain… for they are the creation, together. The tricks of the trade, the artist's unique ploys, and the final appearance are all central to the teaching system, honoring the teacher, the perceptive buyer, and the appreciative guest observers. Within Rural System we see "the system," and shall celebrate its conceived, desired results, with greatly increased value over time—desired change at modest cost. The parallels are the furniture—the functional, working, socially appreciated system; the furniture maker—the creative, insightful teacher or creator of the app or change device; the planned or detailed furniture sketch—the planned educational objectives or "target"; and the furniture buyer—the student, working and using the educational system, equivalent to the furniture.

We need to move toward an appropriate definition of what our desired change is, and what units, exactly, are to be measured to compare present behaviors with those achieved in PowerPlace. I continue working toward redeveloping the concept of education for an expanded, behavioral objective for a teacher or teaching/education Group. "Preventing undesirable behavior(s)" must somehow include behaviors that pose clearly-immediate risks. (Not only in conventional "classes," we shall need to continue to face poacher, arsonist, and natural-resource-related criminal behaviors.)

Within PowerPlace, we are likely to study and use results as we clarify for our personal use, then advance the measures we develop as we certify "learning" and study the time and costs to achieve it. We are likely to seek means to achieved measured *improvement* in knowledge or specified behaviors. We may test current status and, having a good estimate, avoid time and costs in re-doing the work proposed to result in such measured condition(s). We shall discuss continuing development and consistency with learned professionals, those within modern education and having timely understanding of the role of review and "catch-up" (of existing knowledge) for practicing professionals and workers, seeking credentials for advanced work within employment.

PowerPlace will offer programs that will allow people to invest in their education without sacrificing their current responsibilities. We shall attempt to add fresh insights, explore new opportunities, and allow our employees to gain skills needed to advance their careers. We shall suggest pathways to pursue personal and professional goals. Employees may acquire hands-on experience with the latest tools and techniques to help each other boost credentials and advance their careers, which to us means growth within Rural System, but also means becoming even more valuable to *any* employer. We may work with employers to develop very specifically-trained employees.

We shall study successes of students seen in groups of 4, as if each student is located (conceptually) at the corner of a tetrahedron, symbolically related to encouraging, aiding, and learning together on selected topics and benefitting by the gains. We call these groups Tetrads, and shall help students connect with others to form new Tetrads.

PowerPlace will work on moving functional knowledge cost-effectively toward human uses. Nearby each PowerPlace there will be planned, outdoor teaching-learning places for individuals or small groups with "nature" on display—from deep soil to tall trees and shrubs, at a pond or aquarium edge. It will be an outdoor-oriented, hands-on action and display space on a number of management topics: logs and logging, erosion, Alpha Units, and other principles-in-use—on display.

Our online programs will give employees and serious students the flexibility of online courses—studying whenever and wherever a student wants. We shall educate our staff and students (our future) as quickly and as well as we can, at efficient cost and measured financial gains. We shall concentrate on and revise new approaches with students, who will learn how general systems are conceived and how they relate within Rural System action. Aware that more than 41% of the US population, 25 years and older, have not attended college, we shall move staff and interested people into PowerPlace as cost-effectively as possible, achieving desired behavioral change/hr/$. The concept may be too profit-oriented for many with whom we discuss Rural System, but we shall continue testing it.

PowerPlace will pay new parents to achieve a set of competencies and behaviors in life, and accident insurance policies (reducing future costs and heading children into PowerPlace). It will measure achievement, and once there, certify its achievement and move on with refreshers and attention to the new, desired behaviors. There are major financial savings likely from personal use of knowledge of personal and public health.

PowerPlace will award children prizes, trips, and various other awards for achieving certain actions (such as self-awareness of their abilities and limits), physical attainments (weight, health status, etc.), and for core abilities (manners, speed reading, keyboarding, courtesy, speaking, writing, algebra, logic, elementary probability, elementary programming). Students

will move at their own pace; time will be removed (except as it relates to measuring the costs of achievements).

"Courses" are not the functional concept, only teaching/learning units, and these will be selected by students, even with computer aids using their interests, abilities, and past performance successes as criteria. There is no concept of high school "advanced placement courses," only each student's ability to master each unit... and the units will be very numerous—unending.

High fossil energy costs for school bus transportation will be eliminated or reduced. Athletics will be emphasized only for exercise for lasting health. (Competitive spirit is believed to be innate, developed over life, and need not be equal in all people.) PowerPlace will conduct special programs for stressed youths of "broken" homes. It will seek the best current strategies for reducing drug- and alcohol-related influences, likely to be a major deterrent and detractor to effective education.

The interior programs of PowerPlace will provide youths hourly wage employment in healthful outdoor work experiences, improving Rural System enterprise environments. Programs will seek to move public high school youth into PowerPlace, providing alternative certified performance for employers, and reducing social costs. It has the clear objective of moving students into a program of study better than that of the current often-very-diverse, wasteful-of-time, over-priced, grade-inflated, undergraduate college/university programs. With credentials in hand, graduates of courses or programs may seek further study or university experience.

Because of government and employer requirements for quick analyses of applicants, certificates of accomplishment in named programs of study will be given. These will become the equivalent of curricula and diplomas, and we shall seek "official" designations by professional and scientific organizations. The teaching/learning units will allow this rapid learning and preparation for future tasks... not the long press for a 4-5 year "degree diploma."

Educators will be identified and recruited for stabilizing educational quality and behavioral-change effectiveness. PowerPlace will contract firms to conduct a far-reaching international marketing effort to make each PowerPlace participant eagerly employed … because each will be certified, well-accounted, financially-oriented, and existing within a Group structure with potential synergism.

Part of the marketing effort will be to recruit outside reviewers (other than the regional university standards commissions) to visit, study, and even compare a reasonable set of student participants and their abilities, employment, psychological profiles, health, and financial successes after graduation. The work of PowerPlace might energize the universities and create a new era in higher education. We may aspire to that. Rural System and the quality of life for people that is its potential for the future, requires something very new; minor adjustments will not suffice.

PowerPlace may profit from educational programs for local citizens about Rural System; regional educational programs for staff, families of staff, and land owners; and programs or internet courses for sale to university students or university departments and agencies. My book, *The Didactron,*[113] suggests the possible role of a superior teaching space to be created, allowing the teacher full control over the characteristics of that environment and information about student responses to the teaching.

As PowerPlace will increasingly move to an international mode, we shall need many globally-oriented Groups, and the attitude and philosophy that supports and encourages them,

[113] Giles RH. 2012. The Didactron. Blacksburg (VA): Handshake Media, Incorporated.

especially in economically "down" periods. We shall have to plan and build well-connected facilities, teachers, students, advisors, faculty, and administrators to ensure seamless communication as we develop together a scalable, cloud-based intercommunications platform. That platform, within PowerPlace, will operate off "knowledge is power" and thus shape, connect, and build for the present and the ever-changing future.

Diversity is widely believed to be a key ingredient of economic development of rural communities. Diverse communities can withstand industrial disruptions and are more prosperous than others. They can buffer major changes and make adjustments to such changes. Rural System has planned many Groups, with the intention to carefully stabilize rural economies through human and enterprise diversity.

Environmental Justice in Rural System

Regrettably, sections of some small rural communities are said to be in poverty. Poor neighborhoods and rural areas are more likely to be sites for toxic waste processing and industrial sites with high levels of pollution. **Environmental justice** is a rising advocacy movement in response to these conditions, seeking to improve living conditions and quality of life for low income people. Success stories do exist. Majora Carter presents one shining example in her Ted Talk, *Greening the Ghetto,*[114] on her project to create a waterfront park in a South Bronx ghetto.

Green infrastructure strategies are also available, to reduce negative human impacts on natural environments, including ways to decrease pollution to local waterways by treating rain where it falls, and so keeping polluted storm water from entering sewer systems. Green infrastructure is a set of tools and techniques, including green roofs, permeable materials, alternative designs for streets and buildings, natural storm water controls to reduce flow into sewer systems, trees, native plants, rain gardens, and rain harvesting systems. Green infrastructure is a means for addressing climate change and mitigating its impacts by making clusters and communities resilient.

As an example, one project in Syracuse created a ground-breaking hockey rink made of captured rainwater.[115] The water harvesting system at the arena captures an estimated 400,000 gallons of rainwater and snow melt per year. In the basement is a 15,000-gallon cistern system that captures, filters, and uses the rainwater for the hockey rink and other purposes.

Since green infrastructure techniques may be less expensive than conventional storm water management approaches, there may also be cost savings. The need for improvements to the nation's water and sewer infrastructure is staggering, estimated to cost over $650 billion dollars over 20 years. Increased emphasis may be placed on green infrastructure to improve affordability.[116] We shall attempt to merge environmental justice, related EPA concerns, and the concerns of citizens throughout Rural System and in work with green infrastructure.

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[114] Carter M. 2006. Greening the Ghetto [Internet]. Ted: Ideas Worth Spreading. Available from: https://www.ted.com/talks/majora_carter_s_tale_of_urban_renewal/transcript?language=en.

[115] Save the Rain. War Memorial Water Re-use System Complete [Internet]. [cited 2017 Apr 23]. Available from: http://savetherain.us/war-memorial-water-re-use-system/.

[116] EPA. 2013. Case Studies Analyzing the Economic Benefits of Low Impact Development and Green Infrastructure Programs [Internet]. Rep. no. EPA 841-R-13-004. [cited 2017 Apr 23]. Available from: https://www.epa.gov/sites/production/files/2015-10/documents/lid-gi-programs_report_8-6-13_combined.pdf.

From the EPA's blog on May 30, 2014,[117] we learned from Gina McCarthy that Marian Wright Edelman, President and Founder of the Children's Defense Fund, once said: "We must not, in trying to think about how we can make a big difference, ignore the small daily differences we can make which, over time, add up to big differences that we often cannot foresee." Rural System, very aware of the needs and advantages of the *small daily difference*, seeks to assist in making a notable change in communities by improving the lives of families through innovative approaches to educate, engage, and empower regional families and communities in environmental protection and justice.

Some Rural System approaches are conventional, but we shall work from basic human motivation for long-term wellbeing, and we believe that such actions can follow from diverse profits. Unique markets may be on our future agenda, helping to solve the challenge of offering choices for affordable, healthy food in our communities while creating jobs. We may study ways to improve local air quality and thus health, and to help clean up and revitalize areas along waterways, unifying gains, reducing future costs and losses, and developing new, healthful recreational venues.

Environmental quality (EQ), as used within Rural System, is a general term expressing a desired condition of a large set of dynamic elements for a majority of the people of an area. EQ is time-specific, dynamic, and can be changed. The EQ of an area may be challenged; the factors influencing EQ may reduce human surroundings from being enriching or even livable. The environment may be polluted, and the amount and type combinations, timing, and sequences may influence EQ for humans and/or the resources upon which they depend.

EQ is affected by serious and complex barriers and initiatives that are technological, economic, social, political, legal, institutional, and sometimes international—these many interacting factors underscore the difficulty in understanding and achieving needed change. Within Rural System we try to understand the *causes* of environmental problems, and to engage in preemptory work to prevent or reduce them.

Understanding *human resilience* in the context of interconnected ecological, health, and social systems (as in the One Health Initiative) may develop—with sustained programs over time—a new, positive, productive statement of community values and its livelihood for the future. We may achieve *hopeful places*—future scenarios or possibilities in view—especially if the major alternatives under consideration are simulated.

Future scenarios for vital rural communities can be addressed well within the system concept of feedforward, and using GIS technology. The value-weighted, preferred solution may be cast, and then the costs of achieving it can be discussed. It is best, for the future, to lay aside most cost considerations as the real characteristics of the desired future are cast in computer simulations... then alternative investment strategies may be realized, and the present compared to the possible desired conditions. An action plan may solidify the desired end conditions, as well as investment strategies to achieve those.

Rural System will seek improvements in the financial status of residents and associates, stability of worthwhile community elements and adjustments of others, and achieving modern sophisticated natural resource management for stabilized, diverse, bounded benefits. Together, local governments and Rural System can plan for successful, resilient community adaptation to

[117] McCarthy G. 2014. EPA: Making a Visible Difference in Communities Across the Country [Internet]. EPA Connect: The Official Blog of the EPA Leadership. [cited 2017 Mar 16]. Available from: https://19january2017snapshot.epa.gov/aboutepa/epas-themes-meeting-challenge-ahead_.html

the social, environmental, and economic challenges presented by climate change, and a challenging set of other undesirable conditions—those now and likely emerging.

Wealth Management for Citizens

The proposed **Wealth Management Group** will offer and work toward achieving additional profitability for rural land owners, their friends and guests, communities, and for Rural System. Wealth Management staff members will be fully aware of and appreciate the other conventional dimensions of wealth such as health and quality of life, adequate food and clothing, and comfortable quarters.

Basic to our work together are three unequal premises (to be tested):

1. More money can now be made from reducing risks, reducing taxes, reducing payment on loans, and increasing gains from diverse investments and current subsidies than can be made from the soils of a current rural ownership of 500 or more acres.
2. Good health (a fixed definition is sought) may be seen as personal or community wealth. Estimated net annual family monetary gains from health and wellness management may be greater than from Rural System estimated annual regional commodity profits.
3. Modern landowners may benefit from dispersed, wealth-related and risk-avoidance strategies that may yield significant financial gains for owners, some of which may also advance Rural System gains.

The Wealth Management Group, though interested in commodity prices and land production, will play a central role in Rural System by emphasizing that owner success and land retention in viable production depends upon the flow of all funds, tallied in the annual record of total gains and losses of Groups. The process is expected to build a sound base for populations of stable, diverse human communities.

There are many difficulties involved in achieving consistent, good performance in agricultural investments. Owners have to understand the many intersecting forces in order to stay in business, balance long-term investment principles with technical knowledge, and block out confusing "noise." It is essential to try to see the big picture, particularly forces related to social and demographic shifts. There is much to take in and use effectively, which explains for us why so many hard-working rural citizens do not become involved in successful investments, or need to delegate such tasks to other people.

We believe that even modest investments and loss reductions are sufficient to bring the current rural enterprise beyond the marginal financial status that drives people to leave for the cities, or seek care or other employment. We are developing a strategy, with computer aid, of feasible, constrained options to significantly improve average future farm revenues. The Wealth Management Group advice will protect land owners from the financial storms that have swept through the nation, and even the world in the past.

We shall not provide pages from a commercial computer program. Advice will be from our Wealth Management Group, with major options for owners' and Rural System leadership choice in making hard decisions. Not all of our advice is conventionally palatable. We shall work from a well-grounded, evolving, improving model that may, in some years, merely park money in an investment account. Otherwise, the computer system will be responding to data such as the age of the ownership, planning horizons, acceptable levels of assumed risk, desired growth of resources, innovations, constraint, and perceived productivity. We do *not* start from zero and *do*

allow pooling of funds in a cluster's mutual fund, developing a Collaborative investment operation.

We know that "the rural market" is roughly cyclical (known as "irruptive" in animal populations), but that periods and amplitudes are unknown. We shall watch carefully, but include in our models the typical causes of the notable changes in market cycles. We shall incorporate not only market movements, but whether staying in the market matches a landowner's changing financial needs. We shall continually be adding variables and performing group as well as personal-suggestion adjustments.

Rural, state, national and world economies are interconnected, as in ecosystems, and we know about and can model these. Politically dominant corporations and sociological and demographic shifts are changes that will be incorporated and studied using our developing models. We can conservatively make over 6% growth on an investment, more than from forest growth and from most small cropland production. (Though we work hard to improve agricultural and forest management, we know their limits well.)

Finding someone competent enough to advise is very hard for a small investor. Getting piece-meal advice is dangerous. The Wealth Management Group is designed to provide investment and other financial advice. The Wealth Management Group will provide financial analyses for the entire Rural System enterprise, but also present results of financial models to communities, individual landowners, and clusters (Collaboratives) of lands under contract. It will also provide specialized analyses for the employees of The Land Force, and sell related services to other people within communities.

The Wealth Management Group has novel concepts of risk, especially those related to rural resources. It will deal actively with production functions (as ecological succession or transition and yield curves). It will use related ecological concepts of cyclic behavior and complex interactions, such as predator-prey relations. It will confront the silliness of "sustainability" texts, and advance the concept that sustained income is not desired; an increasing (though fluctuating) income is desired. Incomes *can be* sustained, but that is very difficult, almost impossible. The alternative concept, "bounded wealth," is badly needed (Chapter 12).

The Wealth Management Group will also advance the concept of the long planning horizon, 150 years. The rationale of planting a tree as a 150-year investment in land volume must be faced realistically. For decision-makers, it also presents useful comparisons with current present-discounting analyses. A 150-year planning horizon builds feedforward into presentations of decision alternatives. As a well-known example, major new changes will be occurring in fossil energy availability and costs, requiring massive changes within the rural environment.

The Earth Institute at Columbia University within Science Daily in 2009,[118] elaborated on the capability of index insurance to help farmers manage risks associated with climate change. We shall study its local utility. Climate has always presented a challenge to farmers, herders, fishermen, and others whose livelihoods are closely linked to their environment, particularly those in poor areas of the world. A type of insurance, called index insurance, [119] now offers significant opportunities as a climate-risk management tool, according to a publication presented during a workshop at the Global Humanitarian Forum (GHF) in Geneva.

[118] The Earth Institute at Columbia University. 2009. Index Insurance Has Potential to Help Manage Climate Risks and Reduce Poverty [Internet] Science Daily. [cited 2017 Apr 23]. Available from: https://www.sciencedaily.com/releases/2009/06/090624093313.htm

[119] See ATTRA and NCAT YouTube farm insurance webinar related to whole-farm revenue insurance.

"Green" investments are no longer just a luxury, but are now a legal responsibility, according to a new report by the United Nations Environment Programme (UNEP) and a powerful group of asset managers controlling some $2 trillion in assets. The 120-page publication argues that if investment consultants and others do not incorporate environmental, social and governance (ESG) considerations into their services, they will face "a very real risk that they will be sued for negligence."[120]

Even in Virginia, part of a developed country, Rural System's practice of investing partial profits back into the land itself is notable as a form of preemptive risk management, aiming for increased future productivity and planned profitability. The potential for savings in reduced food costs, increased safety, reduced medical expenses, and then for reduced losses from vandalism and theft suggest a complex future strategy. The Wealth Management Group will further offer related, strategic opportunities for conventional investments.

The Wealth Management Group will work with other Rural System Groups on common goals and problems. **The Lands Group** and **System Central** may advance financial gains within **The Realtor Group,** using GIS software heavily for land valuation and optimization. Thus, we see major synergy between The Realtor Group, **The Law and Justice Group,** the Wealth Management Group, and a variety of local and regional professionals.

Rural System recognizes that annual gains from pasture products or from forestry are not generally separated at tax time, and that the entire financial system of the ownership are managed as a single package for decision-making. It is this total system and its profitability that determines good land use, whether the farm must be sold or whether it becomes an increasingly valuable entity within an inheritable estate.

There are many changing laws and regulations related to taxes, and few farmers or forest owners can follow them well (or even at all).[121] To increase crop production by 10% through years of genetic work, fertilization, herbicide use, and cultural practices, only to lose 10% of the net annual financial gain because of excessive taxes paid in ignorance of the current law is not wise by any standard. The Wealth Management Group will work with The Law and Justice Group to avoid the costs of litigation, and to protect landowners from financial losses.

The difficulties and extent of financial analyses are almost beyond comprehension. "Stabilizing profits," a Rural System objective, is much more easily said than done. The impossibility of stabilizing a natural resource system in the environment of unstable federal, state, and local tax laws, subsidies, globalization effects, changing land values, theft, sickness, and climate change—together—is evident. Controlling these, or exerting some control is not among the initial tasks of Rural System. Gaining knowledge-control over them, however, with the aid of VNodal, will add significantly to the potential profitability of any rural ownership. Computer simulation can suggest the most likely scenarios (and limits) for decision-makers.

I'm convinced from my Tennessee Valley Authority (TVA) work and conversations with older land owners and managers that the answers to improved land management are locked into "diverse profits," and that Rural System is the way toward them.

Rural land is reverting to early-succession (fallow fields, shrub growth, undesirable tree species, and erosion) as people leave it for the cities. Some is bought and added to the operations of the large farmland owners (accompanied by the externalities and disadvantages of

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[120] United Nations. 2009. Green Investments a Legal Responsibility, Say UN and Top Asset Managers [Internet]. UN News Centre. [cited 2017 Apr 23]. Available from: http://www.un.org/apps/news/story.asp?NewsID=31464#.V8dOCJgrK00

[121] See, for example, the 2007 Farmer's Tax Guide, IRS Pub 225.

“monoculture”). The financially unprofitable farm creates major hardships for the elderly land owner, the family heritage, and surrounding communities. Residential areas may expand onto these lost farms, increasing urban costs of services and depleted natural scenic values.

The premise of much of Rural System work is that if sound financial arrangements can be made for the rural landowner, significantly more of them will remain or become residents. Others will employ The Land Force to manage their ownerships well. Rural land can stay rural land, be profitable, and provide many financial and social values, such as those of groundwater recharge, watershed protection, abundant wild fauna, landscape beauty, and healthy food.

A Trip to Granddad’s

Many people have demanded: “What does Rural System look like?” Imagining a trip to a Rural System area, one of Granddad's farms, may be easy.

Each contract-leased ownership has a new sign developed by our Marketing Group, backed by large wooden carvings, and the now-smoothed-road has a gate with a quaint gatekeeper, beside a road-panel that generates electricity with every vehicle passing over it. The gatekeeper collects fees from visitors and suggests memberships in Rural System Groups pertinent to their interests and expertise. Information about the ownership is available in the nearby store. A sign reading “Arboretum 3” is adjacent to the road, connected to similar tree groups, identified by little signs with a much-used, wide trail running through.

As bird watchers tally birds seen, the Rural System Arboreta members tally tree-species seen, and Rural System has developed 24 species on this ownership, catering to its concepts of diversification, adequate scale, and developing unique outdoor activities and contests. One young man comes from the dark trail, evidently happy with the additions just made on his list. A family cemetery is up the road, past two gardens. A booklet of family and neighborhood history, prepared by the RuraLives Group, is available at the roadside sales kiosk. One garden is evidently designed for butterflies, another for scented plants, odors well-noticed from the car.

Across the road is Alpha Earth, a mixture sold in large bags but used at arboretum tree bases as well as within nearby gardens. A sign reads: “for use in mined-land high-wall side pockets.” A wall, remaining after coal had been removed, stretches along the slope behind the garden. Below the Sedum-plant pockets already hammered into the remaining mined-area high-wall is the evident hard work required for audience seats of a small amphitheater, created from rock and a few old trees.

Off to the side on the slope is a limed-, boxed-boundary of an “Alpha Unit,” helping all to comprehend the 10-square-meter unit size. Above the wall can be seen a few large tall trees left from before the coal mining. A Tree Tops climbing-sport group at work can be seen from the edge of the theater. Part of the rubble in the theatre base was not needed and a small vehicle pulls a rock sled slowly to a rock crusher at the side, where a mix is prepared of Alpha Earth “soil” for sale and on-site uses.

There is a recently-painted barn, in 3 colors, each part related to its exact latitude and longitude and hours of sun on each surface, for energy savings related to albedo (surface reflectivity). Out-buildings have similar, unexpected colors and shapes and modifications, related to energy budgets.

One large area holds a combined office and museum, in which are described the layers of the Alpha Unit outside the front door. There is a deep hole and a side where people can walk and see the data layers, and a tower is nearby with weather instruments, capturing data feeding into VNodal. Visitors can see from below the ground, up to tree tops. Bird abundance and feeding are of local interest, with the additional knowledge of insects and other life forms and potential disease connections, within layers on display.

Members of the Land Force meet beside the old barn early each morning. VNodal, from System Central and local software, gives the 3-minute-every-day-safety-message at a TV screen. Inside is a waiting room with desks and computers. Some come early for progress toward a GED, advancing their education status. Others work over the small library and local farm and resource subscriptions; two have already started scanning their phones to read about the work for

the day. One studies the wall map to find their place of work and relate it to the assigned GPS-specified work sites.

Chapter Twelve

The Rural Deal

I want you to make a practical "start" with me, to join in starting a company that can make us money and, in the process, add employment, stabilize small communities in the Western Virginia region, and improve diverse natural resource management. I've had the pleasure of talking and writing about it. I've already invested over $500,000 (equivalent) since I retired into Rural System and this book. Together, we need $7 million, total, to start it.

It may be that a computer simulation (est. $300,000), created in advance of Rural System, may be the needed marketing entity for describing and demonstrating the vast number of probabilistic elements, all merging, and each left-behind ownership blossoming into a lasting, profitable entity. *(I predict a scoffing noise.)* I've heard: "No investor will enter a business with a single, advanced-age leader like you." I have invested… and I hope to live for a long time yet.

The secret difference: we don't want a grant; we want many personal investments that, when grouped, provide a line of credit … money we can use to bring Rural System to full operation within 7 years. The line of credit asserts that we *work for our money* and its benefits in starting Rural System.

Why should you or I invest in Rural System?

1. To generate and stabilize annual profit and improved quality of life for 70% of Central Appalachian people, who are in need, and for preparing a crisis-preparation program before 2030 AD.
2. To apply that crisis-preparation system, with feedback, to Southside Virginia. Then, as I continue regional expansion, to provide a stable, ample supply of nutritionally-useful food and water.

You already know about Earth-around changing climate, groundwater, and pollution, but we'll tackle first the crises within the farmlands of Western Virginia. We can show you a **rural revolution,** a new way to deal with farms, farming, and the total rural environment. We'll create a corporation for the region, and later franchises for the worldwide dangers ahead, those of food and water quality and quantity for an increasing human population by 2050 AD.

If you are a rural landowner, I want you to lease your land to me, within Rural System:

- To provide care of your ownership (within your stated conditions),
- So that I may use it well, indefinitely, to make money for you,
- So that we may meet a few objectives:
    1. Achieve and enhance the history, beauty, and future estimates and interpretations of the rural region.
    2. Provide meaningful work and related salaries for our local workers within our inter-related businesses.
    3. Provide funds and strategies for stabilizing small rural communities, with adequate related educational, protection, and social services.

4. Restore, enhance, manage, and stabilize high natural resource production of potential and achieved human benefits over a very long period.
5. Conduct practical, profit-potential-increasing studies.

I want to start immediately. I want you and friends and contacts to contribute money to start a private corporation with me, Rural System, to manage and begin improving over 200,000 acres of lands and waters of Western Virginia … lands and waters of people who have recently left these rural lands for the cities. The emigration is now underway, Earth around.

Impossible-sounding, within Rural System we shall work toward a changing system, one on private lands where they are free to become active and comprehensive, as sketched within *Rural Future*. The planned system is to become one funded by people, families, companies, organizations, and clusters of named private lands that engage in creative, lasting rural land and water management … for us all, for now and the future. That's what *Rural Future* has been "about": doing good for us all for 150 years or more.

I'm asking you to help me get a start. From one perspective, we're starting "old farming" anew, but we see the UN reports, the Earth-around changing problems, and the enormous "scope" as an enormous challenge… and we know how to win that challenge.

Too big to "skim," it's essential that readers—all citizens—become aware that people have left the western farms of Virginia (and elsewhere in rural America) and continue to do so. There are half as many farms in Virginia now as when I graduated from Virginia Tech. The average farmer is about 57 years old, and has moved or stopped thinking about it. There are about 47,000 farms in Virginia, some prospering. I want to work with about 20,000 of them.

I can ignore the others (whose owners seem happy or speculating), and 8% are contributing 90% of the farm income to the welfare of Virginia. Not just in Virginia, but in the nation: 47% of all rural land is in the hands of absentee owners. Rural System can help bring profitability to many lands and waters with modern, sophisticated management. There's a market of 20,000 farms in Virginia alone, with potential to be brought under contract and into Rural System.

A Glance at the Alternative

"Totaled," they said, and hauled it away much too quickly, on the word of only one observer!

They just did not understand!

Rural System sees the potentials in rural land today. Some leave it, but others remain. We do not try to cause population changes—migration or emigration—only to present *the alternative* to individuals for their lands. Rural System is the alternative to recent farming efforts, historical land use practices, and the powerful pressures of resource scarcity now felt by at least a million US citizens.

I've learned that I shall be unlikely to satisfy remaining rural people, those having had mining-salaries, now that the mines are closing. The problems are abundant in the social as well as within the soils realm. I know the abandoned mine sites and recent mine closures. Yes, they can become profitable… as Rural System enterprise environments! Because we've done related work, we can see the problems and potentials and choose the latter. Compared to sports salaries, rocket shots, TV gambling, and bridges to nowhere, Rural System is cheap—world food without monthly solicitations to feed the hungry.

The hammered farm, once grand, is inactive—a son dead, the mom ill, and the dad old and still working near the barn… hurting. They've visited a local assisted-living facility.

Imagine they have now joined Rural System.

They now know more about their land and water than they learned in the prior 47 years they have lived on the tract. There, in front of them, are lists of creatures of the area… "How do they know that species is here?!" (We know from the Rural System database, the **Rural Knowledge Base or RKB,** a massive collection joined into VNodal.)

Because Rural System uses a systems approach, each farm or rural area does not have to be approached "from scratch," as "a one-product job." The region can be managed together, and because of economies of scale, scope, and dynamics, information on each farm area will be more complete and each farm more efficiently managed than ever before.

Within a day, because of past work throughout the region, owner-residents will be able to see graphs, tables, images, aerial views, key centers, special features, and data from the RKB—over 100 "facts" about every Alpha Unit of their ownership. The knowledge base for their area will include neighbors, locations, contacts, and typical map features. We shall unify, for our future work, information on political boundaries, utilities, diverse water features, Crescent phenomena, and other variables, both biological and abiotic.

The point: we know many things about each area of the ownership—every Alpha Unit. Once impossible to get, or even ponder, we can now get the information and put it into software decision-aids for the future. With such rich information, we don't have to repeat or revise the farm, but can begin to create *the alternative farm.* We'll do agriculture, some conventional rural work, and add many Groups to make profitable the many factors, the uniqueness of the land.

Toward the Bottom-Line

Years ago, Professor Kohl, an economist, graciously listened and advised me about Rural System. He said: "Get your numbers in a row." I've been trying ever since.

Here, within this chapter, is much of what I face and that which must still be reconciled: the financial details, too few for some, too much for many. No "small-business" recommendations have served me well. Emigration to cities occurs because of low financial reasons to stay on farms. "Jobs" are one of the socio-economic objectives of the governor's office. I offer within Rural System a solution: many jobs, not just another analysis of failures.

Rural System will exist within the same lands and waters of the present, but differ in many ways in how it manages lands and waters for lasting financial gains. With adequate dynamic credit, Rural System can form, lease thousands of acres from absentee owners in the Southwestern region of Virginia, and be fully operational within 7 years, loan (line of credit) repaid. Thereafter, the new Rural System will be achieving the stated objectives from profits throughout the region, and working on future franchises. With strategies for general small-business and established-corporation success, and facing well-known boom-and-bust phenomena of farming and mining, I now explore the prospective corporation, eager to create a computer simulation to analyze proposed changes within a 300-factor, probabilistic, ecological, financial, sociological, energetics-oriented, and past-practices-bound set of factors.

Rural System is complex, multidimensional, and its success has many aspects. Financial success is one, a pointed emphasis to that of profit-motivated achievement of the stated objectives. The novelty is that the owner may be motivated by net financial gains from all of the lands under management and all of the Rural System Groups, bringing a sub-marginal farm with

over-valued property into the range and participation of a profitable state. Rural System Groups will be a diverse, growing Conglomerate of enterprises, franchises, and e-commerce units, grounded in precision agriculture.

In analyzing Rural System's economic impact and benefits, we shall concentrate on more than goods and services, but upon eleven *benefits,* as listed in Chapter 2. Using computer-aided simulation and range statistics, we intend to engage a variety of equipotent options, finding and using the isomorphism of nature's perceived successes. With this process of computer-aided optimization, we are likely to discover a variety of benefits within synergism.

Our main hypothesis is that Rural System can produce significantly more diverse land productivity, but also annual regional profit, from improving human conditions and reducing costs and losses.

I show herein the only way I can imagine assembling a plan for a dynamic project with the scope, cost, social dimensions, and usefulness adequate for decision-making for the future. I have struggled with for-profit vs. not-for-profit designations:

- Only a *for-profit* rationale seems a likely means to move society now to achieve the stated objectives for stable or improved rural areas for the future, however,
- Only a *not-for-profit* rationale seems an acceptable, known way to finance changes needed to reduce effects of a local movement of people to cities from residual rural areas.

Profit, I believe, is the only proper base of a strategy for Rural System that provides the consistent major motive and opportunities needed for society to gain sustained protection, restoration (as needed), and science-based management of rural land and waters for Earth's people in the near future.

From the back row or the over-smiling listener in the group (I can remember several): "tell me again just how you are going to make money!"

I try—here's what I see, here's "the deal." There really is no *singular*, conventional "bottom line" in a purposely dynamic system.

So-called bottom-line questions emerge from within the tangled, high-risk probability of past farming. What is needed? And what's the cost? What's the risk in a very new venture? What I see now is that a secure monetary investment, equivalent in concept to a "line of credit," is needed, as well as several risk-takers willing to face the risks in the shadow of the alternative of an un-managed environment.

The corporation, Rural System, working together with many Groups, or small businesses, may strive to gain support and money together from hundreds of acres of leased rural land. We shall work with absentee owners who have moved away, often to cities, for many reasons. We shall attempt to protect, restore, enhance, and reserve, features of their lands and waters.

Some of our work is called "precision agriculture," some "precision forestry," some "modern agro-forestry." Other people note our strong abiotic emphasis on the factors influencing plants and animals, domestic and wild. Net financial gain or loss potentials often depend on these abiotic factors, such as nutrients or climatic conditions.

Rural System will rent or lease properties from landowners for the long term. Staff, using **VNodal,** will perform a land analysis and then produce an ecologically- and economically-sound management plan. The plan will be broken into daily prescriptions of when and where management actions should take place for a corporate work force, known as **The Land Force.** Employees of The Land Force will then implement these prescriptions throughout the area, leading to stable, bounded profits.

I have planned over 150 Groups, many working together, to operate on enterprise environments (Appendix 1). They, too, are planned to be profit-stabilizing for the long term and guided by VNodal software. An internal Corporate Service Group, called **"System Central,"** will develop plans, connect with other Groups within Rural System, and provide analysis documents for the first 5 years for the enterprise environments.

Work with Landowners

We propose to devise a plan to contact 20 land owners in the region around Blacksburg, Virginia, within the New River Valley, and perhaps also a mining area around Egan, TN, for tests and demonstrations. (This last due to past contacts and mutual encouragements.) We may make multi-media ads and public presentations within these rural areas to absentee landowners and owners planning to leave their lands within several years. We shall present options and direct them to our website, www.ruralsystem.com, for further information.

We offer absentee owners new perspectives on their land and waters. We shall provide new analyses, protection, care and attention, and new enhancements for owners. We shall make money, share it with the owner, contribute to local enterprises, and improve natural resource management. We shall display a modern systems approach to comprehensive natural resource management for each lessor, family, friends, and travelling guests. The results will include enhanced climatic advantages, local community recognition and praise, human-health gains, environmental studies, financial gains for owners, jobs for remaining residents, and an improved tax base.

Rural System will rent—or lease—land from absentee owners, who then become members of the system—our new Cooperative organization. We shall manage owners' land in new ways for collective benefits for the owner, the region, and Rural System. These practices will include:

1. Tending and enhancing the recorded history, beauty, and future of lands and waters under management;
2. Providing good jobs and salaries for local workers in many Groups;
3. Reducing losses and increasing production and profit;
4. Providing funds and strategies for stabilizing small rural communities—with related educational and social services, and human health and wellness projects;
5. Restoring, enhancing, and actively managing the diverse natural resources of the property; and
6. Conducting practical, profit-potential-increasing studies.

Landowners will share a high proportion of the total, annual income from the entire action of Rural System … all pooled together, including profits from traditional agricultural production, new crops and uses, and profits from the many Groups. Landowners will be able to specify taboo activities, including profit-oriented ones, and prevent them on their lands or waters. Later we can show the financial impact of each such decided constraint, using a computer simulation, and providing opportunity for them to change their constraint.

Landowners will be part of a modern program for:

1. Reducing poverty and homelessness;
2. Reducing helplessness and hopelessness;
3. Providing veterans purposeful jobs;

4. Enhancing the tax base of local schools and small community activity;
5. Improving water quantity and quality;
6. Sequestering carbon from the atmosphere,
7. Developing understanding of Crescent work, including new knowledge about watersheds and their functions;
8. Improving wild animal diversity;
9. Practicing comprehensive systems ecology;
10. Gaining forest strength, beauty, and health;
11. Making cutting-edge adjustments to mitigate climate change; and
12. Gaining new business dimensions of outdoor tourism and recreation.

Landowners and their families will benefit directly from Rural System membership through:

1. Increased land value;
2. Increased product profits;
3. Continued family control over uses;
4. Land and related resource protection, provided by staff;
5. Tax credits based on computer-selected parts of their property (trust land, carbon-sequestration, etc.);
6. Shared profits from all products, services, activities of the many Groups;
7. Increased pride of ownership;
8. Access to services of **The Wealth Management Group;** and
9. Satisfaction in contributing to the regional well-being of the land, water, and people.

We shall attempt to enhance and revitalize ownerships for landowners and their families and associates, and to facilitate responsible citizenship in a rapidly-changing, urbanizing world. Many people are eager but unprepared to learn about the wonders and opportunities of rural land and water ownership. We can enhance the environment now and for the future, and manage it for wonderful, diverse benefits and for financial gains from regional stabilization or expansion.

There is likely to be a contract element, allowing Rural System to extract resources and perform funded work on the land. Landowners will be free to close or sell their ownership with only a 6-month notice. Long-term uses (e.g., hunting and fishing) are recommended. Membership in Rural System will place the landowner within a far-reaching community of people who know that there are changing needs, uses, and expectations of land and waters. They will know that their land is very valuable, of historical importance, and that Rural System is delivering the best-known service… not as a farm only, but as an enterprise environment—a platform volume of effectively unlimited potentials that we attempt to uncover, use, and create.

Well-known, all land ownerships are not of equal value. In the past, those words were usually based on land seen as cropland or lumber-forests. We know that some land has been found to be very valuable because of government or corporate activity. Acreage is also a major difference, and adjacency to various landmarks or locations can increase or decrease land value. Some have found mineral wealth, others a superior tract for commerce. Land can lose value due to natural changes, such as those caused by flooding. The land and Rural System's set of entrepreneurial ideas, together, can become very valuable.

As we see it, land has future potential for applications and development of the many ideas in Rural System. Rural System staff will be selected for discovering special, often unknown land

value after early visits and studies. Some areas may not be suitable for inclusion within Rural System, even with our most creative efforts.

A **Preliminary Analysis** will be performed in discussion with the landowner as an early phase of contract development—intended to be of very low cost, with abundantly used best-estimates, and dependent upon family or local reports. In Phase 1, we shall evaluate each entry to Rural System of an ownership in a region of work, based on the following weighted mix of approximate estimates (with other questions to come later):

- **Total area size in acres** – the larger the better, relative to a minimum.
- **Area shape** – relative to the estimated radius of the area as a circle.
- **Access** – via vehicles, or proximity to a railroad or river.
- **Water Resources** – presence of a running stream, water body, pond, lake, or river.
- **Hazards** – preferred absence of structural hazards, power lines, major utility corridors, abandoned mines, or designated "brownfields."
- **"Flat" Land** – quantity, as determined by GIS analysis; % "very steep."
- **Average Relief** – may determine the number and type of activities or the quality of viewscapes, i.e., diversity of activities may be great if relief is large. We will measure the percent of area in high elevation, by GIS analysis.
- **Reserve Area** – any type of official, often-dedicated area, other than "wilderness."
- **Wilderness Area** – officially dedicated as "wild" or "wilderness."
- **Forest Preserve** – presence of total forest area already "preserved."
- **Electricity** – access to electricity grid, or if planned and underway.
- **Utilities** – access to public utilities, such as water, sewage, and waste, or if that is actively planned and underway.
- **Pasture/Grassland** – percent of total acreage that is pasture or open grassland, not forested, as determined by GIS analysis.
- **Urban –** percent of mapped ownership intensively developed—roads, buildings, etc.—that can be classified as "urban," according to reasonable definitions.
- **Cluster Potential** – adjacency (less than 130 ft.) to an ownership already within Rural System, or in late stage of entry, for potential work/cooperation together to achieve economies of scale and other advantages.

Each ownership will be given a computer-produced "entrance score," reflecting the variables listed above, to provide a realistic baseline measure from which to evaluate progress and estimate potential financial developments. The average initial land ownership is anticipated to be approximately 200 acres. A minimum of 50 acres is typical, and no maximum size is foreseen. Each ownership is acknowledged as unique. Each varies in size, soil, access, grazing potential, forest composition, pond presence, amount of restoration needed, scenic elements, etc., all affecting potential related limits for achieving objectives cost-effectively.

Rural System will provide a standard, long-term contract for the landowner, with full provisions and percent of profits allocated, also specifying the consequences of breaking the contract by selling the land or implementing destructive or inadvisable uses of the land.

Staff will work to convince land owners to assign us full authority to carry out the best recommendations for their lands and waters based on science, sound business, and current markets. Of course, families and specified others may continue to use designated land (e.g., hunting season, picnics, swimming, summer sessions). These are conditions and events we shall

enter into our computer programs to get maximum long-term profits while complying with owners' wishes (our constraints).

Freedom of mind is offered—awareness that family property is being well tended, made whole and productive, structures maintained and improved, and that once-beautiful landscapes will be renewed and maintained as esthetically, ecologically, energetically, economically sound—vital for the future.

Among many, "land rent" or *modified lease* is one view of our work with land owners. Rural System would rent the land from owners under a lease, and would pay specified rent regularly, as well as 50% of all of the profit made from all lands under rent. We would pay to enact science-based restoration, development, and management to enhance the land's value and uses. We would also provide aid to the local community—simple derivatives but also from our community-related development work, including produce markets, recreation, diverse sales, and limited philanthropy.

Rent would come annually from land value enhancement (for future sale if appropriate), from carbon credits, intensively managed crops, and 20 to 30 small businesses operating on or nearby each ownership. VNodal, as stated, would prescribe the best Groups from a list of over 150, for early development on each unique property. We would provide continual reports on the activities and accomplishments on managed lands.

An alternative way to think of our work with owners is as an *investment.* Under a document akin to a bank "line of credit," owners would assign Rural System a portion of the current estimated local value of land per acre (for example, $1,000 per acre for 25% of 50 acres would equal $12,500), and we would use that credit as needed for restorative and developmental actions on their property.

Another way Rural System may work with land owners is with the owner contributing funds directly to the **Rural System Foundation**, aware that all of those funds would be used on their properties. Significant notice of their contributions would be provided to increasing numbers of students, and other guests of the various enterprises, giving credit for providing jobs, ecological education, and responsible land management. Under this third option, the land owner would see their land value increase significantly over time.

A final, rarer option would be for a church, social club, or other organization owning land to contract with us, in land and water development, to provide a negotiated, smaller rate of return because of the inherent decision difficulties and the high costs associated with structures likely to be present. This fourth option has major advantages for state and national conservation organizations (and their affiliates) that could gain foundation funds from owned lands with no extra work, serving to build the organization and improve their lands or facilities. Similarly, we have discussed with bank officials the potentials of banks securing private lands under conditional trusts for their clients, and then having Rural System develop them.

Real-Estate Analyses and Processes: Rural System Tactics to Increase Land Value for Owners

Rural System faces diverse financial and value-based decisions, and will approach them with a matched diversity of approaches, or tactics. Rural System tactics for evaluating real-estate opportunities include the following:

1. Direct comparison of the median real-estate price in the area today with its historic changes;
2. Evaluation of potential gains from the land if purchased and developed;
3. Consideration of recent, equivalent local sales;
4. Estimation of land-value enhancement or change from each Rural System management technique applied, such as view clearing, pond construction, and reforestation;
5. Recognition of features present such as historic sites, hunting potential, livestock odors, pollution levels, and public utilities;
6. Weighing of esthetic attributes alongside other values affecting future land management decisions, so that the overall outcome reached is improved community health; and
7. A paired comparison of present land value with projected land value if a respected individual's standards or wishes are held during future management.

While our emphasis is not on the occupied structures, we propose to work on and around structures on lands under contract and throughout each ownership. We believe the marketing gains we shall make in the appearance of the land, to a select-few perceptive individuals and property owners, will be substantial and increasing in the future.

The value of an attractive landscape to a home's or structure's perceived value has often been stated at 15 percent. We believe, with others, that landscape features *do* contribute to the value of a home, and that these vary both with viewers and with the total environment within which each property exists. We shall spend time and resources on our client's land and typically gain enhanced value on adjacent or nearby land and water. Like other gains, often difficult and unconventional to evaluate, this investment is often modest, controversial, but since probably small, will not impact or eclipse the total other notable annual profit gains. We doubt if thousands of dollars allocated to landscaping will *cause* land purchase, but we suspect that *failure* to invest adequately in products and design and removals can significantly reduce land sale gains. Lost personal sale value is also a local community financial loss, thus worth accounting when achieving desired annual profit estimates near a rural community.

We shall spend time and resources on landscaping, enhancing the managed property's value as well as adjacent properties. In one study,[122] respondents ranked design sophistication as most important, adding 42% to home value; plant size was ranked next important, affecting 36% of value added to home, and diversity of plant type (22% of value) was ranked least important. The numbers vary for many reasons, so a solid estimate of enhanced land value remains, for us, a quest. We seek net gains, and so we shall take increased real-estate taxes, as a result of increasing land value, into consideration.

We work toward an expression such as: "A structure valued at $150,000 with no landscape (lawn only) could be worth $8,250 to $19,050 more with a sophisticated landscape with color and large plants." Having invested in such landscaping, we would claim at least a minimum gain from that documented investment in the land and water.

The value of landscape improvement increases over time since the growth and maturity of trees and shrubs enhance aesthetic appeal. These increases can be incorporated into VNodal computations, the transition functions, for guided Rural System management. Other sources on improving property value will add to our related software within VNodal.

[122] Niemiera AX. 1999. The Effect of Landscape Plants on Perceived Home Value [Internet]. Virginia Cooperative Extension. [cited 2017 Mar 13]. Available from: https://pubs.ext.vt.edu/426/426-087/426-087.html

Land Acquisition: A Note

Rural System faces many diverse financial and value-based decisions, and it approaches them with matched diversity. Buying a home, for example, may provide the priceless aspect of a nice neighborhood, historic land, and the natural beauty of land with rich flora and fauna and complexities. As a society, we know these things are important and that we value them, but we rarely can say with others "how much."

We now need that answer to "how much?" as we face the profitability scope of Rural System, on the way to addressing the international crises of 2050 AD. We study the dimensions and financial differences between estimated real-estate value and current land value.

Our tactics for estimating land value include:

- Direct comparison of the median representative real estate area price today to its historic change;
- Estimated potential gains from land if purchased and developed (land + change);
- Comparison to recent, equivalent local sales;
- Value of features present, e.g., historic site, nearby public land (e.g., hunting), public utilities;
- Esthetic units, weighed alongside other values in our future land management decisions by commercial or public groups;
- Paired comparison, where a respected individual or group names a standard (e.g., a farm view from a public spot on a public road) to compare properties; and
- Estimated values of the landscape. Rural lands are of great appeal and have great beauty to many people. They are acclaimed by tourists and their value and importance vary with the seasons. Variety is part of their value, both seasonally (as for tree colors) and for spring grasses and other flora. We believe and shall study the dimensions of our belief that we can increase the financial value of a property by working on that property, with the landscape of adjacent and nearby properties, and by well-marketed results of our work over time.

The "fair value of land" is a critical concept with which Rural System staff must work. It is critical, and has nebulous elements with which we deal, and those predicted for the future, some avoidable, some with low probability, and some with which we may have alternative understandings. "It's worth is what the owner says it is" has limited meaning. Many variables influence land valuation:

1. **The cumulative statistics** – the mean, maximum, and minimum of land acreage adjacent, nearby, and within a specified region.
2. The above **adjusted statistical expressions** for a land tract, adjusted to very large and very small tracts, suggests the logarithmic distribution of land values that "damps" the large, outlier-size tracts.
3. "**Example expenditures**" for land sale, discounting age, size, notoriety and access, as in "these 3 tracts sold for …$." Prices reported for similar areas within a vicinity can be very misleading.
4. **Reported value of produce** per acre in the past may not be matched now.
5. **Historical value**, i.e., the sale value of the tract and those nearby, may be "outdated."
6. The **additive value** – the likely extra or added value of the property to that of a potential customer (achieving economies of scale).

7. The **nature of rights**, warrants, and trusts of the property and adjacent ones.
8. The **timber value now –** likely, harvested, and minus taxes.
9. The **enhanced or changed values**, success, ponds, land restoration, and proposed access and/or development (including rates of local human population change and market activity).
10. **Land shape** – GIS analysis of slope, aspect, elevation, stream(s) present, roadway length, boundary length, and an actual length to minimum length index.
11. The **border area** – acres in private and public land in a mapped area around the property, suggestive of problems and/or advantages, largely based only on the size and shape of the property being analyzed.

We shall develop a software unit for rapid analyses of the above, results cast as an advisory document for buyer and seller and for potential user sales within a real estate Group or office, perhaps unified with GIS service.

The Realtor Group is a proposed enterprise of Rural System within System Central (with extensive computer mapping capabilities), or it may be developed as an affiliate project of an associated realtor. When active, it will make information about any tract of land within the region available to realtors and buyers.

To know it is to love it may be true for land. The working hypothesis for designing and implementing this unit is that land will be better used and managed over the long-run if people learn about it, come to appreciate it, and learn how to respect its limits and to exploit its potentials. Beside many general public relations benefits of working with Rural System, realtors are likely to increase sales and repeat contacts, improve satisfactions for buyers, and enhance their role within the region.

The Realtor Group is a planned system for people who are appraising, buying, selling, renting, or developing land, for realtors and their real or potential clients. It may also become a partnership development in which Rural System invests with realtors in efforts to sell or rent land. If successful (very likely, with the combined work of an effective realtor and the services of Rural System), a small percentage of the commission of the realtor may be shared to improve The Realtor Group and enhance Rural System.

Most people believe they know what they want in real-estate, and they express these needs or wants in simple terms such as “a good piece of land” or “a place in the country.” It takes work to describe exactly what is wanted. Equally or more important is the problem of describing what they will get. Most people do not even know the categories, what questions to ask about the land, or what information they *could* get if they knew how to ask for it. Few people have much practice in making big purchases. Stating wants and needs for rural land purchases becomes increasingly more difficult for people as the society becomes more urban.

The Realtor Group will provide a report of an expert system analysis (from VNodal) of lands that may meet the criteria and interests of a prospective buyer, and then suggest (if requested) three financial plans for assisting in achieving a sale or purchase. The report is imagined to be like a medical “work-up” on a patient. It can also be compared to military intelligence. The Realtor Group will produce reports, maps, and illustrations that will help realtors sell land by providing the answers to questions that clients may ask about land. It will be the best information currently available within a dynamic database, and will be provided in cost-effective phases. It will attempt to increase the chances that customers will be pleased, that the land and resources will be used well, the people of the area will prosper, and the users of the real-estate business component of Rural System will become increasingly prosperous.

A group of scientists can study a small tract of land for their entire careers and pass it along to their children for more study. There is no end to interesting questions about every piece of land. The Realtor Group will deliver information in three phases and in sequence. Each phase is of different intensity and depth. The Realtor staff, with a university foundation, can also develop a unique program of long-term studies for a client. Besides great taxation benefits, the public relations gains cannot be discounted. The report will provide a baseline analysis as protection against future claims of excessive changes and abuses.

Phase 1 will provide information about the state and counties. It will give the ecological region and general information about the forests and wildlife of the area. It will provide exact location, rainfall, monthly temperatures, growing season, and an estimate of the *number* of species present. It will analyze area, boundary length, and adjacent owners, and the problems and benefits thereof. The most exciting part of Phase 1 will be the maps; based on a rough boundary map supplied by the realtor, the area will be displayed within a topographic map 'window" of about 25 miles on all sides. Expert survey sources will be suggested, and detailed mapping will be arranged as needed. An attractive, three-dimensional, full-color picture of the shape of the land surface inside this map will be presented, along with the rough boundary.

Phase 2 will list which major species are known or are likely to be present, analyze the slopes, soil, and aspect of each unit, and provide extensive documents about the forests of the area. A vegetation map will be supplied, and a map based on the latest analyzed satellite images for Virginia. Five other maps will be presented, displaying slopes, aspects, solar radiation, elevations, and watersheds.

Phase 3 will provide other information about the area, but its emphasis will be on ideas for development, ecological limits, financial options, and ecotourism potentials. Gross forest potentials will be estimated, but clients will be referred to a company especially equipped to move past The Realtor documents—to use them and the investment made in them, and to supply sophisticated, cost-effective forestry services to enhance the land and stabilize its productivity and potential profits.

Investing in Rural System

I believe $7 million is needed for a base agency or enterprise to create Rural System to achieve its stated objectives within 7 years, and to repay the loan. Thereafter, Rural System will continue operations, dedicated to research and studies, site conservation, and education of remaining rural people and their associates, in addition to making profit.

The proposed "investment" is not proposed as a grant request, but as a line of credit to create a private, for-profit corporation to meet pressing health, education, social, and natural resource needs on private lands within the state, in cooperation with state agencies (e.g., the Virginia Cooperative Extension Service, Virginia Tech Information Technology Program, and the Virginia Conservation Management Institute) when feasible.

As an example, consider a hypothetical 65-acre farm with land, house, and buildings valued at $3,000 per acre, thus a total value of $195,000. For a 30-year mortgage at 6%, owners would need to pay $33,951 per year. The estimated annual yield from this hypothetical farm is $25,440, meaning the property costs the owner $8,511 per year to keep.

Rural System can conservatively offer the following to owners with their land under contract as a Rural System enterprise environment:

- 2% land value increase due to an information package about the land, visual quality, reduced risks, reduced problem areas, and public relations as an environmentally responsible, "green" property – an estimated value of $3,900
- 5% increase in forest productivity – an estimated value of $750
- 3% increase in crop production using computer aids – an estimated value of $100
- Reduced storage and working area cost (due to cluster efficiencies) – an estimated value of $500
- 50% of all Rural System profits from ancillary activities, memberships, and services – an estimated value of $3,000

The total estimated annual financial addition for this hypothetical average 65-acre Rural System tract is $11,420, and given the previous estimated productivity of $25,440, Rural System can bring the annual income to $36,860, meeting and exceeding the required mortgage of $33,951. All of the production estimates are average; all of the gain estimates are conservative.

Gross Rural System estimates can bring a slightly sub-marginal farm with over-valued land and house into the range of being profitable. The Rural System affiliation will likely bring additional landowner income as a member of a diverse, growing Conglomerate with profits expanding with additional enterprises, incentives, franchises, and enhanced land productivity grounded in precision agriculture, resulting in community betterment.

Making Money: The Profitability Processes of Rural System

I "give away," up front, the answer to the first question usually asked as I discuss *Rural Future* with friends: "A business! How does it make money?"

The answers are in the book, but here is an effort and a list to damp doubts or give an answer:

1. Rural System, the enterprise, will lease rural land of absentee owners. Subsequently, annually, owners will get a percentage of the annual profits of the entire Rural System—all lands, waters, and businesses. Their land will increase in value, reducing losses.
2. Lands under contract will be managed in clusters, 2 or 3 ownerships close by, achieving economies of scale and major diverse efficiencies.
3. Lands will be analyzed by the Land Force, using technology, including access to an extensive GIS database (all data GPS-specific).
4. Rural System will build from our prescription system with 3 phases, leading finally to private land development for owners… many of whom are absentee, now urban dwellers.
5. Precise analyses and prescriptions will be produced by the diverse corporate computer system called VNodal. Information will grow and prescriptions will be issued from ever-changing "expert system" processes, addressing what-to-do-where.
6. With owner approval, the Land Force will implement the prescription, that for preserving, restoring, cultivating, harvesting, monitoring, and adjusting.
7. Marketing will be very active for the planned Groups.
8. These Groups will change "farms" into "enterprise environments," then into "clusters." The land, redeveloped, will become available for use (if appropriate) by memberships (many Groups, such as those with interests in gardening, turkey, bob-white quail, bird-

watching, deer, bear, bobcats, nature study, and owls). There will be other Groups, not "of the soil," but with more general memberships and services (e.g., poems, music, photography, and laboratory).

9. Rural System will be hyper-attentive to reducing losses and risks, and gaining benefits from topics for which low structural capital investments are required. Net, dynamic, desired differences will often be discussed.
10. Annual profits will be assigned to land owners, investors, and staff (with a portion to be invested in increasing the land productivity) in proportions assigned within the initial contract based on acreage and a "productive capacity index," measuring how productive an enterprise environment is likely to be.
11. Rural System will diversify employment and staff interests. It will provide a new tax base for the stability for local communities. Research- and studies-based, it will concentrate on harvesting past investments. "Jobs and salaries," very important, will be developed, technology added, and made available for the current residents, many of whom have suffered losses from mine closures and the other historical problems of Central Appalachia (and, ultimately, in over 140 countries worldwide).
12. We shall study and work toward a concept of becoming a "lean community," generally saving money and energy, increasing productivity, increasing profitability of such production, making successful start-ups, fixing problems, featuring markets and gaining market quality, and rewarding improvements.
13. Rural System will focus on achieving its stated objectives, but, failing that, will seek Earth-around assistance to form Groups as they coalesce in tending diverse water crises and supplying food for Earth's population—now growing faster than food production and Earth-system management.

The process by which Rural System reduces costs and widens the profit margin is ten-fold:

1. We implement "economies of scale" —notable gains and improvements resulting from increasing staff, project size, etc. —promote efficiency, pool resources, and reduce waste. The nature of the highly-informed computer system, VNodal, with feedback and feedforward, allows for more intelligent logistical strategies. Essentially, we are better able to hover around optimal cost-benefit ratios. Modern biologists understand energy systems, those of cities, forests, and people, and understand communities in terms of energy balance in healthy systems. Energy drives natural systems and can be measured numerically, much like money, and it is a limiting resource, again like money. "Resources" are valid topics, regardless of whether people are discussing a modern human system or a natural system, and all include costs!
2. After years of exploitation, there may be little reliable production left from the land, even if very precisely and carefully used. Knowing this, Rural System gains will be from the sum of land gains, reduced land losses, and reduced wastes. This may be part of "conservation economics" or *profits from money saved*.
3. We consciously and actively work for "synergism," the process that creates gains and effects greater than the sum of two or more working factors. We see this in the

effectiveness of paired agricultural pesticides; healthy, strong husband-wife teams, successful sport-teams, and highly resilient farms.

4. We propose to link profit with the seemingly ambiguous, but omnipresent value of community health. We aim to demonstrate, through a computer-guided business aimed at optimal land management, that by reducing health care costs for families in Rural System employ through improved health and wellness education, we shall increase *net* profits for the company.
5. We shall develop a Wealth Management Group, providing solutions for individuals, families, and Groups, including advice on dynamic farm policy, forest taxation, landscape valuation, evident constraints, and pooled-buying strategies (e.g., equipment). Rural System would also educate people about how, through synergistic tactics, pooled resources, strategic loans and investments, and local computer-aided concepts and simulations, people of the region can benefit now and in the future from the funds gained.
6. Agroforestry (Chapter 8) is intensively recommended by the USDA, so we use our **GIS/GPS Group** to find the best places for "alley-cropping," a recommended agroforestry practice, of poplars and peas, sycamores and switchgrass, and hazelnut and millet on ownerships.
7. People in the past have not been appropriately assigning values to the intrinsic and aesthetic components of the cost/benefit equation, and thus are suffering great costs by not assigning profitable gains from community health. We shall discuss opportunities with active Groups and continue developing practical applications of energy knowledge and opportunities for rural conditions (discussed with Q* action).
8. We shall apply an option of "opportunity cost valuation," e.g., the "value of squirrels" to an owner is at least as much as the woodlot trees' sale-value that a tree owner forgoes in order to maintain the squirrels.
9. We count reduced losses and costs resulting from the work of our **Safety and Security Group** and our **Fire Force Group**, and we explore net gain opportunities for similar estimates with our **Studies** and **Pest Force Groups**.
10. We capitalize on embodied energy tactics, especially those of recovery, restoration, repair, reuse, and value-adding.

Why so complex? Because we have precise and varied objectives, and we need to have a way to make adjustments, and have a common means for computing status and progress. We have to prevent "boom and bust," a past tradition, but provide desirable jobs and stable work. We have to improve and build on the resources we now have, recognize the past and the present conditions, gain funds from state and federal tax sources, agree on a coming future… and prepare for it all at a local scale, with possible messages for the future on display.

Several planned simulations will allow a study of the many decisions needed related to the payoff and profitability options above. They can be combined with expected-value studies within the accounting system. These will be on display in public presentations, locally.

Economic Resource Valuation

In economic resource valuation, we stress equal value of named entities, believing that people are usually able to evaluate an unknown or "topic of concern" relative to a known-value entity.

We shall use small evaluation teams, respected local volunteers willing to visit sites or objects (trees, waterfalls, areas "for sale") and who will submit an estimate of value or a set of relative values. For example, the group may visit viewscapes one day, or photos, make entries of relative beauty or relative impact, or loss or social cost of a lost view or set of views.

We shall monitor the rate of change in timber values in the past few years, suggestive of changes in tree value (median value of local "stumpage"). This estimation of tree value implies real values and their dynamics for less well-known markets than local trees, and for a long list of forest benefits to individuals and to society. We shall add the locally-reported value of land rented for hunting to forest tree value. We shall use the value of within-market soil, and suggest minimum value of soil within-forest area—43,560 square feet x groundcover of 8 inches = 0.75 feet of soil—to assess current market value of an acre of median-value soil.

We also engage contingent-valuation, money that select people are willing to pay for more or less of a forest resource (if forced to choose). We shall start with the option "now known" and go to great lengths in computer simulation and social media illustration to present unconventional but realistic choices with rates of change for decision options.

Dynamic Lean Production

When I see people in serious trouble, I tend to look for help and answers to questions of how to help. Silly; I usually think that I might be successful. I have little evidence of that but I try, usually realizing the problem exceeds my resources. Then I re-focus on "personal resources" of analysis and creativity … topics also limited. Then I try to formulate the basis for the perceived problem. In the case of formulating a Rural System strategy, it must be for the great, continuing emigration of families out of Southwestern Virginia, a great tragedy only slowly, slightly similar to modern refugee moves.

The causes are related and the order will be debated, but the evident result is mainly poverty, related to number and type of jobs, land productivity decline, regional economic instability, landowners aging (making farm-work difficult or impossible), and rising prices of essential commodities.

Local hospitability and inherited land, love of the land, living off the land, and family-sharing resources seem to achieve the current levels of need for people staying on the land. Many people can "do well" by diversifying, depending on inherited land, making wise investments, maintaining land productivity with education aids, adopting favored practices, and working markets skillfully.

I believe the only way to hold a large population within the region for the good of the people and the stability of the socio-economics there, is to diversify private enterprises and to provide part of profits to landowners. Otherwise, they will have to leave, often very unwillingly and retaining a lasting, unfulfilled love of the land. Adequate, lasting, stable amounts of money from the land system seem to me to be the only satisfactory long-term strategy for gaining *a vital region*. We have decided that our objective needs to be achieved and summarized as having a *high index of profit*.

Related waste-reduction analyses involve: identifying a resource in-hand; saving; preventing loss, wear, or destruction; storing and preserving (drying, pickling, enclosing); restoring or re-making; re-cycling; and composting … all with likely local rural market costs. We evaluate objects starting at the beginning of each named "new" resource condition. The **lean condition** is the new one. The measure is valued outcome, or production of each item per unit time as related to the initial cost of the production equipment, and that of the repaired and revised equipment, tools, vehicles, etc.

For us within Rural System, *lean production* is an inclusive strategy[123] for producing value to paying consumers, and desired annual profit index units to Rural System. The two are balanced. Lean production concentrates on reducing all expenditures and losses that can be considered probably wasteful and of unknown purpose.

Rural System: A "Lean" Community

There can be no additional "fat" in our modern community. After work within Rural System, the surviving communities in Central Appalachia and similarly-stressed areas are likely to speak of being diverse, lean systems. They will mean that they tend to be doing the following (for it is a collective, on-going, imaginative, improving activity or set of tactics in a broad strategy, ripe for local improvement and advanced planning).

Becoming lean has been called a mind-set. Developing and living in a lean community is a procedure to save money and energy, increase productivity, increase profitability, improve start-up ventures, fix problems, shift to emphasizing market quality, and to do better when we think we are doing well.

Forming and operating within a dynamic lean community goes past old diagnostics or tearing-apart tools, and establishes a fundamental designing and improving process to work on:

1. Increasing speed without working harder by eliminating delays,
2. Increasing quality estimates/measures by about 50% by deducing defects,
3. Cutting costs and boosting profits (25-50%) by reducing variations and re-work,
4. Re-investing earned income into healthy families,
5. Engaging in making money by keeping money, and
6. Plugging financial leaks related to defects and variations.

We develop **processes** that can be adjusted and transferred. Words often used by groups and on memory banners to stimulate discussions are part of our current system tactics for development, growth, and improvements. Rural System experiments with utility of the **FISH** remembrance tool:

1. **F**ocus on one key problem at a time;
2. **I**mprove each product or process significantly by eliminating delays, defects, and variations;
3. **S**ustain improvement; and
4. **H**onor progress, making it visible and move to report improvements.

Within Rural System, we aspire to leadership by demonstration, assuming a role in the Appalachian community with our emphasis on increasing service and cutting quality-reducing, profit-eating problems.

[123] Ries E. 2011. The Lean Startup. USA: Crown Publishing Group.

To Customers, Clients, and Those Whispering "Help Please!?"

As never before, we have techniques and systems to achieve marketing within the new framework of Rural System, and seek to embrace marketing with the same novelty and creativity of our related Groups. We plan to use predictive models and statistical tests of production, balanced with purchases and profits, after careful targeting and avoiding waste and losses. We work for knowledge about customers to gain for them precision deliveries and timely uses and storage… as well as new products, services, and efficiencies.

We are intrigued by new electronic sources of connection, communication, and experiencing what we have to offer, and the successes and satisfactions that it may produce for a growing population in towns, residential areas, and those at the urban/rural border. For example, see our blog at www.ruralsystem.com/category/blog (and we plan to build a presence on YouTube, Twitter, Facebook, and LinkedIn).

As another example, we have planned **The Listener's Group,** a community-oriented media company that will produce a Rural System podcast, sponsoring local music, art, and poetry. The Listener's Group will also deliver warnings (e.g., hunting season, floods, new water and flood hazards, pesticides) among other activities. The Listener's Group would therefore work closely with **The Marketing Group** (e.g., podcasts combined with social media marketing) and **Earshot** (e.g., finding an optimal sound level for warnings). The Listener's Group might also work with Earshot to obtain quality recordings of owls, and work with The Marketing Group and **The Owls Group** to attract visitors to Owls Group activities.

Our sales environment is large, even unlimited in a digital age, and focused on rural people recently moved to cities, as well as those still living within rural regions.

Marketing has many meanings, but we see it as "enhancing and changing behavior." It's intended for employees, consultants, advisors, and volunteers, and will be well-understood by customers of all types. It is a few words about what we all should be doing together. For example, forest and wild fauna and flora managers are traditionally oriented to the production of forest and farm *products* rather than forest and farm *services.* Developing perspective and sensitivity to such changes is part of the new work of Rural System's Marketing Group.

Rapid changes in consumer demand and tastes have come to farmers and foresters in a much watered-down version, through limited contacts with primary product buyers—who themselves have great sympathy with the foresters' problems of production on the land… The manager of the forest recreation environment, for example, is thus directly subjected to all the pressures of the consuming public and is constantly feeling the cutting edge of changing tastes and innovations. For marketers, there's need for new empathy of staff of other groups with the people using the forests and fields (recreation being one such service).

"Markets" are seen within Rural System as human populations of buyers and users. The goodness of many ideas must be seen as being evaluated by the number of buyers and what they are likely to spend. They are much more specific than "society," "hunters," "anglers," or other non-specific interest groups. (Whether the buyers use what is bought requires separate analyses.) Marketing or using markets (as we now understand and use it), includes: (1) analyzing individual and group wants and needs; (2) taking diverse actions and making media presentations; (3) presenting new options and alternatives that are now (or may become) wants and needs (often synonymous with advertising); (4) increasing desire for needed things (life-quality enhancing and prolonging, or otherwise socially beneficial); and (5) assisting in finding legal and socially responsible ways for individuals and groups to satisfy these enhanced wants and needs.

Stabilizing Profits

I taught wildlife management, an ecology-based course, and realized near retirement that I had taught students—presumed to be heading toward state and federal jobs—how to *spend money* (on conventional wild animal management techniques). I have now realized that I must learn and teach people how to *make money*, if I am to help address the looming national and Earth problems I see for my family and community. Only a broad-scale financial incentive can motivate enough people to become effective against the growing rural land problems, those of wild fauna, now advancing.

In Rural System, we shall concentrate on financial stability, believing that if bounded, sustained profits are achieved for many years, then most of the other important, not-easily-quantified objectives can be achieved. Adequate income, one objective, may be a condition for satisfaction with the other objectives. Threats on display in computer simulations may build desired interest and improve decisions.

"Bounded" signifies the stated upper and lower acceptable limits on lasting profits. The bounds imply the reasonable extremes in annual expectations for profits. Fluctuations of rural conditions are expected and predictions of variability inform managerial actions, preventing excessive high or low annual profit gains.

We know that we cannot achieve "maximum profit" each year. We know the evils of boom and bust economies, the intolerable losses, extreme highs followed by extreme lows. We want high profits, but we do not want to over-invest in structures and machinery needed to gain them, because we know that maintenance and updates can be costly in the future. We cannot stand the losses and the grief of extreme lows, for that is to court bankruptcy.

We want to achieve a high, consistent, uninterrupted performance, amounts that we can graphically describe. Many high gains, within bounds, may open opportunities for Rural System expansions into other regions. "Highs," are often matched with "lows," within bounds, as in other investment operations such as stock trading. We need to state what is tolerable and specify the perceived upper and lower limits over time, i.e., the bounds. The bounds will be set by System Central and will usually be expressed as a proportion of the profit. Decisions about bounds will be aided by computer simulations.

The gains may not change much because of biological and other limits, when compared to current superior land use elsewhere. The profit ceiling may not change much, if at all, but the profits will be notable because of decreased wastes and losses, using lean production practices. Difficulty in gaining profit from owning land increases with inflation, diverse structural development, and speculation. International financial shifts, climate change, local catastrophic events, and national subsidy decisions weigh heavily on estimates of rural-based income and thus investment decisions.

In considering the frequent advice I have received to "start small," I have discounted projects and activities such as those found at agritourism fairs and events at first, because returns on investment are too small and difficult to market. We do look at what people are doing now, find what works, and discover how to be significantly more successful than they are. We already know that most of the owners are having trouble with stabilizing profits. By providing corporate business backup, equipment, secretarial help, transportation, scheduling, equipment and storage space, Rural System Groups will develop economies of scale, cutting costs to increase net profits.

Rural System profits—from all lands and waters under lease—will come primarily from our many planned Groups. Some Groups will produce profit from the land, some from ponds and

streams, some from office-space on the land, and some from marketed services or from visits or sports. All staff are attuned to climate/seasonal influences, losses, pests, safety, and diversification topics.

Rural System gains will increase by incorporating Cooperative Extension Service recommendations on very-specific GIS-computer-selected sites, with superior field operation scheduling and rotations. Thus, there will be more farm produce yields than in the past and much more efficient produce storage, transportation, and sales from new marketing efforts (including social media), and continuing traditional outreach than from recent practices. Added to this are gains made from work at a much greater scale than in the past, both in terms of total acreage and in terms of the network of Groups working together to achieve economies of scale.

Groups within Rural System will use VNodal software output recommendations. Using knowledge of likely change over time (such as animal growth, changes in safe automobile performance, building service, or tree growth), patterns derived from ecological succession known as "transition analyses" can be mastered with computer models known as Computer-Aided Transition (CAT) software, within VNodal, to direct management actions and Group operations (Chapter 4).

Producing food, fiber, and quality water remain important, and are a near imperative. We shall work for those, for our corporate objectives, and for increases. Profits from invested annual income from Rural System enterprise environments can likely far exceed the value of any managed wood harvested, alone, at the end of a long investment period on a property. The annual financial gains will be pooled from all enterprise environments and all Groups.

The owners of lands will receive about 50% of the profits of the entire enterprise. The 50% remaining will be distributed by System Central. We need further analyses and a simulation for the consequences of a decision about how profits will be allocated. The initial proposed distribution of financial gains (the 50% not given to the owners) is as follows:

- 20% – capital and leadership incentives
- 40% – staff incentives
- 10% – staff expertise enhancement and conferences
- 1% – rebate or award distributed to members of The Land Force
- 15% – tract enhancements
- 10% – applied studies, expert consultants, software additions, and systems building
- 4% – opportunity/contingency fund

Benefits to business cooperators and collaborators will be based on contract decisions and treated as direct costs to Rural System.

To summarize key points of this chapter, there are many layers to our company proposals to achieve profit, and we've touched on aspects of economies of scale, Groups, reduced waste, reasonable expectations, and what we offer the landowner. But the real key to Rural System's success can actually be understood simply, not only as profit, but as limited and "bounded" new gains and reduced losses, the sum over many areas over many years as "savings."

I perceive that the only thing to which large, diverse, modern human populations are likely to respond positively, immediately, are *profits*. We must make a WWII-like beginning response with Rural System within local populations:

- Continuing some "farms" (among 47,000 in Virginia) with secure improvements;
- Relinquishing pious and place-specific premises and appeals;

- Recognizing the failures of conservation education, greening, and appeals to state and federal land management at making measurable gains for generalized welfare within highly diverse national populations, many now in poverty, hunger, and using unsafe water supplies;
- Aiding those having moved to cities and who have relinquished their ownership and/or access to some sources of food and water; and
- Implementing the major, dynamic elements of Rural System.

Our rural society *already* has perilous conditions, and we have to make giant changes ahead, before world shortages of fundamental food and water needs and high risks occur. With a few exceptions, what we've done in the name of "conservation," or recently "greening," has not worked. A surviving trend has not been set, and it must be. Herein we have offered the only feasible alternative: a significant, clear profit base for rural resource benefits, one that is annual, long-lasting, and with motivating financial dimensions for people.

A New Farm Story

The following is part of Giles' dream, not real yet.

Fred has just inherited a 120-acre farm. He lives far away, works in information technology, has a family with a child in high school, and, though fond of "the family farm," just cannot deal with it now. He contacts Rural System (RS) for "profitable service." RS "rents" his land from him for $1. They discuss a contract. Fred specifies limits and requirements for what he wants done on his land. The Entrance Quality index of RS, derived by VNodal, the computer "brain" of Rural System determines that his land potentials are high. Fred will receive about 40% of all returns (crops, fishery, forestry, livestock and other Groups). Of the rest of the gain, some is invested in the land, a small percentage in local communities, local worker salaries are paid, a percentage of Rural System's debt is repaid, and RS builds and improves with the remainder.

VNodal produces an outline report, and a 7-factor GIS (Geographic Information Systems) map of the property. Fred responds to 15 questions posed on a PC, all processed within an expert system. Results are within the report, which is downloaded for a laptop. Fred is directed to link to RRx (a software unit of Rural System) Phase 1, where 7 business sectors are shown with links to a collection of 487 related total units with an introductory Internet presentation about services and effects. Based on that and preliminary general information about the area and the new owner, the Phase 1 report lists potential Groups (small businesses) for Fred's study. The report will be the basis for discussions between Fred and RS staff and will lead to discussions about entering Phase 2.

Fred, environmentally astute, realizes the need for land to be socio-economically viable and productive of a large set of interrelated human benefits. He is sensitive to the community's love of land, the several needs to "get away," but also to increasing real-estate taxes and to job limitations for his soon-graduating daughter. He senses potential income from his new land, hears of unexpected income (other than from logging on a few acres), and realizes he can pay to move into Phase 2 or have that equivalent amount of money withdrawn from the first 2 years of returns from the Rural System Conglomerate, wherein all of the Groups work together.

Fred is asked to express future limits he might have to activities such as "no hunting" or "only family fishing," or "no planned uses by others during the last week in September." (VNodal can later estimate the profits foregone by such restrictions.) He is asked if there are areas for preservation or special protection, cemeteries, or old-growth timber stands with special memories needing care.

Staff of Rural System, The Land Force, visit the area for RRx Phase 2; make detailed maps and photographs; visit key sites, structures, road and trail conditions; and note conspicuous flora and fauna to be used as indicators of land-use history. Additional GIS databases are accessed (e.g., slope, aspect, elevation roads, soil use, erosion, geology, wild fauna species known for the county, endangered species present, and pond sites), system inputs are made, and a Phase 2 report is produced.

Shared with Fred, this RS production, so far, is only a comprehensive description of the conditions, constraints, and resources of the area, and a statement of the fundamentals by which the area is being restored, developed, enhanced, and managed. It stresses fundamental objectives, all indexed to corporate profit and that shared as gains for Fred and RS. Fred then signs for Phase 3, after receiving portions of profits from within the first two years.

VNodal notifies all Group leaders of select Groups, most likely to succeed by making significant cost-effective change in achieving stable, bounded profits within each rural region.

For Groups likely to use land space (e.g., fruit growing, mushrooms, agroforestry units, ponds, riparian enhancement, composting, future stables, and forest coppice), multi-factor GIS maps show selected, optimal sites.

All Groups have access to specific required GIS maps via VNodal, used to achieve their objectives of selecting crops and crop sites, building trails, expanding gardens, locating portable toilet sites, marking timber, establishing mowing patterns, scheduling pasture, making preferred re-seeding, building outdoor presentation areas, and developing sales media. The Market Group assists all Groups, especially after each Phase 3 signing.

A Modern Yards Project is started by 4 relevant Groups, primarily to reduce storm water loss, enhance groundwater, reduce mowing noise (Earshot), and fossil energy use (The Energy Group), with The Gardens and Yards Group. It plants flower gardens near impervious areas in former grassed yards, develops a small-version "Victory Garden," and does garden-cluster marketing. It uses mob grazing (for soil nitrogen gains) by goats in mobile, electric-fenced yard areas, adds yard sculptures, and gains certified status as "fine fauna" places for diverse, year-around songbirds enjoyment. Its major financial gains are in intensive, modern forestry within the clusters. Many forest sites are "woodlot-scale," but for large tracts stands are seen as populations within Alpha Units, almost tree-specific and managed based on site access, watershed and enterprise environment function, species and site concordance, carbon sequestration, age-related growth rates and profit gains, and units of "energy forests."

Some Groups do not work on or utilize land products or even access the land units. Rural System is advancing a *Conglomerate,* and seeks to profit from all things legal, rural, and objectives-oriented within Rural System. VNodal itself will likely become free-standing and produce documents under contract. RuraLives, one Group, profits from soliciting, processing, storing, and selling the experiences and wisdom of regional people. Floats, another Group, similarly publishes poems from the region's people.

Chapter Thirteen

You and the Environment of Tomorrow

History, in general, is sweeping and international, but there are specifics, nameable events and blockages. Rural System, as told in *Rural Future*, at best as seen later, is nothing more than an element of history. I've had good fortune, education, and health, and have read about and observed "rural" for over 50 years… a chunk of history. I've seen the rural emigration, hardly noticed, and I fear the unnoticed stress ahead in the water resource and elsewhere. … And so, I've shared what I *know*—the only response I know for readers.

Why? Because, selfishly, I want you, the reader, to do something. (I'm an educator, committed to the idea that teaching is changing students' behaviors.) "All is related" is a message of this book, and thus, I encourage readers to find a part herein of interest and ability, a part of Rural System, and to work with three others of similar mind. Work as a foursome, together—a tetrad—for the future, using a systems approach with your specialties of knowledge and abilities… clarifying objectives, selecting or developing processes, and sharing freely your results. There is no time to gain perfection or wide acceptance before acting. But be open to feedback, perhaps, and pause early for "standback," because copying history can be a waste… or fearfully instructive.

The number of countries now suitable for high-quality human life is far less than 190. "High-quality" need not be debated, only discussed personally for needed, daily food nutrition for an adequate-size, predominately-healthy human population density for a country (we need each other for many roles—system operation and production, now and for the future). We can "size up" *our* country or *each* country, begin to evaluate our resources for our families, and then decide which activities and resources are suitable for each person… given that *war* is not and cannot be a successful strategy, by multiple criteria, to achieve (1) the water balance or (2) the food balance that we need.

Rural Future seeks an effective expression of continual change… toward assets for objectives, undergoing feedback adjustments and "present-adjusting" feedforward. Anger grows with unheeded warnings… that human populations do not decrease with increasing affluence, for there are two other old players in the game: worries over inadequate food supplies and stored foods… and the *imbalance* between human consumers and the *nutritious* supplies for them.

What's to be done? The enemy wears masks with two eye-holes:

(1) *water quality and water quantity –*

I studied radioactivity as a means to investigate pesticide spraying within a hardwood forest. I want nothing more to do with the threats and yet-to-be-discovered life in a world cast-over by radioactivity… and I'll wager safely that neither will you. "Water" is much too general a category of concern: acknowledge the dry sands, the frozen poles, N and S, the saline waters, the deep waters (some already pumped dry). "Quantity" is the problem of enough fresh water for people. "Quality" is a problem freshly presented in current household drinking water contamination problems in Flint, Michigan.

(2) *human food needs –*

I have proposed various *food production subsystems* within Rural System. We need to produce foods of optimal nutrition-value per gram, for "volume eaten" is no longer the criterion of success and survival.

Few people still listen or read; many want to *see* Rural System. Encouraged, I fear more and more that *description* of the doubtful problem or the doubtful solution has not and will be unlikely to work. A demonstration is feasible, one of the equivalent size and cost of a US "moon shot," but without the construction or delivery risks. A demonstration with nearby access to Washington, DC may be in order. Investments are needed, not grants, and a system must be created for demonstration… then rapid expansion to curious and supportive groups… for the future is "now" and upon us… "rural" is next door to 190 countries.

Rational robustness is needed, for there is not much time left—no time for a best-test or perfection, no one solution. The one being proposed within Rural System and herewith is for a "single sample" experiment, *undergoing continual revision*. Readers who comprehend working together, realizing the parallels of ecological relations (the ecological succession and production functions in Chapter 4) will see that these, as elements of equations, worked together, will produce useful answers. Just the elementary parallels are needed first… that gradually can be built to describe and use the equations to progress *forward*, or to heed the message to: "Stop! Danger ahead!"

I'm Not Done!

There are good days and bad ones. Some, I suspect, may never end; others give hope for tomorrow. Some days whisper to me of the past, and I can hardly hear, surrounded by the noise of sculptures being destroyed, and recognition of heroes and successes being renamed. There's noise and odors of places unknown, atypical, "artistic." This is a bad day. The evidence of failed societies remains, desecrated. Past societies have left evidence, records, education, images beyond sculptures, loosened scrolls— *"once-talented, I existed"* —whole destroyed villages are found, with buried villagers and drowned hopes. Some days I start, tired, for I must sing the same song, tell the old stories, give the same warnings to audiences that I once knew well and felt membership. Now I am alone in standing, contentious crowds, wishing to sit.

"I'm not done," said a departing neighbor at his bedside, and died. Now I have hope that I can perform as a wise friend once said: "Just tell the reader what to do!"

The order was too steep! I know my limits. I hope the readers will accommodate them and face the needs—specific and obscure—as best they can… with their education and diverse personal abilities. A unique situation may require a historically special convergence. There are things, very small (obscure), that can and need to be done from among the topics, tangles, and links suggested in this book. Some will be new, others providing service through well-known brute force… and most delivered in new combinations, new assemblages and subsystems—maybe tetrads—inventions and things static, now functional, and merging within the dynamics of the day… short of rainfall, long on war-clouds.

I'm almost done, at age 83 (2017 AD). I want you to get busy on improving things matching your strengths; build on solid grounds with the "bricks" of personal interest to you, to meet the conditions ahead. Attack the problems emphasized in this book. Form groups for mutual strength, as well as for lasting stability for the long haul, for the many important challenges ahead. I know now of your uniqueness; you know of my shared thoughts and

experiences. I hope that you sense "felt-change," then use your new-found energy, perspective, and pointed force to create the future, achieving certified objectives.

Huddled together, I suspect we now know (together) the major topics for us ahead, sense the pain, recall the rejections, and readjust to the secret burden we now carry together: the secrets of the basic system. We standback and reflect in the glare of the present, gaining insurance to suppress sure failure ahead, knowledge that planned futures *do* happen… and unplanned ones certify past wastes and guarantee wasted futures.

Not subtle, I have real fears that we shall only achieve a desired future, an Earth-future, if we powerfully address the problems contributing to likely global collapse. The UN targets for work[124] are clear; we need *a human population balanced with a food supply*. Thus, we have a dominant task, challenging for *Rural Future* readers, to meet the various challenges within each of *over 190 countries* (some more stable in quality supplies and costs than others).

A similar giant challenge ahead is *an adequate quantity and quality of water for human populations*. Untold, large volumes are used and more are in demand, for all countries… some with unmanaged, unstable supplies for their people. And, Earth-around, people are leaving rural areas for the urban areas where water is demanded. "Best wishes for your survival and that of your children" is surely not your only wish, or that of your collegiate readers. Yet, "may you never suffer thirst" seems real—a timely, cherished greeting.

Rural Future exists now as a plan for future people, welcoming precise correction, improved recommendations, and creating new-found Groups that, together, may stimulate, or cause to be built, real elements for Earth.

Education is not for secrets-held.

But shhhhh. I've been advised that readers will not read or accept text that sounds negative or down-beat. [We've lost (used up) our grand USA groundwater supply; we've almost lost *(used up)* our available phosphorous supply, and our crops need it; salt water creeps into Virginia's underground coastal water supplies (and people there seek fresh water, piped from distant, scenic Virginia mountains); Virginia/West Virginia coal, tossed like a rubber toy in current politics (the game), does not achieve its fundamental energy richness regardless, as miners move out, coal-layers depleted, leaving school houses with buzzards clawing off the roofs.]

Knowing what I know and have told you is very stressful, saddening, but I must share with you the grounds for my belief and action. Let there be no more gory future; no more threats, or claims of "fear-monger!" But also, let there be no more delays and words of "better times ahead," or mindless "hopes." Certainly, we need no more "God willing!" quips, or "the sun will come out tomorrow" songs.

Yes, the sun will come tomorrow, but our atmosphere must be cleaned. The sun's all-out solar energy must be captured and directed, priority uses implemented along with energy conservation of all types, from interior home uses all the way to outside wall coloration to achieve desired "albedo" (reflectivity or absorption). Comprehensive improvements of energy use have been noted herein, and need to be part of the rapidly-changing resettlement of urban structures, from hot water for baths for children to energy for men and women, and for health. The time has come!

[124] Costanza R, Fioramonti L, Kubiszewski I. 2016. The UN Sustainable Development Goals and the Dynamics of Well- Being. Frontiers in Ecology and the Environment. 14(2).

No, the time has passed. We have more people now with elaborate resource requirements than we can sustain for long, along with a society requiring a high quality of life, now and for the future.

Reviewers have commented critically, sensing this may be another "sky is falling" book. No, the sky is *well-connected,* and I'd like for it, in all of its primitive and changing modern, basic characteristics, to become well-known and programmed for continued study as global changes *now* occur, frequently, ponderously, dangerously, and so restricting former freedom and future opportunities.

Perhaps an observer will find the challenge of mastering such complexity to be life-changing.

Granddad taught me: "There's more than one way to skin a cat!"

Now I'm stymied by this idea of "many means to the same end." I cannot tell you specifically what to do about the problems ahead, any more than I might tell you specifically how to win a soccer/football game …or skin a cat… With regret, I think we have to do a long list of things—some micro, some macro, some gaining from your personal talent and our effort *together*. I continue with hope, in imagining and then demonstrating partial but growing successes. Such optimism may seem silly in the midst of war and current, Earth-around insensitivity. Objectives will not be clear, but they deserve major work… and must be area-specific when key resources run low.

Parent-based assumptions about help, protection, and future safety are said by some to be unsupportable. Organizations are not solving the problems because they are new, not yet organized enough, unsupported, and unrewarded for preliminary action.

Such action is all that's left, it seems… vacant spots and hopelessness on display. Small communities exist, "hope" undefined, and none expected. "Tomorrow" is unknown, and "perception" is hopeless to be gained. By starting now, I believe we can avoid being just another failed society in the long history of such failures here, in the USA, and on Earth. What can we learn? Failure *is* possible, deadly, and expected.

We might be different, and at least delay the inevitable longer than have past societies. I think delaying is our *best* option. (Because of knowledge of the past, I reject the best option of a global commission on a new Earth strategy to avoid imminent global war… I surrender to piece-work.) We have to create our own, diverse community energy sources as rapidly as possible. Then, we need water resources–especially purification systems—for the water problems are *now* very real and increasing. Now we can (must) model our systems to show us our likely risks, and their speeds and sequences, for we already sense that the future is now upon us.

Now, we are aware that massive, critical action demands personal involvement and superior attention to the complexities of pending difficulties at a never-seen-before scope and scale. We see "equifinality," i.e., equal pathways to the same destination. Which pathway shall we choose or tolerate? The equipotential is also known, but how shall we decide to select? I have to have been convincing, herein, that we have an enormous, unique problem rushing at calendar-speed… only a lifetime away before we face the consequences of not believing and acting on the content of this book and related, superior texts, unavailable to former populations.

Sustainability is so commonly used that few people can define it, and those who can never admit that they do not want to sustain the *current* conditions, projects, or programs, for they all seem to be failing in vital parts.

Local transportation is about to become (in about 30 years) minimal, along horse-and-wagon trails within clusters. We need to rebuild the "settlement community" of the late 1700s: a

common center, self-supporting agriculture, communal work, internet-based medicine, strict health programs, community education, intensive language programs, and "visits" outward to seek or build markets for all local people, and share successes. Already short of time, we need food, soon, *and for 50 million* more *people!* (There are only 350,000,000 in the U.S.!) (Locally, we import food; many other regions, worldwide, import much more per person than we do in the U.S.) Hope, alone, seems pitiful.

The muffled vibrations of that noise are:

- The labor supply is uncertain in rural regions.
- There are scarce and declining amounts of high-quality fresh water.
- Oceanic fish stocks and production are declining.
- Salt water now invades our coastal underground, its pressures reduced. Trees and people do not intake salty water very long.
- Coastal farmland areas for food production shrink with ocean rise.
- Confident phosphate-fertilizer supplies, essential for crops, are in decline.
- Energy-cost uncertainties discourage rural investments.
- Competitive invasive plants, animals, and related diseases loom large.
- Urban/commercial/residential development spreads over prime farmland.
- Genetic crop modifications threaten human production and consumption.
- Soils continue eroding and they decline in productive capacity for food crops for increasing human populations with increasing consumption.
- Nuclear warfare threats, if acted upon, results would contaminate all food, Earth-around. It looms large, a mystery no longer—certainty.

Wild flora or fauna do not even rank as being in a reasonable list of high-magnitude threats to world collapse. Threatened, ancient forests like the cedars of Lebanon will disappear before the last acres are used for trying to grow food. Goats will be notable livestock; efficiency and the need for their milk will rule.

We all must try to grasp a condition within the USA, for it affects thoughts about the future; in the U.S., 80% of the population is now in cities. The emigration is still a mystery to me; the rural-world "food force" cannot say quickly or loudly or enough: "Nation awake!" We will soon, before you know it, be out of food for daily needs… and our sources may be under attack, and polluted. Polluted or not, food-related attitudes, pressures, rights, and whole economies depend upon water and food-trends and available energy … and waste is criminal when people starve.

Maybe "things" have been so good for me and for so many people that we could not learn from the past that the present is not guaranteed. Our present is not captured in our genes; it is not heard within bird-like rules, such as: "Make a nest every year, no matter what! Deny efficiency, effectiveness, future dreams, diversity ... *do all* as in your genes, no questions asked … just fly; build one nest. Sing a singular song, clear and understood. That's all."

The needs are very great; every person, of all ages, is challenged (as in America's war-years scrap-drives) to "do something, take part in the fight!"

There are millions of people, among millions that may be counting on us (you, readers and writers) to act. "Just do something!" And we are fearfully aware of the major clump of superior projects needed now for the dark future ahead, including reducing births, tending those born prematurely, increasing nutritious food production for all children (shapers of *our* future), reducing consumption, reducing waste and increasing its residual uses (reuse, reuse!), increasing

solar energy production and use, and reducing pest damage… *all at once*, soon, fast, even though production systems are out of balance… That's all!

I do not really *know* what to do; no one does. I risk readers "turning-off" to such a big problem…to such an admission. I do not know how to make it small, and if I did, that notion would only partner with the failure. I do not know how to stop wars among countries, while protecting or claiming food banks and cleaning reservoirs for their starving people and collective battalions.

Otherwise, we are now little more than a mine camp, a temporary exploitative condition for a bunch of people, soon migrants or dead. We are a temporary group, one small society that would otherwise have neighborliness, trust, sharing, learning together, stable marriages, politeness, diverse ages, and a place of creative work, with each engaged in their real place of stable, adequate, built resources.

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"I'm not done," but I sense clear limits now, at age 83. What to do, and some processes as to how have been suggested herein, and I hope for groups of people that will create the systems and duplicate them for the future Earth, which has amazed me and given me and my family life. I hope the reader will take with them the messages for long, enhanced life, and the elements of continuing life within real, lasting constraints… some natural and more self-imposed and decided.

I so wish to learn from readers, to meet with people who can see a means for funding a Rural System or equivalent startup, approximately as described, dodging re-titled "ecology projects" and "sustainability," and working with inspired people who have comprehended the wholeness and computer power needed for a solution. An improved design, soon, will be useful.

I want action for benefits and normal longevity for my family. My want is selfish, but consistent in interpretations of nature. I want people to be reading and studying now, for there is little more time to read, create, and market solutions, Earth-around. A few great solutions will be consumed, over-weighted in importance, hailed as rescuer and survivor, over-grazed, over-exploited, and subject to crowding-stress… among the starving and cold.

Richly endowed, repeating in unison: "to whom much is given, much is expected." I now ponder one among many resources: classic soil richness, as sand falls between my fingers. I know that water costs more than can be afforded (in energy-coin) to be cleaned. "Pretty" costs 1,000 times more energy in the city than "anti-ugly" costs within the countryside. Few know the countryside "look" any longer… and do not seem to care… for today is tolerable and tomorrow is a nest for someone or something else to build.

"Urban" is nest-like. Gambles about food and water sources demand instant payoffs. We near an end that is not of our choice, but made of our neglect. We ponder in pain, and remember learning that education was once for today and tomorrow, for encouraging people to avoid past mistakes and limits. "Preparing" was for the future, using past discoveries and accumulated knowledge, inventing for fun… but especially for social good. Most all work was done for *social* good—the person, the family, the groups—small and large… *together*… *on Earth*, interrelated by elected governments, and aided in time by police, soldiers, an informed citizenry, and insurance.

Many people now know Earth and its scale and limits more than any past Earth-folks.[125] There is more abundant and better-recorded and presented information about the present and past than ever before. There are projective, probabilistic computer models that (unless rules of nature, such as gravity, are violated or suspended) mean we *know* what will happen in the near future.

We name the major parts of our world and realize that they are what's in VNodal. Yet, the "joins" and bridges seem obscure, fog-hidden. Our rural lands, more than "dirt," have social, economic, environmental, political, legal, historical, administrative and other working, living characteristics. All aspects are "organs" within struggling life forms.

Now, in days near the last reading of the last chapter of this book, I'm challenged by reviewers, even my daughters: "Dad, now that you're 83, what do you really want for Rural System? You've been at it too long. What do you want us and the readers to do?"

I am completely perplexed by their question. I have seen the answer: "Probably not!" I see no probable solution, given the power of forces involved and the eminent collapse… so I must:

1. lay it aside,
2. do something (thoughtful, planned… however ineffective), or
3. unite in someone else's action, despondent and suicidal.

I choose #2. The climate-change or Earth-change problem is too big to face, and must be left to others… but "others" may not be found—never previously identified, never a folk-story told. We need a superhero, one beyond comic-book extreme.

We can hope, as we expect, for many organizations, small and large, to attend to large problems (and we suggest rewards herein for such practice) … or else we must face and tally the equivalent losses. Collapse of civilization? We can avoid it; we won't! There's no counterpoising law of physics. Nowhere is the scope, diversity, and flexibility at work, with staff abundant enough, funded, equipped, or prepared for the speeding Earth-force, asteroid-like, oncoming global changes—those climate-based, and food and water shortages for a growing population.

There are hundreds of acts within which individuals may become involved to slow or reduce the perceived stressful food/water/population imbalances approaching rapidly in 2050 AD.

My respected advisors say, "Just tell us what to do!" At the personal level, I can, but I fear insulting your, the reader's, intelligence, by suggesting to not waste water or food, or to not add pollutions to your yard or cut grass too closely. I can suggest you encourage songbirds, beautify your yard and gardens, stop excessive energy uses, and recycle all food and organic wastes—all actions apparently quite personal and small, semi-trivial—and then advance and engage in the more general activities for neighborhoods and areas… whole counties and states.

I just cannot specify from such a list what's best for each person to do, for it depends on their support, knowledge, funds, and time—their personhood—as well as their environment. People are further influenced or limited by the environment of their affiliates, friends, co-workers, partners, and special "others," such as available experts for consultation about special sites and proposed practices.

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[125] A significant paper makes that message as clear as it can be made:
Ehrlich PR, Ehrlich AH. 2013. Collapse of civilization: can we avoid it? Proc. The Royal Society B 280, 20122845. Available from: http://rspb.royalsocietypublishing.org/site/misc/perspectives.xhtml

I learned, poorly, long ago, that "good advice" is active and well *given*, but the receiver must *take* the risks that accompany it. What I want you, the readers, to do is to work toward achieving the objectives of Rural System.

What I must tell you, or somehow show you as I have tried, is how to achieve annual profits—for a dynamic, long term (150+ years)—including a diverse supply of nutritious food, water, diverse structures, and energy resources from rural land and waters, while also achieving high quality-of-life index values. These values include individual and family financial stability and wellness, productive studies, high or positive recreation potentials, defenses, diverse access to services, and an expansive regional history. I must share with you a base plan for a regional, startup Conglomerate for 8 to 11 billion people on Earth by 2050 AD, starting now in 2017.

There are not as many personal-life years as you might think until 2050 AD and so, whatever we decide to do, it probably needs to be presented with an attitude of emergency, or perhaps high-efficiency, as in planting a field of blueberry shrubs for wine; it's time to get started for a taste that is in the future.

I'd like for you to realize that your loved one's farm is a wonderful thing, nearly precious… so much so that you and others around you might gaze with awe and appreciation, as done by visitors looking at vases and objects in internationally-famous museums. You probably know of, or have seen on TV, the modern mechanical monster marvels that now magically produce grain for our needed breads. *Those* owners are not leaving their farms for the cities. [Perhaps forgotten by readers of *Rural Future*, this book is largely about *absentee land owners*, swarms of them having left their rural areas for the cities. (This is still a surprise and challenge and wonderment to me, because the rate of specific food and supplies from rural lands and waters must balance with specific, recently increasing urban people's food and water consumption.)]

"Realization," here, includes learning about diverse rural life, culture, and productivity … and its potentials, now and soon. As you may detect, the present changing conditions sadden me, but I see bright, exciting, clogging-music kinds of potentials for people, pastures, and profits on the horizon. We have to encourage, even demand for the social good, superior urban management—a critical application of "urban ecology," as we deal with the rural-urban borderland.

Already, residents have aged into human sub-populations with no information (none!) about farm lands or their sources of food or water, or even about mega-topics on which they now vote in ignorance of residence. Even assuming that the people of rural lands know and understand their lands, nevertheless, global economic and political changes and conditions will not, cannot work for the state. Neither can such knowledge be sufficient for the remaining rural people, or for supplying the newly-settled urbanites. Rural System becomes essential.

Boil it down! What do I want readers to do? I want you, beyond wonderment and anxieties, to:

1. financially support Rural System advances;
2. lease your land to Rural System, if you are interested in your land becoming one of the described ownerships within Rural System;
3. stay informed of Rural System's planned, ongoing reports and knowledge units from the Rural System website and blog (www.ruralsystem.com);
4. help with advice and action in getting local assemblies to form, perhaps those already committed to global economies and ecological work at a grand scale;

5. teach others about new or novel approaches to project and program developments that might carry the Rural System messages forward; and
6. try to make it personal, that *immediate* and *new* are more important now than past disagreements, slights, and individual pique. *Time* is now a real enemy; win-or-lose is decided in 2050 AD.

Or, just actively select and implement (with personal or group expertise) one or more from the following options:

- Study this book, and work actively to conceive and develop a personal or small-group strategy (now or after advanced education) to improve or build a major part of the rural future in your area.
- I see a few people and small groups achieving great results. I hope that you will unite with others, and pursue yet-unseen, perhaps untested strategies to achieve the needed changes for your nation, perhaps as demonstrations for others, Earth-around.
- If you are a faculty member, a public health official, or a student, willing to work freely on one or more of the Rural System topics within this book, please get started on a project, and contact me for more ideas.
- Maybe you are already "into" all the dimensions of action suggested as needed herein. I regret any oversight of your successes, and will try to announce your progress (as I get Rural System well-implemented). Share with me your locations, or staff of projects, with Rural System concepts well-underway.
- Make a tiny start: graph the general system (Figure 1). Agree on a small objective, such as "plant a dozen trees at an urban border." Study the parts, and write about the losses and gains for the future. Were you successful? I hope to continue the Rural System blog, in which I may share your results… and our continued plans for Earth.
- I've referred to needed books and other resources (and I omitted many for many reasons—the resources behind some of the Groups I have planned are vast). I work toward building the Rural Knowledge Base (RKB) for the work ahead. Write to me; share with me in a growing library and documentary of ideas and interests.

As in getting married, I deeply fear the negative to: "marry me." I fear the conclusion, herein, and I want you to join me and other readers, and to start immediately. Please, work toward your personal best. I invite your additions to this file, and what it will do for you and the groups with which you work. We'll move toward opening, for you—an entrance to a grand display of meaningful, essential work underway.

We can send you a booklet on our plans for work within the Virginia piedmont region, a new project concept intended to address social and other, very diverse issues facing the people of the historically tobacco and cotton areas, facing new lives within the vast, piedmont borderlands of South-Central Virginia and Northern North Carolina. Only if protected very well, made clean, and marketed uniquely can this "now-defunct" region emerge as *the* food source for local, healthy people, and for superior food export to address nationwide or even Earth-around needs.

Gaining the Well-Developed System

I implore you and colleagues to apply feedback with correction and emphasis, related to the imagined corporate dimensions of Rural System in the near future. Study, vote wisely, comprehend the rural complexities of gaining and using food and other resources, and visit rural and border areas. Revise the current Rural System concepts and premises, and continue developing descriptive and functional units and system components within VNodal.

Stability and innovations are local, timely objectives. Make special emphases and acknowledgements, for they are needed for knowledge of effects and expectations, affecting, for example, rarely-used *sequence* phenomena in social, ecological, and business systems.

The International Role

I failed to study for the international role of Rural System, and to add a select group of insights needed for Rural System to be moved into open countries. Major nation-based war now seems inevitable to me, and will likely be closely related to resource-available areas, to water production, and to changing healthy-human birth rates, categorized by national sectors and urban sub-sectors.

I see now that we must move past *local countries,* and gain expert advice and help in comprehending the predictions of world food and water crises in *country clusters* before 2050 AD.

Rural System must be re-conceived and planned for dynamic nation-states, for they are always (it seems) on the verge of initiating war as a "solution," however narrow, minimally as a means to reduce local food or resource shortages of several types. In *Rural Future,* I described the beauty of "rural clusters" and their potential for the future. Failing Earth-scale description, I did not address the dynamic relations of nations—some with and others without food or water sources. Many are in monetary wars, some are naturally resource-diverse, and clean water sources are all variously disadvantaged or changing. Few are comprehending the carbon budgets needed within each country. Such budgets are now affecting country waters, wealth, and high-quality food supplies for humans and livestock.

We probably have sufficient "war-history" to construct an anti-war plan, and to find the approximate rewards to offer people to retard significant future losses of regional human health. I cannot hide my skepticism!

It's not very praiseworthy to greet "a catastrophe" land forecast with problems as diverse as any "biodiversity" estimate task. I knew it was coming; why was I not only not prepared but also had no descriptive words for the years past 2050 AD?

Perhaps another time in another book… but today I see, for the survivors, continued stress, high mortality, and success among military forces, scouting and outdoor groups, taught survival skills.

Everything in our rural areas are related, and these relationships are dominant in what we select for work. In the era of survivalist communities, we are limited, fully constrained by inferior water, difficult to get, and inadequate food, especially for the children, some now already at rest… forever.

Financial Source and Support

We know we cannot hand-off solution actions to industries, business agencies, or non-profits. More than "help" is needed; more than country-based curatives are needed. A new corporation is needed, one like the Conglomerate planned for Rural System. That Conglomerate

holds an answer, but perhaps it is too much to think about and worry over in this emerging pioneer stage.

Readers may help secure start-up funding for Rural System. As described, 7 million dollars is needed for the first 7 years, as a line of credit to implement VNodal and the first 50 interrelated Groups. Profitable status is likely to be gained in year 7. We shall clarify our objectives, establish leadership, continue staffing, rent land, form and combine Groups, and achieve first-order successes.

My request for you, the reader, is (with a company, group, or as an individual), to invest in Rural System for a few years until it is self-supporting and advancing daily within its stated objectives, first in Western Virginia. Perhaps you will continue investing, as Rural System begins expansion to South-Central and Eastern-Coastal Virginia, with nascent work on exporting the demonstrable, variable, functional system to adjacent and welcoming areas of the nation. We hope to then expand the ever-improving, feedback-informed computer models for inviting nations.

Significant, large, well-protected demonstration projects in each of the major human food-production and water zones seem like needed minima—exploratory, demonstration-scale action. Evident, modern problems with carbon-dioxide levels will require expansive test applications of our best current knowledge of air pollutants on plant food-production systems. Several major companies can hold or gain international prominence in Earth-success branding, by creating demonstration areas for combined Rural System Groups displays, demonstrations, and small-population survival.

Objectives will not be clear at once, but they deserve major work (feedback)… and must be area-specific. If they aren't, when shortages occur in areas, invasions and human predation will be called "war."

A union of ecological experts with their existing software might "coalesce." The problems have. The pests are watching. The schools question their questions. Now is the time (let's not debate) for widespread clean water and nutritious food for Earth's children.

Having seen ignorance and having seen "changed behavior," the basis of modern education theory, it seems feasible to use specific processes to achieve stated, measurable objectives for human survival… at least in large areas and for their people. We concentrate on education within PowerPlace, and wish for past insights that might prepare many of us for the survival-tasks *now*, and also very soon.

I was a child at the beginning of World War II. I collected waste paper, "tin-foil," and scrap-iron for the war… so I know it is possible to involve people in massive projects at the micro- or personal scale. There is a large set of Earth countries heading for war-like conflict over economic and political survival by 2050 AD. I write this year: 2017AD.

Regions and Nation-States

I've never aimed too high; I have met critics of past "dreams," and yet I know people who have been successful at implementing such dreams (as in system "standback"). Not a predictor, I appreciate the several computer statistical packages that help me see the past clearly as I try to understand it … and use such analyses in tomorrow's decisions about money, crops, populations, crime dangers, and likely equipment use.

It works! Computer-aided systems work, and others make decisions based on data … from the past. To "make decisions" is to take constrained risks. Computer analyses of "the past," while using many other factors and techniques, can significantly increase decision power,

improve timeliness and location selection, and reduce losses and costs, omissions, and failure rates. There is evidence—it works!

In the light of such enthusiasm, I also gain awareness of the darkness of computers, the limits of statistical power and the systems-approach (even its enemies[126]). I've studied, programmed, used computer programs of several types, and I understand system performance. I've faced the critics of such systems' work and fully expect criticism of elements of this book.

I shall not retreat to the "how do we know" unit of this book (Chapter 5), or to the difficulty of describing what "to know" means when it is achieved, by what criteria, and what you or any specific decision-maker will find acceptable or tolerable for decision-making (typically involving personal risk, matched with unknown risk).

I can't *know* the content of this book, only proportions, only stages in change, only after current impacts … only reasonably when making best-estimates or approximations, and being aware of constraints and limits … of estimated, changing, and well-modeled probabilities. The doors seem wide open for effective use of GIS for rapid changes needed for the geo-spatial-temporal units of the near future. Using GIS abundantly seems like a good idea.

A major parallel: I do not know whether the proposed Groups sketched and listed in Appendix 1 will "work," or become profitable. Some have not been implemented, offer no "ideas from experience," or will work only within the right context (not each one instantly, but within designed units, often in tetrads).

I cannot prove Rural System "will work." I am challenged by the meaning of the phrase, the expectation, the measure of required success, the listed components and Groups, the duration … the annual dynamic of any probability level. I want you to critique the text carefully, participate, and begin to implement it, hopefully with others, growing it into one or more useful, profit-based, commercial corporations for the public good—now and rapidly, smoothly, before 2050 AD and afterwards, without cease. I'll try to be helpful and continue investing, but time is now my evident enemy. I wish you great success … for the good of us all.

I try herein to summarize key points, wishing not to destroy whatever ideas, connections, and innovations might have emerged within you. I'd like for you to know my list of things you may have learned, and/or need to do:

1. How well-off we all are *now* needs mending and attention, and a sweeping awareness of a potential "good condition" is needed—the objective.
2. Studies now available tell that human population size and its increase are correlated to monetary "richness"; the greater richness for people, the lower the birth rate. We need universal awareness of the need for rational, humane human population reduction to levels that can be supported on Earth. Planned, healthy children must be encouraged, being born into homes of healthy, educated, resourceful citizens with high future life prospects and a role in society… but not beyond Earth-capacity. The energy required for population growth on other planets is unavailable. Birth control, by legal diverse means is needed, yet unlikely. Death procedures are intolerable; population expansion is also intolerable… for adequate food and other essentials will soon be unavailable… resulting in intense local wars of acquisition… and abundant, highly-stressed societies.

[126] Churchman, CW. 1979. The Systems Approach and its Enemies. Basic Books.

3. What to do? Stop thinking such thoughts alone, for there are not enough kindly psychiatrists, or clinical psychologists, to respond to addiction-related helplessness, especially if you are (or once were) parents.
4. Start thinking about desired local social conditions, targeting 2030 AD (water quality and quantity limits) and 2050 AD (food limits).
5. Tend the coastal children of the world, as ocean boundaries change, saltwater encroaches, and coastline vitality is threatened. Oceans, beyond comprehension, can be managed—subsystem by subsystem.
6. Work toward Rural System, for I have no other significant alternative.
7. Develop water capture and local filtration, since atmospheric water may become the least hazardous to collect and use. I am nearly certain that nuclear proliferation will now occur, and there will be known isotope consequences, those forgotten and now unknown, some derived and others hidden.
8. Develop small-animal meat sources, with rapid growth and low contamination.
9. Learn to manage a solar energy collector for low-risk, regular family needs.
10. Develop healthful, well-protected energy and food reserves. Re-evaluate energy sources and savings of all types; protect future sources from theft and destruction.
11. Watch wild fauna, because "all" will change and, together, the behaviors of birds and beasts will suggest the latest, best conditions likely available for average, observant citizens. The morning electronic note to a neighbor will become as natural as the new morning "coffee-talk" (soon to be a local plant tea), sharing observations of the local tree bud-burst, snow tracks, or feeder visits (phenological studies).
12. Cynical and skeptical of conventional education effectiveness, experts in national crises will likely invent, soon, a chess-like, total-environmental computer game, with widespread appeal and monetary pay-off for experts "winning," i.e., achieving international survival and quality of life. (For several years, I used my brief, programmed game in classes, the objective of the game being to stabilize the shrimp population in a coastal estuary.) Trivial-seeming, teaching the world-game is ahead, and may be helpful to some in crisis.
13. Declining social infrastructure will be noticed; it was "put-off" for solutions by future societies … and now "we" are "they."
14. We must not just be anti-crime, but pro-wellness, pro-wastelessness, pro-justice, and energy-attuned… the societal elements will become evident and actively discussed, because long-term society must become part of the national conversation for cost-effective life and survival. Every child must be in a home with hope for a rich, future life… all able to discuss with meaning for the future. ("Rich," as in, minimally, no longer suffering adrenal-failure and crowding-stress.)
15. It's now time for information on each major Rural System topic to be readily accessed. We must find and expedite access to topics to be placed into decision-aiding software—survival apps, the new Extension Service—to advance the systems needed.

16. A Virginia demonstration may be useful, moving simultaneously from Western Virginia to Southeastern sites (southern conifer forest and once-tobacco land), then coastal sites (encountering salt-water intrusion at the coast and continental crop-land).

I beg of readers to get busy … for our, *your* sake! All of us! Recruit owners, hire and assign staff, get many key Groups started, especially those serving all of the other Groups. (We know they'll not appear to be productive in their early stages of development.) Achieve your stated objectives, nothing else. Draft a plan for expansion to the mid-Virginia region, no more, yet, just a plan. Describe *a plan* for expansion within the Washington, DC area. Build a staff and a minor demonstration in the Southwest Virginia region within the first 2 years. We want all investors to understand, fully, the need for a *basement* to this thing, a system of systems (and to understand that minor, net positive returns, likely within the first years, will be used for development and growth).

In addition to timely releases of Rural System staff successes, we'll show annual reports, tours, and prominent on-site displays of our participation in the origins of Rural System and its successes. We'll be pleased for you to inform others of *our* contributions to the successes of Rural System and associated gains, and potential parallels and isomorphism of important, productive rural land and water. We'll be debt-free and very busy, adjusting to regional differences and climate change, also to land restoration, and to adding new tracts as emigration continues.

Flower and food exports will emerge from tall-tunnel, greenhouse-like structures and cultured fields, with paths through agroforestry carbon columns. Superior goat herds will supply milk and products for urban centers (as well as attractive weekend tourist events). New approaches to farm fisheries, recreation, food uses, compost, and nutrient application and sources (e.g., phosphate) will be explored. The unique elements of the regional topography, including soil and geology, will focus attention to regional museums and generate profit with broad education. PowerPlace, first developed for Western Virginia, will become a sharing, mutually-beneficent educational force in rural regions. And, at last, over 150 planned Groups of Rural System will be developed among local people.

An alternative drug addiction unit will explore contacts throughout the state, including new programs at Virginia Tech, community action, and with emphases on job growth, purposefulness-programs, and project action. As in Western Virginia, the elements of the book, *Rural Future*, will be on display and in use within key Groups and projects: diverse exercise for staff and visitors; attention to forest knowledge; carbon sequestration; walk-through gardens; flower-export gardens; medicinal and cosmetic-plant gardens; pond fisheries and contests; dog parks with energy units; camping/hiking for girl and boy scouts, families, and other groups; and multiple, small amphitheaters with programmed units by school theaters and art centers.

We may feature educational and "special' evening flights of bats over pond units, evening butterfly experiences, earthworm density discoveries, and insects of the tall canopies… as elements in an entomology program, to expand, share, and describe the entomological diversity of rural regions for students, visitors, and publications. In aquaria and terraria, we may display the fauna of the lands and surroundings, and explore fish exports for guests and the greater region.

"Excessive-sounding" to some readers, the proposed work is that of developing—for all who wish to become a part—*a diverse rural economy*. I want you to join me in starting a regional company, expanding with hard work to improve natural resources, make money, add employment, and stabilize it for healthy families and communities within Western Virginia, for

later expansion. There is a crisis in the farmlands of Virginia, as farmers age and move. Farmers need new ways to deal with farms, farming, and the total environment of Virginia—all, soon, smoothly, uninterrupted… almost a revolution.

Virginia has about 47,000 farms and we, within Rural System, need to work with at least 20,000 of them to contribute to farm income and the welfare of Virginia. I want to talk to the absentee land and water owners. There are half as many farms now as when I graduated from Virginia Tech. I want Rural System to work for them, and to bring about 260,000 acres into lasting profitability and superior, modern management.

A few lawn owners that I know say to lawn companies, "handle it, handle it!" (the whole grass, soil, water, and pet thing). I want many people, especially the absentee owners or others at work on other projects, to have Rural System handle it!

We can build the "brain" of Rural System now. The brain, VNodal, will present a prescription for what needs to be done to meet owner needs and limits, to achieve a list of benefits… and pay the owner for gains achieved toward profitability. We're at the verge of having no more average recommendations—no more "teaching" you about your land (for within computers we have built a growing knowledge base). Now, a computer-produced prescription (with your constraints and limits included) can be used for a payoff. Help me to convince many absentee landowners to bring their lands under our precise work… achieving profitability and restored land for the people of the future.

A Future, Just Any One

I've tried, but I fear failure, not of itself, but the results. I write to convince people of the Virginia region—and hopefully the USA and abroad—of the immediate needs for action to prevent the collapse of society likely by 2050 AD. I fear failing to stimulate the creation of several small Groups, to work actively on changing rural conditions for the near future and creating the systems described herein for immediate action.

I once wished that there was one way to solve the problems of human needs that I see ahead. I know there are effective skeptics and hero aspirants… free to be aloof and positively uninformed, never having stood in line for happiness or survival.

I "delay" raking up leaves from the yard, but that is not the "delay" of not preparing for the future food and water needs for my family, or for funding a responsible organization with which I can work to implement, direct, and develop active elements within 190+ countries, as we lurch toward thirst and inadequate clean water… even to enliven the crops for our now-hungry children. We now selfishly lower our own quality of life, as if residual amounts after atomic weapon "testing" have no effects. "No known effects" is the specific designation for ignorance present.

"Tell us what to do," I've been told. I won't now, for you are too special, unique, and within your selfhood, you, personally, will find the serving action, right name, right amount, situation and sequence… for you. I've tried to suggest solutions, some small ones in an additive role, others highly social, others highly electronic or mechanical, and most requiring surrender or delay in test runs... to gain rules and combinations for the future.

Now we must, as never before on Earth, tend-well the children and respect-well those who understand the collapse of civilization. We can work together, and use procedures and concepts for stabilizing low amounts for food for carefully-social, carefully-fed, assiduously safe, and energy-wise citizens… of all countries, as friendly neighbors… for it is a small Earth

with large, polluted oceans, and limited land for a yet-growing human population (many members of which cannot read or understand modern "crisis" or "collapse").

"Tell us what to do," I've heard again, several times. I don't know; only you will know… later. I stumbled over the title, *"Rural Future,"* very early, in the Rural System elevator speech. The book has been about Rural System, but also about the past and present, what *can* be done and what *needs to be done*. But, do only what is "right" for you and your family, as you learn together about rural history and perceive the difficulties likely ahead… but hopefully with inventive courage, and responsible, effective action for *all*. We all will struggle. Those who struggle less will discover historic roots in access to abundant water, energy, human knowledge, human strength and ingenuity, social skills (leadership and group-forming), and access to transportation… all known from history, now re-suggested for Earth tomorrow.

We just have to create a new foundation for a working system, soon—one evidently full of happy, story-telling, dancing people … sharing and working through it all, again… after 11,000 years when pre-settlement people slid off the Eastern Canadian glacier, ate passenger pigeons, chestnuts, box turtles, frosted persimmons, and cherries, and rode horses in the coal country of Virginia.

What to do? What is the best action for you? Of high value will be learning about yourself and human history—Earth-around—but with local intent and analysis. Evaluate your strengths and those of the modern family, it having changed or emigrated. There are elements of the systems approach, very relevant to the new city as well as the arms and areas left behind. We need Rural System very personally, a new corporation devoted to its system objectives of:

1. Achieving and enhancing the history, beauty, and future estimates and interpretations of the rural region;
2. Generating meaningful human work with appropriate payment for such work;
3. Stabilizing and building the strength of small rural communities;
4. Improving lasting natural resource restoration, enhancement, management, and designed profitability (long-term and bounded); and
5. Conducting studies as needs are discovered.

I have only a few inappropriate words, associated with beneficent, altruistic comments about Rural System. It is asocial, dynamic, likely having small failures and "over-looks" that will be called "personal-slights." I and others will never survive the diverse wrath of the "scientific community," topic-aligned-individuals working with fervor on their perceived system parts, for which I give praise and recognition where possible. I never intend slights or oversights.

I see a future, and I've shared in this book what I see. More than "just a book," or another claim "written in the wind," I've worked toward an understanding of what people face in the near future. I've tried, compelled, to understand—for good reason—what's ahead, for my daughters, and all other Earth's people, as they find or make their place. I write from my history, age, studies, experience, concern, and confidence. I write in modern technology and willingness to share what I have to offer, for an extremely large, complex, intended *mastery* of Earth's places for people. Warned of over-confidence, over-generalizing, and overlooking small, pivotal points of history and shared knowledge, I now seek the rationale and answers from helmeted-risk-takers for rejecting the global risks ahead: too little managed water to sooth the hunger pains of inadequate foods. People, in pain of all sorts, deny "high quality of life," easily discussed and difficult to define.

I suspect that, more than reasonable, *survival* is a first-order criterion for people. It can be rushed but must now be planned and scheduled by the means I have shared with you. *Rural Future* is now here for *our* future—all of us, for the whole Earth … since few in the past have had the resources or reports for tests. We have vast histories, libraries of thought, studies, diverse Earth experiences, images, and a world of computer power for real solutions and preparation for the future Earth Society, with only one key shortage: *time.*

Be brave; be kind.

Appendix One

The Future Rural System: Sectors, Groups, and Major Projects

Groups and their projects in tetrads are likely to become enterprises working on or around the leased rural lands of absentee owners.

"Well what about…?" is part of a question that gets in the way of almost every attempted description of Rural System. I try here again from one angle.

I have a plan, one that I continue to develop, to help significantly improve the contributions of rural areas in Virginia, and beyond … to Earth. In Rural System, we shall help meet the needs of landowners leaving rural areas for assisted living, and those following their families toward urban jobs and conditions. We shall help some owners form "clusters," or Collaboratives, for significant financial reliability and gains. We respond to the great needs of people for jobs, and to do that, combine with lasting purpose enhanced education, community strength, and diverse resource-related opportunities.

Rural System is designed to contain Support Groups: The Land Force, The Lands Group, System Central, and Safety and Security. All are seen as related, mutually supportive, and profiting together in an agriculture-like, modern rural "Conglomerate." Only a few of the Groups are likely to be within conventional, well-known types of land-based farming.

Rural System is designed to work well on the lands and waters of absentee owners who have left for the cities. It's for unoccupied land and all other aspects of the evolving rural area: its appreciation, uses, and products. The list of Groups is a set of ideas about potentially-profitable enterprises for rural areas, for achieving Rural System objectives… motivated by profit for the long-run, for the land owner and Rural System, and for the good of the region.

As you have read, some of the Groups are land- and water-based, while others are quite varied. They are believed to be feasible, practical, but only likely to succeed when cast within Rural System, by design, intent, and with enormous amounts of well-linked work. The main characteristics, about which you have read, are:

1. a general-systems approach;
2. diversity of scope and scale, dynamic and with feedforward;
3. land- and water-based "approaches," but others as well;
4. precision practices (computer-generated decision software aids with GIS and GPS);
5. single-ownership decisions, plus clustering of contracted land ownerships;
6. using published research findings, and engaged in studies;
7. using value-added ploys throughout;
8. using intensive, widespread, computer-aided marketing and careful branding;
9. using services of System Central, The Land Force, and The Safety and Security Group, with shared working teams and equipment;
10. making widespread use of transition functions, expert systems, and with a rationally-robust strategy;

11. using diverse time-scales, with historic input and planning for the future in 10-year increments, over 150 years;
12. working from a bounded-profits objective;
13. employing "lean" strategies with production efficiencies; and
14. employing a modern "Cooperative" or "Conglomerate" strategy.

We unify these strategies, in response to a growing population of people who have moved from rural lands. We plan to meet the needs of people left behind for many reasons and to achieve major gains over the high "poverty walls" around us, partially by using new tactics in addressing addiction and poverty.

Herein is a changing list of over 150 Groups planned for development within Rural System. Each Group will be very independent, but share in the financial successes of the Conglomerate, rewarded by cooperative efforts with other departments, and contributing to unified financial successes. Each staff person with these Groups will be engaged (within their major and/or professional field) in the list of Rural System objectives. Successful, diverse marketing and creations are expected for profitability within the Swarm (Chapter 2).

Numbered Sectors, below, are temporary organizational placements for the Groups. Each Group has a corresponding 2-8-page descriptive file,[127] suggesting a prescription for the landowner to consider after his/her request for land advice. Each prescription is followed in the file by parts of the rationale. Only minor introductory comments are shared here.

There are 6 Sectors (roughly similar categories) and over 150 suggested Groups. Some of the Groups have been discussed elsewhere within *Rural Future*.

Sector 1: System Central

1. **System Central** is the administrative unit of Rural System. All leadership employment, record keeping, accounting, insurance, and "paperwork" are handled through this unit. Large computer systems are also maintained.
2. **The Collaborative** is designed for developing and improving a lasting enterprise, working locally, then regionally and internationally. It may have significant influence on the conservation, preservation, restoration, and management of natural resources and the people dependent upon them for a system of modern, sophisticated, computer-aided natural resource management.
3. **The Water Group** performs Crescent management on all enterprise environments, working for ready, assured access to the increasingly scarce and variable water resource and its benefits for Earth's people.
4. **The Drinking Water Group** tests and maps sources and supplies of drinking water throughout the region.
5. **The Groundwater Group** stays in touch with national groundwater resource data and attempts to relate it to changing surface water supplies and dynamics.
6. **The Healthy Streams Group** works closely with The Water Group and The Fishery to manage streams on enterprise environments for multiple benefits.

[127] The full text for each can be found at ruralsystemguide.com.

7. **Land Partnerships** – Forming a legal partnership is a way to get a cooperative approach to manage rural lands and to preserve the integrity of the larger ecosystem, developing and aiding "clusters" and a new organization similar to agricultural cooperatives.
8. **Ranging** is a word for action together for all dispersed outdoor recreation and related activities. It is a new form of soundly-based, diverse, regional tourism, eco-tourism, and sightseeing, combined with most forms of extensive outdoor recreation (hunting, fishing, archery, boating, swimming, hiking, biking, camping, climbing, birding), outdoor projects, events, memberships, shows, contests (e.g., triathlons), and games. It is for residents as well as guests, some called "ecotourists." It is a planning, guides, media, and coordinating enterprise.
9. **The Base Group** is a marketing Group promoting all of the enterprises, a mini-chamber-of-commerce seeking memberships, affiliations, and attendance at conferences and other participation.
10. **The Insurance Group** provides a few experts to handle the complexities of modern recreation, land use, health and other special insurance for the public and for all members of all of the Groups. The Insurance Group seeks comprehensive knowledge and efficiency over services dispersed within each of the enterprises.
11. **The Wealth Management Group** assists land owners over the complexities of forest and land taxation, investment strategies, and land trust decisions, all affecting risks and annual decisions about planting, timber harvests, building improvements, energy conservation measures, funds for college tuition, and inheritance estates.
12. **The Law and Justice Group** offers and contracts a wide array of legal services for rural residents, ranging from land sales and trust arrangements to protecting clients from unknown laws and regulations and impact-condition violations.
13. **The Rural Knowledge Base** (**RKB)** has unique international library and database connections that allow superior reports to be prepared on almost any rural topic. Results are useful in management, research papers, legal briefs, and in work with The Memorials Group and others that contract for books and marketing documents being developed on assigned topics.
14. **The Statistics Group** advises and makes functional the published indices, e.g., related to diversity, spatial analyses, and population dynamics.
15. **The Lands Group** collects information on lands under Rural System management for landowners, and as input to VNodal. It takes care of boundary dimensions, maps, and photographs, essentially managing a profile for each enterprise environment. It works closely with The Realtor Group to ensure management is proceeding optimally to improve land value. The Border Group is consulted over disputes between neighboring landowners, and within clusters.
16. **The Realtor Group** locates desirable sites for clients, and helps owners sell lands and facilities to those with special interests. It provides exceptional information about land via RRx documents and links, increasing land value and the means for its improvement and development … or resale.
17. **The Marketing Group** coordinates marketing efforts for Rural System and all of its Groups.

18. **The Guides Group** is a group of bonded, insured guides and interpreters, available to safely conduct individuals and groups to meet needs of all types within the region, as related to Rural System objectives.
19. **The Transportation Group** coordinates Rural System's vehicles, and explores topics associated with transportation and its impacts on wild flora and fauna (such as transport of invasive species, pollution, and habitat fragmentation, but also technology for improved energy efficiency in transportation methods).
20. **EarthQuilt** provides advice and connections for failing communities and groups, helping with suggestions, information on past successes, and opportunities for working ideas. It works with The Rural System Foundation.
21. **The Rural System Foundation,** a nonprofit, was often recommended in the early days of the design of Rural System as "the way to go," rather than "for-profit," since Rural System was so evidently interested in environmental topics, in conservation and improved land use, and had strong educational, health, and poverty-reduction components. Sticking to the "for-profit" theme, an alternative was developed for an internal foundation dealing with esthetics, education, conservation, environmental improvement, and research.
22. **The Safety and Security Group** provides a variety of aids to Rural System landowners to protect them from fire, theft, vandalism, and trespass. It installs hardware, patrols, and conducts modern education on safety and security topics (in collaboration with PowerPlace).
23. **The Health Group** concentrates beyond the natural resource-based part to deal with the human health aspects of the system. We approach human aspects as part of system objectives (socioeconomic, value systems, esthetic, recreation and ecotourism). People in rural areas need to know about healthful gardens, diets, exercise, avoiding trauma, and how to gain emergency treatment—all to reduce loss in the profit equation for rural life. The link to The Safety and Security Group in preventing accidents is clear.
24. **The Communities Group** of Rural System is focused on meeting our community objective, and on providing annual reports with information about Rural System's impact on employment rates, health and wellness, and quality of life. It looks first to see where the heart and soul of a community is, where people gather and what they value. It gathers data about conditions in communities near enterprise environments, consults VNodal for prescriptions to improve those conditions, and works with other Groups (e.g., The Health Group, PowerPlace, Advance Group, The Land Force, StairSteps, Elves, Inc., The Border Group, The Foundation, etc.) to enact those prescriptions.
25. **The GIS/GPS Group** tends to use the Alpha Unit concept, seeing land as 10 x 10 meter squares (with other vertical dimensions), and, from past work and data sources, maintains a knowledge base of over 100 factors about such map units. Handled within a computerized Geographic Information System, such data can be transformed using statistical models into site-specific values, such as "probable suitability" or "likely production," and mapped for use in the field and elsewhere. Most field-related Groups use the services of this Group in planning, precision management, impact analyses, and legal action.

26. **The RRx** (Chapter 4) provides information and guidance for making difficult, multifaceted, high-risk land use and development decisions that have long-term rural effects. It is now in Phase 1 for a dynamic planning system for large areas and an alternative for land-use "zoning." It emerged from work with TVA, U.S. Naval Surface Warfare Center, and with a county-level comprehensive planning effort. The RRx system is planned to produce a dynamic plan for a landowner, available from a secure Internet site. The landowner will be able to call up his or her plan at any time, see color images, photographs, graphs, maps, and the latest information about the area and the plan. Models for components of everyone's plans are managed and improved from a central office but each person's plan remains directed to their personal objectives and local conditions.
27. **VNodal** is the data storage and prescriptive software system organizing Rural System. It is essentially the brain, compiling decades of research to provide prescriptions for optimized management actions on Rural System enterprise environments. The software stores data spatially using GIS software, and uses complex algorithms to analyze the data and make prescriptions. VNodal directs both intra- and inter-group operations, determines what groups will be active where on enterprise environments, and how enterprise environments share resources in clusters.

    VNodal is a large, complicated system under continual development. It can produce a daily prescription based on a plan for each of many areas. It has people, space, past research findings, computer software, databases, and hardware all working to produce, on demand, a "document," a daily prescription for action by the Land Force and others. VNodal holds that a total natural resource system, if managed very well for profit, can be sustained and made profitable into perpetuity. The working premise is that only a profit motive (or self-sustaining financial motive) for a complex, modern, private enterprise can assure superior, ownership-specific management recommendations.
28. **SBNodal** is an all-in-one business management solution. The "Small-Business VNodal," or "SBNodal," was proposed to serve each of the many Groups of the Rural System Conglomerate. SBNodal will deal cost-effectively with contact management, email management, document management, project collaboration, telephony, scanning, and more. SBNodal will be designed as a single business solution—a small subsystem that can manage these communication activities and bring separate reports or business documents for staff and board members, and then other relevant parts to system landowners, Land Force members, the public, and to market decisions.
29. **The Software Group** objectives are to find, acquire, and make useful functional software, matched-well with the objectives of the conglomerate, serve individual enterprises, and press to meet all software and simulation needs and financial opportunities.
30. **Inquire** is the unified laboratory and laboratory referral service. It may be included within VNodal but sells specific services in soil, water, forage, seed identification, and toxic substance analysis. Cost-effective work and notable marketing set off the enterprise. It is closely affiliated with The Foundation. It develops applications of Ecorods.
31. **The Energy Group** works with and promotes the leading paradigm of rural resource management, that of energy budgeting. Concentrating on "embodied energy," the energy required for an object or idea to be produced and exist (the major energy equivalent), the

Group does optimization to meet needs in long-lasting objects or produce, with minimum energy inputs. Antiques, for example, are highly prized and usually have been temporally-, energetically-, and monetarily-costly to produce. Special tools help do work, and those that are costly to produce (e.g., stainless steel). Lasting objects are favored for their embodied energy. Solar radiation is carefully mapped (GIS) and studied for maximum crop yields. Energy analyses are arranged for structures.

32. **The Carbon Market** studies the carbon sequestration or storage policies and opportunities for carbon credits throughout forestry, gardening, and rangeland and pasture developments. The Group studies carbon estimates for water, soil, litter, grasslands and corps, and forests, and collects or creates models for pictures of likely carbon "sequestered" within each ownership over time. It advises on carbon credits for land owners and how they best fit in land-use, and in energy and financial budget optimization.
33. **The Waste Management Group** works to ensure proper waste disposal or use for all Rural System clusters and Groups. The Group seeks to reduce waste, to determine opportunities for reuse, direct organic material to Alpha Earth production, and to recycle wherever possible.
34. **The Zeta Group**, or international program, is a company promoting the expansion of Rural System internationally. It studies the ecological potentials, the legal and financial limits, and works to assist localities to implement Rural System locally. Its premise is that the only major changes in the mapping and software dimensions are those of translation and changing coefficients for models that are in use. It works with the RKB to capture "folk knowledge" for the prescriptive systems.
35. **The Reach Group** has members who are not authorized to speak for the Group, but are encouraged to raise questions and, as stated, "share concerns." The Reach is within Rural System and seeks to strengthen the rural economy, starting in Virginia, going internationally, but responding specifically to about 50 million Americans.
36. **VNext** describes and promotes the Rural System corporation for its near future. It is a special marketing, advertising, and promotion Group, selling not the Group itself, or any other particular Group, but developing the Rural System concept as a whole, its uses and utility with stable, professional backing.
37. **The Land Force** is Rural System's workforce, shared among clusters and sometimes also among Groups. The Land Force is responsible for carrying out management prescriptions (RRx) on rural lands and waters.
38. **Advance** is imagined to be a small Group within Rural System that assists the public local courts and affiliates in achieving supervised community service work for individuals—work that is required and is constructive, meaningful, and planned in the region.
39. **The Work-at-Home Group** is built on the increasing awareness that many employees do not need to work at a central office or plant. Many can work efficiently during many days each week from their homes, or from local central places. Computer programmers and others can correspond by voice and image worldwide via the Internet to deliver products and to make conventional business arrangements cost-effectively. The company arranges procedures, finds willing participants, and monitors work performance.

40. **Competency** is a Group that assures employers that rural workers have the competency that they assert. It is skeptical of "grades" and "diplomas" and overly diverse programs of study, and conducts field tests of individuals for certification to prospective employers in ability to perform each of dozens of small tasks – some in the field, office, laboratory, or computer.
41. **PowerPlace** is a plan for unique, physical educational spaces, learning/teaching facilities where high-intensity education is done. While augmented with distance learning, the spaces emphasize essential human contacts, physical materials, and group situations unavailable by modern computer-based education. These are spaces where advanced research findings flow to give greatest possible individual behavioral change per unit time and per unit dollar.
42. **The Studies Group** conducts diverse research studies in collaboration with PowerPlace and other Groups.
43. **StairSteps** works from an office in a rural community where it maintains a private, for-profit employment service for people with special talents and abilities who seek part-time work. The business model is somewhat like that of Uber. The members (often in tetrads) choose to work whenever they want, for as many hours as they want, and there's no need to ask anyone for vacation. They are a new type of consultant, often with *many* skills and talents (as is common within rural settings) and willingness to work alone or within small groups.
44. **The Histories Group** works to complete records and use them in historical and ecological analyses and projections, ensuring such documents are a part of the history of each region, tract, or ownership.
45. **The Signs Group** creates signs and puts them in correct places. Signs can be used to create Group branding, and used to maintain awareness of hazardous areas.
46. **Stoneworms** is a trail building and maintenance group. It relates with national and international trails but builds trails on local lands that provide for recreation, education, and solitude. Stoneworms creates specialty trails for hiking, horseback riding, and mountain biking.
47. **The Border Group** will coordinate rural-urban border management actions, and resolve any planning conflicts that arise. The urban and regional border is a place of growing conflict and difficult problems. As homes and shopping malls proliferate, the United States loses about 6,000 acres of open space every day, four acres per minute. Border area development is among the most important in the world.

Sector 2: Forestry Topics

48. **The Forest Group** affiliates with existing forest inventory and management enterprises, helps market their services, and expands on their potentials by the Tours Group, Nature Folks, Certification Group, Fire Force, and others. It has a primary role in dealing with the part of lands with trees and can be a major income source. Their role in the probable increase in financial productivity over the long-run is notable.

49. **The Foresters** is a local organization for Rural System staff, associates, colleagues, school children, and anyone interested in forests and forestry. The Foresters cover all of the forest-related topics related to Rural System enterprise environments and their problems, values, benefits, management, and use. It is a means to promote the forests, reward successes, and increase communications. The Group provides tours, an annual conference, advantages in clothing, books, and equipment purchases, website access, recreational advantages, and discounts on Rural System services. It may become affiliated with Nature Folks. Income is from membership fees, advertising, conferences, tours, and commissions on publication and book sales.
50. **The Certification Group** promotes and arranges for cost-effective forest land certification under Smartwood. Smartwood is a recent development in forestry and wood processing generally. The Rain Forest Alliance and the Forest Stewardship Council have developed a set of criteria for well-managed, sustainable forests. When a forest meets the criteria, it may be certified as environmentally sound. Special attention as well as economic incentives follow. The Designation significantly increases the value of the forest products from the areas, initially by about 5-10%.
51. **The Fire Force** as part of The Land Force, adds to the quality of the Smartwood certification but deals with prescriptive burning for select silvicultural needs, pasture management, and above all provides a superior emergency attack crew to fight against rural fires, typically non-structure fires. It engages in prevention, clearing buildings from threats, and serves as a local "hot-shot" crew for rapid attack of fires. It continually monitors the literature for new insights into fire behavior, arsonists, and attack efficiency.
52. **The Firewood Group** provides superior dried species-specific firewood to urban and residential markets from Rural System forest tracts. It studies and may become involved with biomass production for energy needs.
53. **Holiday Trees** raises superior "Christmas trees" with the distinct strategy to appeal to many people of different religions during the holiday season. We may contract with growers for special uses of their lands. Beyond "Christmas Trees," the Group explores a market for trees sold seasonally for other purposes and profits.
54. **HyperHardwoods** is a Group applying a systems strategy for managing hardwoods on Rural System enterprise environments, which must be managed over many years for optimum wood-quality.
55. **The Chestnut Group** seeks to work with existing organizations now developing American chestnut orchards, hybrids, etc. Involvement ranges from nursery and tissue-cloning through crop marketing and expansion of working orchards.
56. **Walnut Vales** is a group using GIS to locate superior black walnut growing sites. It then attempts to secure or rent such sites and to develop superior, well-spaced trees for nut-fruit production as well as furniture wood. It develops sites, gatherers, husking centers, waste disposal and alternatives uses, and manages the sites for high-quality wood, nut, and nut-shell products.
57. **Antique Nut Groves** will select a species suitable for sites with good growth potentials and abundant nut production. This is evidently a demonstration of a lasting concern for and investment in the region. It is an emphasis on a high-valued crop (like tobacco) of international (potential export) interest.

58. **The Cedar Group** operates to preserve, enhance, develop, and manage a Virginia red cedar resource. It exploits a new single-species strategy in natural resource management, one intimately linked to all of the other Groups within Rural System.
59. **The Arborist Group** specializes in work with individual trees, especially those of the residential and rural village landscape. Involved with tree health, it is also concerned with developing wild fauna habitats, reducing convective energy losses from buildings, recycling leaves and debris, and finding alternative ways for enhancing land value.
60. **The Wilderness Group** helps use well such areas locally that occur on state and federal lands. It is keen to note private tracts that have wilderness-like characteristics, and to seek reasonable protection for such areas in the midst of intensively-managed forests on adjacent land. It is a key unit for many members of Nature Folks, sponsoring wilderness tours and diverse events.
61. **Earshot** is the soundscape Group. The Group works with Nature Folks and listens for and records the sounds of nature, such as the calls of birds and particularly the night sounds of amphibians. It forms a paying membership; issues a newsletter; sells equipment; sells tours; and provides certification services for industry certifying certain noise levels and changes resulting from management, private groups promoting a quieter space, and sales of services for quieting situations (such as buildings, dog barking, individuals, and equipment). It utilizes research on noise attenuation resulting from vegetation. It uses GIS to analyze gun shots to assist in law violation detection. The hunted zone and its gun noises (randomly distributed gunners) are mapped for general interest. Locating houses and recreational sites can be done with noise sources in mind and measures (or topography) selected to reduce effects of noise on people.
62. **The Odorscapes Group** works to detect and understand the odors (microparticles, including gas molecules) of substances. It provides services for analyzing the potential impacts of factories and developments on natural areas and other rural areas of importance, and developing a rapid analytical system for expressing likely olfactory impacts. It analyzes wind and its effects within ecosystems, including timber harvest patterns; works with scenting security and hunting dogs; studies baiting; and assists in rural law enforcement and hazardous material detection and cleanup. It presents regional floral odorscapes and quantifies the seasonally-changing fragrance (and allergens) of gardens.
63. **The Viewscapes Group** works with visual concepts of the rural culture. It maps, describes, quantifies, and develops scenes, themes, a county beauty index, and a procedure to negotiate balancing losses and gains in natural beauty that may result from proposed development. The land of the Central Appalachian region is already beautiful, but that beauty can be enhanced. Even more important, it must be managed so that it is not diminished, and so that the full messages of the Rural System and of a system of total land management can be carried forward onto other lands. Staff develops plans, policies, and procedures for esthetic enhancement and management that will give the lands of the enterprise a personality and will assure benefactors that their lands will be similarly treated. Not another 'park service' or 'forest service' appearance, the new 'look' of the Rural System lands under its stewardship shows care, attention to studied concepts of natural beauty, cost-effective work, diversity, sustainability, durability, and functional amendments to views and scenes.

64. **The Landscape Group** of Rural System links well with the Gardens Group, and concentrates on the broad field of the home or office garden, yards, and vegetation… but also the vast scapes of the rural areas under management and effects of nearby national and state-owned public lands.
65. **Elves, Inc.** is a modern sophisticated program for creating, restoring, and managing cost effectively scenic, healthful, nature- and tree-dominant communities of rural towns. It is likely to require a cooperative, a business or public/private coalition, or a conglomerate to achieve the benefits of diversification and synergistic relations. The results are *Elves lands*, the more natural managed spaces of trees and shrubs, landscaped spots, streamsides, ponds and their borders, and, in coordination with Viewscapes and The Border Group, areas at the borders of towns and cities.

Sector 3: Wildlife/Nature

66. **Nature Folks** is a membership organization like the Audubon Society. It has many special-interest parts, listed below. It caters to people with diverse interests in nature, in unusual spots, in wilderness, and in invertebrates and "creepy places." It manages an electronic bulletin, conducts tours, and promotes studies of phenology (the timing of biological events such as flower burst and leaf fall).
67. **NatureSeen** collects observations of nature rarely reported elsewhere. Electronic storage at low cost allows nature observers worldwide to prevent the loss of unique observations. A search procedure allows subscribers to benefit from these usually-singular observations that may form a pattern over many reports over time. Born of a rich, novel curiosity, the reports offer unlimited ideas, a story-fodder for writers.
68. **The Coyotes Group** conducts tours of areas to observe coyotes and foxes, usually by use of electronic recorders at night. It builds a community interested in the wild canids of the world, and sponsors tours to build life-lists (akin to the well-known bird life-lists).
69. **The Foxes Group**, more-so than for other species, will require special attention to allow and provide human recreational viewing as well as diverse alternative uses in pest control, hunting and trapping, rabies outbreaks, and as predators in ecosystems.
70. **The Owls Group** conducts local evening tours for bus-loads of people after a restaurant dinner. Owls are "called up" on managed Rural System enterprise environments, and later people enjoy evening entertainment. Owl research is sponsored, and tours are arranged for those seeking a life-list maximum for seeing the owls of the world. Sculptured owls are sold from The Sculptors Group.
71. **The Plant People**, also of Nature Folks, specializes in the non-tree wild plants. It creates special gardens, conducts tours, sells plants and products, and sponsors art and poetry contests. The Plant People monitors plants, caters to knowledge of the plant populations of wilderness areas, and promotes life-list progress for members. It harvests plants from areas about to be destroyed, covered by construction.
72. **The Butterfly Band**, of Nature Folks, is the insect and arthropod company seeking to maximize profits from insect-related activity, primarily that which is related to moths and butterflies. Expressing interest in biodiversity, a national and international concern, the Band seeks to learn of the ecology of the insects of the area. It deals with pest species, but

caters to bees and honey production, biological supply of house products, and tours for those making collections and additions to life lists.

73. **Prospectors** is the geology enterprise of Rural System. It works with GIS maps, collaborates with soils specialists, conducts educational tours, and provides specialized groundwater and mineral resource analyses for Rural System area owners.
74. **The Fishery** is a large, diverse group with separate talents for pond and lake work as well as those for stream and river work. It builds communities of managed farm ponds within an area, offering diverse private land opportunities for recreation as well as food. It sells opportunities, film, supplies, memberships, guide services and educational materials, does analyses of ponds, lakes, and streams, and markets, relating to trail and wilderness interests and fish production. It conducts a growing wild-fish life-list-building enterprise with aquaria and equipment sales.
75. **The Raccoon Group** is new. Few people realize the complexity and relations of the system relating to raccoons. We must apply findings of many studies, not just on the biology of the animal alone (the past trend), but on the total profitable enterprise. The prospects are not for recreational trapping (strongly opposed by some), but for a viable, profitable enterprise utilizing one of the natural products of the Rural System areas in ways no one else has been able to sustain in the past. This is a single-species system, related not only to furs but also to several types of hunting and related hunting dogs, and to population management in forests and wetlands.
76. **The Furbearer Group**, clearly related to The Raccoon Group, is primarily interested in profits from a fur enterprise. The Group's strategies include marketing of furs; strategic buying; improvements in trapper success and humane taking; improved care of the pelts; storage; local cutting and trimming; and alternative uses of each entire carcass. Fur markets seem to fluctuate due to style and other phenomena. We propose to work with the fur industry, seek new marketing strategies, avoid public confrontations, retain a private-for-profit stance, diversify the work of the group, and demonstrate the potentials of storage to achieve sale when prices are high. Work will include sophisticated research (expected to attract visitors and students), and develop memorial books about furbearer species; furbearer workshops for biologists; trapper schools; vertebrate pest damage management schools; and fur-buyer classes. Software development will enhance some work, especially as studies show how ecological communities (that support each furbearer) change over time. The Furbearer Group will create maps depicting trapping zones, the presence of animal sign, species conflicts, profit per unit area, and costs-to-take.
77. **The Beaver Group** is a specialized program for beaver management, including beaver removal, tours, education, anti-preservationist work, publications, damage assessment, legal assistance, and integration with forestry and fisheries.
78. **The Deer Group** seeks to develop a productive wild white-tailed deer resource with net benefits to citizens within the county and region.
79. **The Black Bear Group**, like that of the Bobcat, Wild Turkey, and Raccoon Groups, is a deviation for an oft-recommended multi-species or "multiple-use approach" to wild fauna management. It caters to people interested in bears, offers tours to see bears and their

habitat in the wild, sells photographs and sculpted objects, attends to pest and damage issues, and provides membership services.

80. **The Bobcat Group** is a wild felid-oriented Group with memberships, conferences, tours, and active management of the bobcat population in select areas. This Group, perhaps more so than other Groups, concentrates on studies of the animal and its environmental needs. Clearly associated with wilderness and the furbearer groups, the cat resource is important to tourists, hikers, and others seeking outdoor experiences.
81. **Flights** is a complex, "total" bird resource center, studying and working from extensive data for bird resource reporting and public presentations. It coordinates bird watching interests, assists with BirdGolf, works with federal and international migratory bird organizations, sponsors bird watching tours, uses the state bird data bases actively, and assists The Owls Group.
82. **BirdGolf** is a new bird-watching sport, developed on a few select Rural System enterprise environments or contract areas. Users pay a fee to use the course and, after describing their abilities and the characteristics of the day and date, a "par" is computer-produced. Participants play against their own past scores or competitors, seeking to see all of the birds of the area. A score is obtained. Life lists of birds seen on all such BirdGolf courses expand the play internationally.
83. **The Phenology Group** is affiliated with Nature Folks and others. It concentrates on phenology, the study of the timing of biological event occurrences, the change in these events over the years (e.g., the migration of geese, the fall of leaves, the blooming of daffodils), and their correlations throughout Virginia and the region.
84. **The Geology Group** brings modern local geology knowledge to citizens of the region helping all understand structure, history, potential dangers, and extended appreciation of the local world's geological influences.
85. **The Wild Turkey Group** serves BirdGolf in some areas, but is primarily for bird watchers and hunters. Guided tours are conducted to permanent blinds. Memberships include tours, publications, records, equipment reports, life history, and ecology work.
86. **The Quail Group** works on farm lands to stabilize key bob-white quail populations. It works with dog owners and field trials, developing select areas with high populations, and scoring areas and populations for memberships for people with specific high-intensity interests in quail, quail hunting, and quail as part of the living rural landscape.
87. **The Grouse Group** studies regional dynamics of ruffed grouse and relates it to potential dynamics on Rural System tracts.
88. **The Dogs Group** works with hunting dogs, maintains quality kennels, conducts dog training, and sponsors field trials. It has a unique scoring technique for trailing abilities of hunting dogs. A separate unit works to control the harmful effects of dogs on wild fauna and rural systems.
89. **The Bison Group** creates a special ecotourism destination. It maintains facility occupancy, allows uses of other enterprise services (e.g., Prospectors, The Fishery, The Owl Group). "After you've seen some, you've seen them all" may be the reaction of some people and satisfaction will only come from diverse experiences in a short period but over many years with regular returns to a planned special bison-related event.

90. **The Invasive Species Group** works with The Pest Force, but focuses exclusively on removing invasive species from enterprise environments. The Invasive Species Group maintains a list of invasive species, creates publications to educate the public about which invasive plant species to avoid in planning a garden, and otherwise works to prevent the spread of invasive plant species.
91. **The Ginseng Group** monitors the ginseng plant on Rural System lands, which is endangered in some areas due to Chinese medicinal interest. The Group assembles knowledge of the plant and its functions, seeks substitutes, and plans site-specific tactics for its survival.

Sector 4: Agriculture Topics

92. **The Pasture and Range Group** seems inseparable from The Fence Group. It designs and develops superior pastures for livestock of several types, using GIS and soils knowledge to achieve superior grass production and pasture and range conditions and uses (e.g., water and wind protection) for animal systems that will be profitable.
93. **The Fence Group** promotes new and attractive fences in the region for improved pasture management, and for manipulating the spaces of several livestock groups. It uses special dried and treated woods and develops protection against deer and other garden pests.
94. **The Pest Force** confronts vertebrate faunal damage as a system, concentrating on long term, cost-effective reduction of measured financial and esthetic damage, and not on pest reduction.
95. **The Bees Group** keeps bees under contract on suitable enterprise environments, working with The Products Group to develop high-quality honey- or beeswax-based products for Rural System guests, employees, affiliates, and for export to regional communities. We plan to diversify honey taste and quality, and market nationally and then internationally to key groups. Select management units will contain flowering trees within agroforestry lanes, with visitor/guest trails to come to learn, study, and experience our bees and honey.
96. **The Gardens Group** works with agroforestry concepts, promotes “victory gardens,” employs Alpha Earth, uses designed fences, beautifies and enhances land value, and participates in the work of the Carbon Market, Odorscapes, and Viewscapes. It develops specialty gardens such as those for moss, ferns, daylilies, and vineyards.
97. **The Good Garden Group** will specialize in superior garden products of comparable quality to “organic” certified produce, but without the extra cost of organic certification.
98. **The Day Lily Garden Group** studies recreational plant beauty and values, compared with plants grown for food sale.
99. **The Flowers Group** concentrates on maintaining flower gardens of emigrants. The Group responds to pollen supplies of bee populations and creates colorful attractions to managed areas for guests and potential future markets.
100. **The Moss Group** grows moss for floral uses. It is designed in part as competition to remove pressure on wild mosses being exploited. It caters to specialized fern and aquatic garden sites.

101. **The Bamboo Group** specializes in selecting optimum sites for the many species/varieties of bamboo. The Group makes site-specific sales, uses the plants for vegetating unique areas and providing special habitats, wind barriers, and develops handcrafted bamboo products.

102. **The Black-Eyed Peas Group** seeks to develop an expanded complex subsystem related to this single plant species.

103. **The Fruits and Vegetables Group** seeks maximum extensive profit from carefully-selected, GIS-specific Alpha Units, leading to abundant, high-value, market-specific produce for the future.

104. **The Yards Group** unifies work with the Pasture and Range Group, The Garden Group, The Sculptors Group, and The Fence Group to produce and manage pleasant, grassy areas and meadows around rural structures, urban borders, and "play" areas.

105. **The Blueberry Patch** produces blueberries on GIS-selected sites, and then provides specialized markets for large volumes from widely-distributed growing sites. The Patch is an under-stated system. It is created for private profit, employment opportunities, and heightened value of land that makes it especially worthwhile to tend well. It is more than a "patch"; really it is a system of patches, and the total Rural System that includes them.

106. **The Soils Group** tends to soil quality on the Alpha Units of all enterprise environments, and works with Alpha Earth to offer superior soil amendments.

107. **Alpha Earth** is primarily for vermicomposting and developing superior soils from waste products, sawdust, earthworm action, and thinned forest products. It sells a composted medium with instructions, equipment, and services for local gardens and yards.

108. **The Vineyards** are GIS-selected areas, selected to produce grapes for sale to local wine producers. Regionally dispersed, the well-selected sites provide local income.

109. **The Mushroom Group** will work to cultivate diverse mushrooms in several types of sites (forest, garden, etc.) on Rural System's enterprise environment for commercial sale.

110. **The Stables** provides services for horse owners, trail rides, and several horse-training areas, with wastes provided to Alpha Earth.

111. **The Beef Cattle Group** is large and comprehensive, and is as sensitive to soil chemistry as to methane within global warming concerns. It works toward profitable herds of site-specific, selected animals within rural land clusters. (It will be delayed until local caretakers are regained.)

112. **The Goat System** works for improved goat herds worldwide, develops wildfire services (field and shrub fuel reduction), and works for improved pastures and quality dairy products, widely marketed. Goats are more efficient than cows in forage energy use for milk production, they survive bad range or forage years better than cows (thus reducing entrepreneurial risks and boom-or-bust situations), can improve the range itself, and have more stable benefits than cows. They do require more manual labor than cows,

but this is appropriate in some areas where there is surplus labor and/or where an active life outdoors is viewed as of high-quality.

113. **The Sheep Group** develops a major market for "organic" lamb. By "organic" we mean lamb that is as good for people as it is delicious, because the sheep are produced without using antibiotics, added growth hormones, or dangerous pesticides. Relations are explored with "hair sheep" and specialized meal recipes.

114. **Pasture Chickens** is a Group focusing on moving sled cage units around pastures to raise chickens for sale. Avoiding the morass of "organic" certification, the pure-breed chickens are presented as pasture-fed in healthful outdoor conditions, free of pesticides, medicines, and food additives. They can be seen by guests on farm visits in their pens. The pens are dragged regularly in rotation to new foraging areas throughout a pasture. There are bantams to meet meal-size preferences for individual and small-family buyers. Thirty percent more bantams can be produced in the space required for larger birds. They are well-protected from predators and selected in the brief period of optimum growth and nutritional healthfulness. All waste products are re-cycled into the "chicken pasture," a unit of other pastures. Planned spatial routes prevent excessive manure buildups and undesirable sheet erosion and waste transfers.

115. **Future Feedlots** will create and manage superior feedlots now for Rural System livestock.

116. **The Rabbit Group** is profitable, though widely dispersed, with very small operations within a single large system. Small livestock, such as rabbits, have in common the characteristic that they are relatively undemanding in their feeding requirements and easy to house and manage. They provide the same products and services as larger livestock, such as cattle, but are less risky, are easier to replace (they are not costly and reproduce faster). By optimizing the management of rabbits, as well as integrating them into the farming system, the total production of the farm can increase considerably. They may offer regular cash income throughout the year for youth and others.

117. **The Goose Flock**, in addition to promoting domestic goose flocks, prepares and sells domestic geese, holiday meals, other products and services. The Goose Flock diversifies farm income from the total flock system on many ownerships with managed water bodies.

118. **Worm Corral** is a low-cost, efficient system for producing a wonderful natural soil booster. This is a system for moving organic materials into dark, pleasant earthy-smelling, friable matter that helps create world-class garden soil. The system builds soil and changes organic wastes into a useful, valuable product to enhance personal gardens and landscaping plants.

119. **The Wired Ecosystem**, a place for visitors, uses technology and knowledge from studies measuring temperature and various other ecosystem variables. It provides a place for people to learn about different ecosystem processes, seeing information measured live.

Sector 5: Sports and Recreation

120. **The Wildland Crew** is a Group for adults, sharing common, guided experiences to build or develop wildland structures, or engage in useful projects. The Wildland Crew organizes 3-day outdoor experiences, with meaningful exercise, team work, recreation, and lasting memorable experiences. Local crews gain unique experiences, and also form bonds with other regional crews.

121. **The Bear Hunter Group** will some day gain name recognition for its care and treatment of dogs, full-scale use and development of all bear parts gained, farmer-protection investments in bear-related damage costs reduction (e.g., bees, sheep, pets), and supporting books, trips, studies, and counter-action and alternatives to *illegal* gathering and sale of "bear-parts" (hides, organs, skulls, claws, meat, and fat).

122. **The 4 x 4 Group** has great interest in off-road vehicles. It is an organization that sponsors safety, care of the wildlands, special events and tours, and does vehicle-dependent service projects.

123. **Under the Hood** explores a school for automobile performance repairs and enhancements, especially for rescue, field work, and general lifetime experience economies, and safety.

124. **The Wildland Walkers** is a hiking and camping club. Members use trails on Rural System areas and other trails, receive an e-newsletter, and are invited to conferences and shows. Safety, trail etiquette, and campcraft are frequent topics.

125. **Run Along** is a program to promote and encourage youth entry into natural resource-based and rural outdoor recreation activities. The program develops safe options, incentives, and guided programs. It is related to health and physical fitness, gender neutral, and links youth to public and private lands for rural work, as well as where outdoor recreation opportunities exist.

126. **Tetra Race** is a regional cross-country race seeking to become one of international interest because of high-technology dimensions, rural attachments, and major prizes.

127. **The Triathlon Group** sponsors triathlon events and related Rural Challenge events.

128. **Rural Challenge** sponsors an annual field event on a Rural System enterprise environment. The event features weight and strength contests dealing with rural items such as trees, hay, machines, rocks, etc. Stressing health and fitness and accident prevention, it profits from reduced costs of living derived from healthful practices over longer periods. Providing a notable target or justification for people exercising throughout the areas, it links exercise and health and the opportunities on Rural System lands.

129. **Getting Together** is a Group producing a central event for past and likely participants and neighbors, every 2-4 years. Fair-like, perhaps circus-like, the Getting Together event is diversely socializing, linking, sharing, and opening doors to local Rural System resources and plans.

130. **The Biking Group** is for people who own or are interested in the many uses, applications, and secondary consequences of using non-motorized bicycles. The Group is dedicated to increasing use of bikes, their proper and safe use, and to improvements in

health and land and resource conservation resulting from such uses. It works with the Triathlon Group, Wildland Walkers, and others.

131. **The Rural River Runners** have great curiosity about and love of the Powell, Clinch, New, James, and Jackson rivers (and later other rivers), and seek new ways to enjoy them, but also to protect and improve them. There are paid memberships. Members conduct tours of the rivers, refine use-oriented maps for the rivers and their tributaries, develop refined GIS databases for the Crescents, and monitor and report on land use dynamics within the selected Crescents.

132. **Tree Tops** is an enterprise featuring the potentially-growing sport of tree climbing. It has paid memberships, climbing events, and training sessions, but is for "loners" as well as for people who use modern climbing ropes and gear to go to experience new places, new views, and rarely-visited parts of ecosystems.

133. **NovoSports** capitalizes on interest in health and exercise. It promotes new, active, diverse ways for all citizens to become participants, non-spectators, and also to "get out" and to establish new relationships with others and with the outdoors. The Group may find special relevance to students of nearby college and university recreational programs, both for study as well as creative student involvement and personal enjoyment. Currently proposed Novosports are conducted outdoors. Money is made from memberships (as in a health or exercise club), and in attendance in the many diverse activities associated with potentially-growing new sports. Related units are The Triathlon Group, Tree Tops, The Biking Group, Tetra, and The Fishery (e.g., casting tournaments) and Great World Ball. Various conventional races (e.g., through Tetra or the Biking Group) are sponsored, but others, such as rope climbing, tug-of-war, and weight lifting may be explored. Atlatl Spearing and Topple teams are sponsored.

134. **Atlatl Spearing** promotes the sport of atlatl spear-throwing, sets up courses, cooperates with existing related enterprises, and sponsors contests for distance and accuracy. It recommends low-technology by restricting competition to primitive (non-metallic, non-plastic) instruments. Demonstrations of other atlatls and their properties are encouraged as part of shows and events.

135. **Great World Ball** is a diverse game for all ages played with a giant 8-foot diameter rubber or plastic ball typically covered with deer and goat skin. It is played in a 100-meter diameter circular field. There is an "equator" center line and north and south poles. Two teams face each other and the ball and, on signal from the" tender" (the referee), try to push the ball to touch the competing team's pole. The game is one of strength, dexterity, stamina as well as strategy because "outside" becomes a competing force as the ball is pushed nearer to a pole. It is definitely a team sport. It can be a spectator sport, but participation of everyone is encouraged. It can be played in any season, indoor or out, any weather.

136. **Topple** is a new game where two players stand on 2-foot sections of large logs (about 12-inch diameter) placed on end within a sawdust pit (as needed to reduce injury from falls). The logs are about 16 feet apart. A 50-foot rope is stretched equally between the logs. A player stands on the log and, on signal, tries to get as much of the rope as possible (or needed) to get the other player to step off of the log. The winner is the last

standing on a log section. The game requires some strength but depends greatly upon strategy.

137. **Rappahannock Rock Skippers** is another game-oriented Group, promoting rock skipping as a sport. Fees to play the game are taken; gambling is avoided, and all fees go to promoting the game, developing the skippers, paying for the official stones, paying for the computer membership rolls and their backups, and contributing to the objectives of Rural System. Occasionally, travel fees are paid for winners to demonstrate and promote the sport, its publications and skippers, and otherwise to promote Rural System. Only small prizes are given in contests to emphasize the winners and playing for the fun of playing and to de-emphasize the material aspects of so many other games.

138. **Good Dog** is an enterprise that offers to owners of tracking hounds (typically raccoon hounds) an opportunity to quantify the goodness of the hound. The owner brings the dog(s) to a course which is on land of Rural System. A miniature radio transmitter is attached to a dog with a collar. A scent trail having been laid out by the staff, the dog is released and tracked by radio. The match between the path taken by the trails person and the dog is made and an analysis done. The squared deviation is used, a chi-square statistic. The dog that does not deviate from the scent path gets a score of 100.

139. **GPSence** is a business related to all aspects of global-positioning satellites (GPS). It sells GPS units and services them, provides training programs, and sells related technology such as altimeters and range finders. GPSence is a new organization involved in all aspects of geocaching. It combines excitement, adventure, knowledge, and strategy. Typically, each person rents a GPS unit (or uses their own) with vital coordinates of a cache. The location is very precise. The individuals or a team collaborate to find the caches (hidden boxes, metal stakes, marked trees, etc.).

140. **Rural System Riders** is a Group focused on offering horseback riding opportunities on Rural System enterprise environments. Several stables throughout the region may be marketed as a unit. They provide superior horse care under a veterinarian's supervision. A computer-based nutrition program for each horse and simulation system provides an analysis of status, finances, health scores, and shows achievement of system objectives. Publications and presentations on web sites and elsewhere include sections on ecosystem management, the role of horses in wildlife management, the attitudes of horse owners to a cooperative system of horse use and trail rides, the behavior of wildlife related to the wildlife-observer (whether on foot or on horseback), the horse trail and its construction and use in recreation and wildlife management, and the potential role of horses in ecotourism.

141. **Boating** works to offer canoes, kayaks, and small boats for visitors to rent for use on ponds and rivers on select Rural System enterprise environments.

142. **Youth and Adult Camps** first work with existing camp owners, then supplement or expand activities for year-around activities and services. These include day or extended camping experiences for youths, special programs for the elderly, and, in some areas, the Writers' Camps. These "camps" may be on university grounds, within or supported by Rural System Inns, or within separate grounds and facilities of this Group. A special facility, a language camp, is part of the dream.

143. **The Writers' Group** works with writers' talents and interests, promotes writing, provides services and contacts, and works with other "outside" Groups to achieve Rural System objectives as well as writers' related objectives.

144. **The Tours Group** works with local tours, acquainting local people with their own areas and opportunities. It conducts statewide and national tours that are related to Nature Folks and a variety of natural resource topics. "Exchange" tour programs are offered with Rural System Groups developing in other countries. A variety of bird and other animal "life-list" building Groups are formed, and tours are designed for them. The Tours Group depends upon Rural System Guides.

145. **The VA Touring Group (VATG)** in Rural System will study the *existing* natural resource areas, specifically of the Commonwealth (called herein "parks"), develop relations with transportation and nearby lodging and food enterprises, and work to build a specialized, tourist-based industry in Virginia (later expanding elsewhere).

146. **The Arts Group** is modestly confined to artistic activities of painting and sketching of pictures, sculpting, and with making pottery. Photography, poetry, song writing, wood carving, garden objects, and cabinet making, landscaping and flower arranging are typically (but not exclusively) dealt with by other Groups. The Group sponsors a membership organization with regular meetings with lectures, shows, news, techniques, and art-supplier advertisement.

147. **Dis 'n Dat** is a proposed idea that Rural System or others sponsor a contest, perhaps computer-aided, perhaps once a year, for people to win substantial prizes based on knowing word usage, one aspect of SOL comprehension and journalism abilities.

Sector 6: Products and Services

148. **Right Rural** is the large, comprehensive citizens Group, an organization for everyone in the region and, later, everyone interested in the activities, operation, and successes of Rural System. Membership fees support the development and growth in effectiveness of Rural System, but it also provides members many benefits including a newsletter, access to their own website, alerts, discounts on equipment, products, clothing, entrance fees, and priority access both to consulting as well as uses of Rural System enterprise areas.

149. **The Past-60 Group** is a membership organization for folks that have done a fair amount of aging. Brought up on the idea of the importance of history, of building on the past, of respect for experience, on maintaining records, and of standing on the shoulders of giants, they still have those ideas and feelings. Members believe that they may still have something to offer and do so through their website. Local groups may form. Special advice, products, and related memberships are offered.

150. **Fog Drip** is an enterprise that collects, produces, and sells recordings of rural music. It brings citizens a vital part of national culture, the songs and music to which we all listen, play, and sing. It sells the new songs of the people of rural areas of the USA and, later, other countries.

151. **Floats** is an eChapbook and brings to citizens a vital part of national culture, the poems that give us pleasure, understanding, insights, and otherwise often-unattainable

dimensions of life. The poems are made available freely (the share-ware concept) to subscribers, and are primarily from the people of rural areas of the USA. They are original, unedited, and the best work of the authors submitting them. They are screened by the production staff.

152. **The Fauna File** is a place for writers to place articles that they do not care to submit to the journals of the Wildlife Society. It is an alternative, hardly a competitor. All articles, voluntarily submitted, go on the site and there are no reviews. It is a place where rejected manuscripts can be submitted and stored. It holds the premise that most things in the field of wild animal resources are unique or are expressions of equifinality. They are rarely genuinely subject to the standards and principles of laboratory or agricultural science.

153. **The Products Group** develops and sells products of some of the enterprises of Rural System. Some have beautiful, interesting things to sell that add profits and reduce the costs of achieving the greater system objectives. There may be little difference between products and services, but this group deals with the physical things, most of which are for sale. Though many products from the System are not trees, animal, soil, water, or fish, the product sales contribute to reducing the costs of achieving the central profit-making objective of Rural System. Thus a progressive, learning, improving system can be developed. Land, with its managers and users, "produces" things. They may be viewed as "goods," as "income," or as "benefits," but these words overload the decision process with multiple past definitions and yet-debated, even un-identified nominal unit concepts. We call these things that are produced *product units*. They may provide service, aid in work, pleasure (art), memories, enable and augment membership, and stimulate ideas.

154. **The Toys Group** sells a special product set of handmade toys from Appalachia and other rural areas. These may be sold from an eBay drop-off unit or from the e-catalog. Some of the toys are sculpted from wood by The Sculptors.

155. **The Sculptors** is a business that promotes membership for those interested in sculpting in wood and other media. It is a new organization that forms local clubs, gives seminars, publishes a newsletter with ads and advice on a website, and has a chatroom. It sells quality, solar-seasoned wood, extracted from the certified sustainable Rural System enterprise environments. It encourages hobby carving, provides suggested patterns for work, and assembles carvers for large projects. With The Tours Group, it conducts high-quality, family-oriented carving schools such as conducted in Austria.

156. **Topics** are unique wooden and metal objects, often mobiles, large and small. Creating Topics is a form of sculpting, done by local people and sold to garden outlets and floral shops. These are numbered and authored objects, typically following a theme, and preparation offers local, part-time employment and marketing through The eBay Group and other Groups.

157. **The Big Bandana** is an example of a trivial product (bandanas) that is a marketing- and name-recognition device that can barely breakeven but is run from home by a part-time worker. Many unusual uses are featured with each purchase, and eventually other related products are added to the line.

158. **Ecorods** and ecodiscs are decomposable plastic devices used to measure the total, complex biological decomposition rate of forest and other soils. Grossly measuring the life of the soil at precise points (each with its own GPS-informed GIS database), the devices provide baseline information, measure effects of land treatment (or pollutants), and tend to provide a way to assure desired soil biodiversity.

159. **Brown Bags** of Rural System is an enterprise devoted to profit from producing a healthful, low-cost meal for health- and weight-conscious people of the modern era. Available for pickup or deliver as a kind of fast food, the image is one of healthful rural people enjoying lunch after a good morning work or hike. It may be developed into an early morning curbside, drive by, quick pick-up for school children and others' lunches.

160. **The Clumper** is a beautiful aid to personal lawn care, usually used in two ways. Leaves are raked into a flat row or cone-shaped pile. The Clumper is grabbed in the center of each bar, then wrapped over the pile, enclosing it, then the two bars are pressed toward each other as far as they will go, bar to bar. The leaf bundles are carried to the compost pile. Later, for clean-up, the Clumper is laid flat on the ground and leaves, acorns, etc. are raked onto it. The bars are pulled together and the bundle then carried like a satchel or suitcase to the compost pile to be dumped.

161. **Dogwood Inns** is a confederation of local dwellings, some "bed-and-breakfast," all maintained and operated to conserve energy, reduce the need for local investments for housing visitors, maintain the local character, and to help the aging owners of rural places. Aided by the Land Force, and closely related with the Gardens Group, the Inns provide dispersed housing for writers, conference goers, and business and school retreats. These are essential for profitability of tourism groups.

162. **Home Place** is a Group managing rural area homes that were left by emigrants, as hotels for temporary use, and upkeep. The Group functions as outdoor-related temporary room for guests relating to the long list of Rural System sights and actions.

163. **The eBay Group** is a drop-off spot (or spots) for local people to sell their items. It provides services (e.g., temporary storage, mailing, etc.), makes images, and secures highest prices, reducing the needs for the expertise required for such processing. It expands with eBay options, and offers an existing alternative to the price-based e-catalog of Rural System.

164. **The Warehouse Group** uses select, well-located lands that are unlikely to grow crops or provide other opportunities for storage (e.g., borrow pits, mines and quarries). The group benefits from GIS knowledge and from optimizing placement for those with produce (e.g., lumber, Alpha Earth) or items (e.g., vehicles) to be stored.

165. **RuraLives** captures the wisdom and experiences of rural people. For a modest fee, people submit information about themselves or their departed family or friends. RuraLives stores these stories on their servers for a fee. It seeks to value and conserve the lives of people, especially their rules-of-thumb, unique observations, grounds for success, and words for their grandchildren. Not an obituary entry, the enterprise allows expanded notes to be saved about people, and includes search capabilities for key words.

166. **The Memorials Group** offers special places for the placing of cremation remains, places of beauty and solitude and for reflection. It coordinates with RuraLives

and offers access to lasting memorials in books dedicated to loved ones. It offers special programs and projects for awards to retiring people of Rural System Groups.

167. **The Cemeteries Group** works with The Memorials Group to maintain cemeteries found on Rural System enterprise environments. It works with The Studies Group to learn about past peoples in the region, and works to make cemeteries into places of solitude.

168. **Outfits** is a clothing-related enterprise that offers a fit- and wearability-approval service, produces some prototype clothing items, provides advice for industries, markets computer-designed clothes-maker mannequins, and markets a computerized, personal-pattern producer.

169. **Pond Disks** are revised Seckey Disks that provide estimates of the amount of particulate matter in pond water.

170. **Stills** is an Internet marketplace for rural-related images of all types. This is a place for staff photographers as well as others (for a fee) to display their images from within the region for sale and other uses. It takes pictures to support the technical and marketing dimensions of the other groups. It holds profitable image contests (slides, prints, etc.) It supplements TV and marketing efforts.

171. **The Structures Group** creates solid-wood or whole-log cabins, providing them for recreational purposes such as hunting, fishing, and just plain enjoyment without having to go through the expense of building. Now “energy” cabins are being studied.

172. **The Zoo Group** would affiliate with established zoos and add value through offering its many products, educational material, and services. Within current law and policy, select native animals of the clusters may be kept on display for diverse educational and “studies” importance.

173. **The Aquarium Group** is for the many people who enjoy and keep aquarium fish. The Group would sell large aquaria with bonded service and a hotline, develop zoo displays of mollusks and their related fish (and sediment pollution effects), develop the water-garden-as-an-aquarium concept, promote the aquarium as a terrarium, relate to The Moss Group, develop aquaria sales with local pet stores, and develop cold-weather and electrical-emergency strategies.

Appendix Two

Rural System Founding Premises and Promises

We see parts of Rural System from the realm of regional poverty that may spell failure for us, but we overcome persistent negativity within the synergism of our premises, given below.

Premises, children-like, have been expensive to develop as any parent will agree. There may be elements here of a theory of rural land and water use for future societies. Premises here have been hiding or I would have found them before; silent or I might have heard them, but like bird-calls in a distant land, I would have not recognized them or their species or their nests. I want to share them with you for your use, additions, and the good of us all. You will recognize them from other chapters herein:

- The modern system of general systems theory (Chapter 2) is the only likely pathway for success in avoiding a collapse of civilization reaching profound food limits by 2050 AD. Similar stress in shortages of high quality water is estimated for 2030 AD.
- Defining "rural" is "fiddling while Rome burns." While interesting and valuable to some, such talk can be delayed as the nation urbanizes. Rural System cautiously engages The Border Group (Chapter 11), between urban and rural.
- It is essential for resource managers to make money, i.e., reduce costs and losses, and concentrate on measurable net financial results in their decisions and careers. Adequate or increased money is likely the only currently functional, broad-scale incentive for responsible resource management.
- The football analogy needs thought and discussion. Now it is time to concentrate on a total rural and natural resource enterprise. We can be independent ... and lose something we hold in common, the vital country, and our rural regions. We need group work. The team, as in football, is essential for natural resource management success and that can be measured in the clear objective of significant, stable profitability for educated citizens.
- The *farm* is not the step to a solution, nor a single, high-value, commodity-production unit, nor even a perceived average of a list of superior farms! A distant solution is a *Conglomerate*, a single supra-regional system of many parts or subsystems. The parts are ownerships, clusters of ownerships, Corporate Service Groups primarily serving other Groups within Rural System, and Functional Groups. These separate Groups are all computer-aided and working together with a profit incentive.
- The Rural System lasting objective is to gain annual, bounded, significant profits, not farming or yields of fish or board feet of lumber. Thus, gains are to be made on each property or ownership as well as off of it, with integral attachments and service-units. Together, the complex profits need to be responsive to existing or potential markets outside the ownership, or clusters of ownerships, within the region and beyond. Maximum profits are not the lasting objective; adequate, bounded profits is the objective, and we may therefore find *continual* success, thus a surplus with which to stay within

bounds. The result will be banking, savings, and investment options in more areas, general dispersion, then studies, and then related diversification toward the same objectives, Earth-around.

- The market for products, services and benefits is now international, not neighbor-to-neighbor; we are connected by satellites. The economy of the successful farmer is much more complex than the average small family can maintain, especially now, and must include the changing economy of crops and livestock, but also changing technology, international markets, land value, college expenses, investments, family and regional health, potential catastrophe, and more.
- High technology education, with rewards centered on behavioral change, can become a base of local and expanding salaries and quality of life.
- We continue to reject "sustained" as a resource objective. I use "lasting" and have discussed "sustain, sustained, sustainable, sustainability" (Chapter 3). I fear the present rates of change in populations, environmental degradation, and many aspects of the human condition, even rural research and its results applications, and I beg others to *change them* toward precise, decided objectives for tomorrow, not to sustain them as they *now* exist!
- We have found a way to avoid many "boom-and-bust" periods using our CAT software (Chapter 4). Ecological succession models can now be processed with Microsoft Excel for diverse uses within Rural System. We work with CAT, Computer-Aided Transition software, curves describing start-up of sites after fire, flood, and soil slippage, as modified by the dominant nearness factor(s).
- The beaver premise is that, like beaver families with their secure, intensively-built dams, the animals are genetically predisposed to move upstream regularly and build a dam. Every Group within Rural System must be prepared for destruction (known and novel types), for rebuilding, and for area or basic-resource expansion. Within Groups, this premise reflects an intrinsic, "place-based" epistemology (Chapter 5) as well as a "genetic base," with high survival value for the species.
- The more common, the surer of knowledge by "many people," the greater is the need for intensive scrutiny, tentative rejection, and testing of a well-formulated counter hypothesis. This is described in the story about Dr. Heikkenen and his bark beetles (Chapter 8), along with recommended aspects of Rural System forestry.
- "How I know" (anything) is resolved from within the epistemological base (Chapter 5), encouraged for use herein. It aligns with the counterintuitive.
- We often use the concepts of rational robustness (Chapter 6).[128]
- A systems approach to rural problems is very powerful. It can be strengthened by embracing it with useful additions of ideas about "temporarily-closed" systems (Context specific), and sequenced and layered systems, with standback, Context, and feedforward.

[128] Giles Jr RH, Oderwald RG, Ezealor AU. 1993. Toward a rationally robust paradigm for agroforestry systems. Agroforestry Systems. 24:21-37.

- The system principle feedforward depends on forecasting and futurism, and that, for Rural System, is based on prominent, *new* ideas and developments—few of the past and present.
- Similarly, feedback (corrective and adjusting) is only reasonable with established objectives.
- We must advance data related to *sequence* of events in rural studies. Sequence often has more influence on a named dependent variable than any independent variable or suggested set of such variables.
- Computer use, especially its relations with social media, shape our cultural, technological, conceptual and creative work.
- With computers, we explore vast numbers of real and potential options, and with criteria and constraints, allow the computer to "tell us what to do" —the best, well-constrained options to meet our objectives.
- We discuss and actively question whether our work gains from Robert Reich's 2008 book.[129]
- We stay alert to competition and conflict perceived for the near future: interstate game licenses; adjacent, multi-state data sharing; GMO uses; phosphorus fertilizer shortage or alternatives; increasing drug addiction, drug contamination of groundwater; saboteurs; poisons and pollution affecting wild fauna; and lack of low-cost fuels for rural work.
- We work with real things—soil, water, wood, plants, animals, produce—and we communicate often and well.
- Abiotic factors (Chapter 7), especially those within or computed from GIS data, may be and are assumed to be more dominant in rural models, over more species, areas, and periods, than sparse biological data.
- We have advanced an alternative concept for watersheds as Crescents (Chapter 7), allowing uses of GIS and land slope-aspect-elevation relations within the current form to provide useful discrimination on land and runoff.
- Drought tolerance of plants, soil surface albedo and heating, and a selection of plant varieties recognized or advertised as broad in tolerance, need to be studied for use in models.
- We use split applications of injected nitrogen in plant communities and seek an efficient procedure for doing so.
- Drones may fit well into rural land surveys, viewing proportionate allocation of vegetation types, disease notice, wildfire management, wild faunal law enforcement, and services in cattle and timber counts.
- We comprehend that we work with dynamic, complex systems that are well understood; predictable; isomorphic; and often with non-linear elements, changing with "sequence" and from slow, low-probability forces.

[129] Reich RB. 2008. Supercapitalism: the transformation of business, democracy, and everyday life. New York (NY): Vintage Books.

- “Interactions” is a word abundant in most textbooks about ecology and the environment. I now know none, only “relations,” many, micro and instantaneous, but only for pairs. Return is not essential for a true ecological action.
- *Companion plant* emphasis in gardening has not likely reached into large-area wild faunal management. Proximity, adjacency, or nearness quanta may be more important in analyzing and modeling plant relations and community existence than any other conventional abiotic factor. Adjacency studies (e.g., of the Alpha Units in GIS maps) in the rural area may yield explanatory and predictive models.
- Organisms such as terrestrial snails are integrators of factors of some landscapes, and when located and explored using GIS may become useful; similarly, explorations of human and animal disease related to tree-hole mosquito species are needed if very old trees are favored in carbon-capture tactics.
- Synergism is a positive concept, one of enhancement of effectiveness, or as seen in an *increasing* effectiveness of two combined pesticides. We'll find its negative “sister” concept, more negative than “antagonism.”
- We cannot achieve biodiversity, for we conceive of the now-known and estimated biota, beyond meaning, comprehension, or use, such as current “light years.” We have experimented with biodiversity estimators and, by carefully selecting, can get indices to increase or decrease with the selection of estimator, not the differences in the field.
- Every act has energy cost; controlling and reducing system entropy seems desirable, even essential. To restore land... or anything, has energy costs. Lands and waters can be returned to energy collectors and storage units.
- We work for economics of scale (e.g., numbers sold x price per item per unit time yield mass production phenomena), and the positive dynamic it supports (mitigating succession, aging, depletion, maturing, competitive forces, and accidents).
- The conditions for Rural System success are such that the parts, or even the entire enterprise, need not be “blue-chip,” or able to survive alone. Each has to be reasonable (at least) because the strength and the real performance is from the Group work-unit, the “teams” or “tetrads,” with combined energy, ideas, resilience, and reliability.
- Nodes are the physical and conceptual small points of union with which we work. Primarily, “output” from one program (system) becomes “input” to another at a “node,” an event often chained, suggesting conceptually very linear systems joined, thus a “network.”
- We create useful simulations, following the paradigm of using our knowledge base and models—X becomes all of the conditions for producing a specific, profitable product, and Q becomes those numbered products (i.e., the computer “tells us what to do”).
- Computer-produced messages to staff on *timing* are especially relevant, e.g., crop seed planting, supplies being ordered, bills paid, harvests expected, system calendars, and project reports due.
- We recognize the information of history and of the rural knowledge base, and work actively within Rural System to gain, store, communicate, retrieve, and place that

knowledge into use. Rural System has a "used knowledge" emphasis, with eventual financial rewards anticipated.

- We avoid waste and loss. We do not punish or discount for waste or loss observed, but reward for well-timed and executed performance.
- We rely on strong leadership, both at System Central and Group scales, and with frequent, computer-aided communication for the diverse, often seasonal work—with VNodal being built by all employees and paid advisors.
- We articulate perceived limits or constraints throughout the system, and work to change them as needed, as well as to avoid exceeding them at a given time (exceeding constraints is associated with losses, costs, or dangers, and biological laws of minimum).
- We perceive that Rural System's comprehensive computer system will yield insights and positive results, unexpected from the successful subsystems themselves.
- We may find great public interest, via various social media, of displayed computer action and in-field results.
    - With ecology dominant in Rural System, we study relationships and relations in general.
      n^2 – all members of a 5-person committee send at least one note to each other = 25 notes
    - n(n-1) – paired for a 5-minute discussion, 20 places to sit together quietly
- We create trails, ponds, retaining walls, and tree plantations, among other features. We attempt to allow staff and others to exercise ways to personalize these most-permanent accomplishments
- We intend to exploit GIS-GPS unification further, creating "training" images with GPS-specific observations made by The Land Force and guests, using roads and trails as "learning lanes" —observations at GPS sites "not-seen" area images, "faunal-probable space," and dynamic "mulch-depth" maps.
- "Greening interest" is reported to be slowing; hunting interest continues to decrease; fur-wearing decreases. Rural System, along with urbanization interests, can likely *gain* in diverse outdoor recreation action, rural and nature education, remembrance materials, and visits and experiences, e.g., apple processes, and diverse rural-related sciences.
- We depend on the past and its significant accomplishments in agriculture and forestry, not negating it, only fitting in units of excellence into large, "whole" systems.
- We appreciate concepts of chaos, think we understand chaos well from agroforestry and agro-ecology experiences, and expect "wins" as we continue exploring its utility.
- Economic analyses of rural lands are all-inclusive, but not crops-, forestry-, or wildlife-specific. Reasonable managers include all of their land units when buying and selling land, paying for insurance, and filing tax forms. Keeping things separate, for example, doing economic analyses of forests, as if they were not part of the total potential annual economic picture of the private landownership and adjacent properties, is patently wrong.
- We know from computer use that highly-valued products can result from abundant, low-cost or value items. We work against the rural tradition that "common" is of low value.

We move to "common" for everyone (large numbers), for all want to be "in" and "with it," and similarly related (as in clothing, caps, insignia, or in similar action such as petting an animal and hiking with a noted group); the more the better—the more common, the more valuable… a grand reversal over many decades. We may open our "secrets" and programs to all for widespread use, because it increases brand awareness and allows *interaction with diverse parts of rural areas*, acquiring value of these areas, named contents, relations *and* the other systems. Kelley called this the "plentitude strategy"—that of creating things that have as many systems and standards flowing through them as possible. "The more networks a thing touches (linear) the more valuable (exponential) it becomes" (Kelley 42).[130]

- Rational investment is seen in planting a likely-valuable and likely-to-become an old forest tree (i.e., at the age of an elderly person… the expected age of 100 plus half-expectancy of a grandchild (50) is "recent historical," not ancient). The rational investment in the tree requires investment in the tree-space of "real-estate," for each tree and often for adjacent trees for full-expected-survival-and-growth. The conditions, the design limits, generally include for us increasing employment, increasing rural community stability, increasing insurance, reducing tax drains, increasing land value, adding tree-related faunal and soil-related enterprises, and creating a profitable system for managing human environments for diverse high-quality lives, and participating effectively in globalization. Research results and computer power make such theorizing possible, of low risk, practical, and now-essential.
- Clearly aware of costs and limits, we operate based on the highly general idea that the more opportunities are taken (diversification), the more newer opportunities (products, services, benefits, and innovations) are likely to arise.
- Replication greatly *decreases* costs of entities after the first! This is a principle and hope for Rural System itself, expanding exponentially as it becomes known, copied, or enhanced. We see it in others, encourage it and reward it *within* staff of Rural System. Rural System's value will be expressed in the scale and spread of its applications and effects on people now and in the near future.
- We explore ways to take information to the rural outdoors and to return information for combinations in programs and decisions for action (finger-size data-storage) and drone images in the field.
- We see ourselves in an inventors' mode, resources brought to use and profit made before being devalued by price/supply phenomena.
- We encourage employees to present concepts and inventions for new products toward building services and auxiliary companies. They likely respond well to whole-system successes.
- We allocate spare plots on ownerships for select employees to experiment with their own new ideas, practices, amendments, and structures.

[130] Kelley K. 1998. New rules for the new economy: ten radical strategies for a connected world. New York (NY): Penguin Books.

- We are aware that we are creating an alternative, perhaps new business model, harvesting from the vast agricultural knowledge of the past for super-fast use in software to provide sustaining money for Rural System, for benefitting rural area workers and residents, and providing a working model of food supplies that can be produced for people by 2050 AD. We may benefit by subscriptions, or paid memberships of "the curious."
- Given predictions of massive web use for the future, we begin preparing for the diverse and multilingual needs of the people of the 21st century.
- We work toward awareness and expertise in gaining competence within the animated network, one vastly interconnected with *changes* in value, location, roles, health, and other phenomena—reported and actionable for many in the public. Prices change with weather and currency, and investments are changing with corporate risk-taking, crop values are changing with the passage of import-export regulations—all information flowing in networks, and some within forest, farm, and agroforestry networks, and their logic becomes inputs in select computer programs at nodes, as in VNodal.
- The network, dominant, shares space with Rural System's VNodal, and with PowerPlace, where manual workers are augmented by safe tools and efficient, often high-tech equipment advised by timely VNodal units. Networks are dominant, and continue to challenge Rural System developers as they "try to computerize everything for cost-effective results" and to gain others in supportive local organizations.
- We recognize, fear, and avoid sub-optimization, but acknowledge it can occur. We are gaining tactics for "creative destruction" and re-engineering, to move from the sub-optimum conditions that may arise or wound us and cause us to "start again." Not to do so prevents us from seeing new options, even avoiding a crash. The more successful the enterprise, the more difficult the demise and restructure/restart.
- We define "liberal" as "abundant and diverse," and even study "shake liberally" throughout our involvement with ideas, people, poets, historians, philosophers—as we expand our personal lives, we discover emerging, important ideas and concepts for ourselves and for the Rural System enterprise.
- We have to be canny about access to money and the speed of money transmission among accounts—accurately and safely. Relations to workers, salaries, and local residents need to be expressed in analyses and reports of such successes in Rural System.
- Aware of many organizations in rural areas, we tend to work toward their interests, relate them to our Groups, attempting to form alliances, sub-units, or important aids.
- Rural System, with networks, can be said to be in a constant state of turmoil and flux.
- Large-scale systems are grown, not installed (Kelley 116).[131]

[131] Ibid.

Appendix Three

Decent Work

This unit is proposed as a working, base concept of "the good" in Rural System. It is a statement of policy-like objectives, discussed in *Rural Future* and related documents of the proposed Rural System. I have placed it here, in the Appendix, for the same reasons that I prefer not to discuss my personal religion. If what it is does not show clearly, then there is hardly any need for discussing it.

Several layers are imagined to be behind the way staff and participants in Rural System work or do business. No one is told what to believe, think, or what attitudes to hold, but we like to communicate our intent and direction, as well as merge layers of knowledge for our staff and customers. This appendix unit suggests that the content of the book and its *intentions* can be tested against the statements here. I believe they are consistent, and if not, adjustments need to be made over time.

Staff and participants are encouraged to hold these ideas collectively, as a code of conduct that landowners and citizens can expect from us, while working with all aspects of Rural System. *Rural Future* attempts to express, even in a limited way, what we "stand for" —concepts in which we believe, and how we operate and address public, client, and personal concerns. We try to extend our limits and correct quickly our failures in living and working according to the creed herein.

We do not hide that we are profit-oriented, and we hold that "long-term, bounded profit" *is* a key phrase, as is estimated quality of life (Q*), an index to how well we are improving the environment and improving the life quality for rural people of the region (and associates everywhere).

We the people are dependent upon our communities and groups, and all are dependent upon the environment … *all together*. We allow citizens ways to participate in restoring, producing, and managing the rural environment, and in gaining personal and family profits (net gains) from doing so. Of course, there are many gains other than profits. "Profit," herein, is an index to, and prerequisite to, most of these other gains (listed in Chapter 2), collectively called the results of **Decent Work.**

We understand "quality performance" as that which:

- has clear requirements and standards, definitions of "the good";
- measures production conformance and customer satisfaction;
- seeks conformance to these requirements and standards;
- seeks ways to prevent, then eliminate, non-conformance and defects;
- avoids secondary, often unseen and undesirable costs and consequences; and
- seeks ways to reduce the difference between the listed benefits delivered and customer expectations for those.

"Quality is never an accident. It is always the result of intelligent effort."
—John Ruskin, English historian

Following the list of benefits, we work to guarantee courteous, prompt work to deliver cost-effective, practical services that meet our customer and colleagues' objectives ... and we work hard to help them clarify and articulate those objectives. Our products are of high-quality, are safe, reasonably-tested, while often being innovative, and we guarantee them and are willing to provide reasonable returns or replacements if there is significant dissatisfaction.

We have many select products, grown under superior conditions devoid of known toxic agents. We offer many, diverse opportunities and seek to meet the personal and group needs and interests within the rural context, of both staff and customers. We seek out and offer special views, but work to achieve lasting, diverse pastoral, aquatic, and forest viewscapes. We seek to impede destruction of scenes that are important to many people, and to build a regional visual "personality," or spirit.

We move reasoned ideas into tested prototypes, when and where we can find or join risk-taking investors. We move observations and data toward information, and we seek to build a workable knowledge base for improving models leading to sound decisions and related action throughout the rural region, with its evolving needs and challenges.

We encourage developing places and times for reflection, since they can provide reflection and inspiration. Inspiration also comes from opportunities provided for observations of plants, animals, natural systems, and scenery, as well as from special behavior of individuals and groups. We know well that there are individuals and "loners," but we also know of the needs for relating with others for help, for resilience, reliability, teamwork—and for many, health, religious, cultural, and recreational reasons as well. "Community" has expanding meanings for us. We work for planned synergism among community members. Thus, we offer many memberships providing secure opportunities for forming micro-communities and knowledge, reliance, and resilience from such associations.

Our local events combine benefits, but a few can be singularly spectacular—at least for individuals. Special lectures, tours, and group meetings on "the green" seem to be useful, likely events. However, electronic conference-calls and Internet-exchanges may be rich events when they take on special meaning and discovery, locally, for some people.

Memory seems personal, but some of us hold that it is a shared thought or process that can be changed, and is affected by drugs, diets, and wellness. We work to provide products, services, and opportunities that produce pleasant, perhaps exciting, consoling, positively-dynamic, and helpful memories. We work on developing memory skills, but also on helping people gain texts, images, art, and tasteful small objects that focus and assist in pleasant or useful recall or reflection. Our concept of **Decent Work** includes actions and attitudes of:

- being effective and efficient with energy and time;
- having sufficient resources for a quality life;
- minimizing waste;
- maximizing embodied energy;
- sharing expertise;

- using sampling concepts reasonably;
- being gentle on the land;
- achieving and maintaining personal and "public" health, both physical and mental;
- having concern for children becoming fully human;
- being superior parents and/or being supportive of parenting;
- having high literacy, always learning;
- being diversified;
- avoiding conspicuous consumption;
- engaging in meaningful physical and mental work and exercise;
- gaining full control of impulses (e.g., aggression and immediate gratification);
- displaying appropriate manners and attention to shame;
- being supportive of and assisting others, and living in an environment of teamwork;
- having standards, with non-negotiable limits;
- enhancing conditions for tomorrow's citizens; and
- being clear about the difference to people between efficiency and effectiveness.

Seeking long-term, adequate profits from the rural land and waters requires retaining and building resource productivity, as well as its many benefits, for diverse current and potential users of private lands. To this generalized end of profit, the staff tends to develop highly-related programs and projects reflective of the above dimensions of Decent Work, including:

- treating each unit of land as unique, but also as a changing system, guided by intrinsic "rules";
- encouraging appropriately long timber rotations;
- making site-specific, multi-purpose timber production prescriptions;
- preserving and enhancing visual quality of the lands and waters;
- reducing water-borne land, road, and trail sediments and their movement;
- using and maintaining integrity of riparian-reach volumes;
- using fairly, forest site-type and age-specific logging techniques;
- using well, relevant information about adjacent and surrounding areas;
- avoiding losses in areas in numbers of animal and plant species (i.e., richness);
- discouraging numbers and effects of invasive species;
- protecting and increasing soil productivity;
- protecting included wetlands and riparian volumes;
- encouraging mixed tree species and mixed forest product production;
- enhancing wild plant and animal population densities and their uses;
- reducing waste of all kinds at least until it is well-managed;
- engaging in many types of cost-effective energy conservation;
- engaging in spatial as well as temporal planning for Rural System areas, lands, and waters, converging on reasonable levels of accuracy and confidence;
- developing procedures for adding significant value to products, opportunities, and services of the land and waters;
- making spatial arrangements for positive synergistic effects among resources; and
- studying and resolving unified concepts of land health and/or wellness.

We are evolving, perhaps with the characteristics of conscious capitalism introduced by John MacKey of Whole Foods Markets … still concerned about virtue as well as profitability.

Are we really among the *conscious capitalists?* Who are we, really? Staff and Rural System members' purpose is clear; our main system objective is to make money … in addition to—and in order to—achieve our other objectives. Where does that lead; what does it mean? We work diligently on employment and the environment, while doing diligent work in health, education, and human survival. We work for a culture that fosters love and trust, and invite others to "look around" and decide whether we become successful in doing so.

Governing Thoughts and Concepts Often Found Within Decent Work of Rural System

1. We have a strong bias toward modified General Systems Theory, and its usefulness as an aid in organizing and communicating within the complex enterprise. Modular subsystems with common objectives and a set of policies can excel in natural resource management.
2. Principles of biology and ecology shown to allow species and systems long-term survival are noted, and can be used to advantage within Rural System.
3. We make attempts to share ideas and knowledge, test the goodness of some of them on the land, and gain energy for the fight ahead for an environment fit for humans.
4. Rural System can be considered an experiment—a test of the soundness of an entrepreneurial paradigm for sustained natural resource management.
5. Rural lands and waters may be seen as a working platform, with unlimited opportunities for producing ideas, products, and services (see the list of "general benefits" in Chapter 2). The platform must be tended very carefully if it will improve and sustain profits.
6. Dynamic and chaotic social and environmental conditions, as well as resources undergoing predictable transitions, can be estimated, and profits can be sustained if managed with computer optimization as a whole system.
7. Major fossil energy shortages (of various types) will occur within 20 years, and such shortages can be the source of major profits from alternative energy sources if preparation is made for those conditions.
8. A rationally robust strategy (Chapter 6) needs to be used in rural resource management.
9. Ranging (Chapter 9), comprehensive diverse outdoor recreation and tourism, can excel in a region with evidently-increasing quality of life and natural resource management.
10. The results of successful, diverse economic development may be linked to the requirement that a sound Q* index to such results must be stable or increasing.
11. We maintain desired conditions (those achieved), and link them to designed, diverse, managed ecological systems.
12. Having a rural concentration for efficiency and effectiveness, resilience and reliability, we work with influential, *trans-border* urban and frontier systems, and seek cooperation.
13. We attempt prompt, courteous service, a few of the "old manners" that remain good for our potential and current customers ... and for us.

14. We emphasize “the long-term” in our strategies, models, and planning, because we study history and likely future.
15. We welcome suggestions for improvements and attempt to offer incentives for making them, and rewards for those that become part of the profit-base of the total enterprise.
16. Our facilities and appearance are safe, clean, attractive, and are part of our marketing base for “good-health.”
17. We provide progress reports and timely information as well as results for customers.
18. We compete with equals or lesser enterprises, concepts, and agencies. Competing with known superiors is irrational; competing with equals only assures wins half the time. Competition is done to win. Our preferred alternative is collaboration, or forming a partnership… when “win” is well-known and decided.
19. We do not “discriminate” in any of our programs and activities on the basis of race, color, national origin, gender, religion, age, disability, political beliefs, sexual orientation, or marital or family status. We actively seek to find employment opportunities for people who seem disadvantaged by circumstances beyond their control or major influence.
20. We *do* discriminate against employing and maintaining current employees on the basis of ability, performance, dress, and appearance … any behaviors that may likely lead to lost or diminished profits; attitudes leading to reduce group cohesion and positive synergistic results; and impaired creative work linked to the objectives of the enterprise.
21. We engage in restoring physical and biological systems of rural areas, and restoring associated quality of life of families and communities.
22. Information is our primary product and resource, hard-won, and we rarely provide it at zero cost.
23. Ability to do synthetic work and make superior decisions are also resources that we plan to sell. The results can also be sold. Empowering others to do work (as with a computer program) is more important sometimes than providing information.
24. Research results in theses and dissertations and government reports are rich “mines” from which wealth can be gained. Mining them is one of our tasks, and we may seek funds or “trades” to secure such results.
25. We check into the fair-trade provisions of cooperating companies and individuals, and their products (e.g., clothing, crafts, music, coffee, tea, cocoa). We'll attempt to avoid including those in our activities that are not in compliance.

“**Decent Work**” is a decent concept. Mark Levin, Director of the International Labor Organization (ILO) Cooperative Branch in Geneva, Switzerland, described the results of thoughtful work on the concept in a paper published in the Owners at Work newsletter of the Ohio Employee Center. The idea of Decent Work includes employment for people where there are conditions of freedom; not having discrimination or harassment; providing sufficient income to satisfy basic economic, social, and family needs and responsibilities; having adequate social protection for workers and their families; and being able to have a voice and participate in decisions about the workplace.

Decent work elements seem highly consistent with the long-held tenets of people in the agricultural cooperative movement and others—people who strive for the traits of honesty,

openness, social responsibility, and caring for others; honest dealings with fairness and accuracy, and accountability in local as well as in the international trading and financial marketplace; reliable quality and fair prices; and a unique level of openness throughout the organization. The values of social responsibility and caring for others reflect concerns for the health and wellbeing of individuals within communities.

Seems decent.

Decent Work concepts provide insights about the roles that the community plays in the success of any enterprise (e.g., security, support, landscape, setting, infrastructure)—including Rural System—and thus the opportunities for appropriate and fair participation. We are trapped by the insights of Friedman in his book, *The World is Flat*, about the outsourcing of work and the flow of employees and their expertise. Efforts within Rural System tend to agree with him that:

> "The more lifetime learning opportunities that companies provide, the more they are both widening the skill base of their own workforce and fulfilling a moral obligation to workers whose jobs are outsourced to see to it that they leave more employable than they came. If there is a new social contract implicit between employers and employees today, it should be this: ***You give me your labor, and I shall guarantee that as long as you work here, I shall give you every opportunity - through either career advancement or training - to become more employable, more versatile."***[132] (Emphasis mine)

We study how to become the "human factor" in regional land use policy and Rural System practice, in that we work for safety and comfort of workers, job satisfaction, high performance rations, and conditions seen as socially acceptable (such as those of unions and OSHA rule conditions). We test ourselves for proper (truthful) labeling, branding, and "value-adding" attempts.

As we seek to describe desirable conditions of work together, we find they are much the same for life itself, and when fully developed they become a description of "the good life" for each of us. We have found premises of secular humanists consistent with much writing in the rural systems realm. We encourage thoughtful work with the following premises for ongoing efforts within Rural System. Discussions and suggestions for revisions are welcomed.

- We plan to create opportunities for Decent Work and income in rural areas through enabling investment and through developing opportunities for gaining or improving skills, particularly for self-employed people and for micro-, small, and medium enterprises.
- We work to create a participatory, creative culture—first a regional one.
- We resist speculative financial markets and move toward a real economy based on savings, investment, and creativity that generate solid companies and quality jobs.
- We promote social entrepreneurship and socially-responsible investment funds (e.g., limiting linkage between pension funds and stock markets). We are sensitive to our *ever-changing* corporate status.

[132] Friedman TL. 2005. The world is flat: a brief history of the twenty-first century. New York (NY): Farrar, Straus and Giroux.

- We protect the value of savings and investments, and invite discussions with our Wealth Management staff.
- We seek to relax perceived limits on local or national economic growth with environmental regulation, encouraging investment for developments with results that can be sustained using new, environment-friendly technologies.
- We are committed to discovering truths and to applying reason to understanding the universe and to solving human problems.
- We are skeptical of untested claims to knowledge, and, as open to novel ideas, we seek departures in our thinking.
- We deplore efforts to denigrate human intelligence.
- We invest in information technologies and enable poor people, regions, and countries to access these.
- We believe that discovery and technology can contribute to the betterment of human life.
- We are engaged by the arts no less than by the sciences.
- We enjoy life here and now, and seek to develop our creative talents to their fullest.
- We are citizens of the universe and are excited by discoveries.
- We discourage explaining the world in supernatural terms and looking outside nature for "salvation."
- We are committed to—and work to see practiced—the principle of the separation of church and state.
- We believe in an open and pluralistic society, and work to implement an effective democracy as a major way to protect human rights from authoritarian elites and repressive majorities.
- We cultivate the arts of conversation, negotiation, and compromise as means of resolving differences and achieving mutual understanding.
- We place policy options on a sound footing by promoting dialog among workers, employers, and representative voices of society.
- We encourage open and free flow of communication, and offer training and inducements to develop involvement in "the enterprise" (an ownership culture with knowledge of objectives, financials, production, and efficiencies).
- We engage in participatory management where possible.
- We attempt to secure justice and fairness in society and to eliminate discrimination and intolerance. We balance such efforts with those essential for Rural System success and survival.
- We attempt to transcend divisive parochial loyalties based on race, religion, gender, nationality, creed, class, sexual orientation, or ethnicity, and strive to work together for the common good of humanity.

- We support the disadvantaged and the handicapped, and support assisting them to be able to help themselves and to participate in Rural System actions and projects.
- We attempt to protect and enhance the Earth and its resources, to preserve it and its productivity for future generations, and to avoid inflicting needless suffering on other species.
- We respect the right to privacy. Mature adults should be allowed to fulfill their aspirations, to express their sexual preferences, to exercise reproductive freedom, to have access to comprehensive and informed health-care, and to die with self-guided dignity.
- We believe in the common moral decencies: altruism, integrity, honesty, truthfulness, and responsibility. We think our ethics are amenable to critical, rational guidance. There are normative standards that we discover together. Moral principles used are tested by their consequences.
- We are cultivating moral excellence. We participate in the moral education of our children. We want to nourish reason and compassion.
- We seek realistic alternatives to theologies of despair and ideologies of violence, and for sources of rich personal significance and genuine satisfaction in service to others.
- We believe in and work toward the fullest realization of the best and noblest of which we are capable as humans.
- We believe in optimism rather than pessimism, hope rather than despair, learning in the place of dogma, won-knowledge instead of ignorance, joy rather than guilt or sin, tolerance in the place of fear, love instead of hatred, compassion over selfishness, beauty instead of ugliness, and reason rather than blind faith or irrationality.
- We strive for consistency in actions displaying this underlayment that we consider Decent Work.

*Perhaps you will share ideas related to aspects of **Decent Work** with Rural System staff, about one or more of the topics above.*

About the Author

While many Americans are presently astonished at conditions in rural America, Robert Giles, Jr., Ph.D., has been working tirelessly for decades on planning solutions to interconnected rural problems. Dr. Giles is a Professor Emeritus of Wildlife Management at Virginia Tech where he taught for 30 years. His Bachelor of Science degree in Biology and Master of Science degree in Wildlife Management are from Virginia Tech. His Ph.D. in Zoology is from The Ohio State University.

Dr. Giles was born on May 25, 1933 in Lynchburg, Virginia. He attended E.C. Glass High School, during which he was awarded a Bausch and Lomb Science award for studies of the ring-necked pheasant. As an Eagle Scout, he was awarded the W.T. Hornaday National Award for Distinguished Service to Conservation and the James E. West Scouting Conservation Scholarship. During his undergraduate years at Virginia Tech, Dr. Giles was an editor for several magazines and the president of the V.P.I. Corps of Cadets of 6,000 students. He was also a member of seven national honorary societies.

During his time as a Professor in the Department of Fisheries and Wildlife at Virginia Tech, Dr. Giles was known for his innovative applications of computer programming and Geographic Information Systems (GIS) to land management questions well before such skills became standard practice within the field (and before GIS was a term). With the support of the Tennessee Valley Authority (TVA), he created the woodland resource management system of TVA, once used on 300 farms a year. With staff and students, he created the first wildlife information base (BOVA – Biota of Virginia database). As chairman of a local planning commission, consultant to the National Wildlife Refuge System, aid to the State Cooperation Commission, consultant for Wintergreen and several realtors, and as a landowner himself, he has developed a unique and alternative perspective on land and its management. He wrote the first plan for wildlife other-than-game for Virginia.

Dr. Giles began working on the Rural System concept in the early 1980s, but did not begin in earnest until his retirement in 1998. When asked about his aims for designing Rural System, he said, “I am now convinced that a superior demonstration of modern comprehensive natural resource management is badly needed and is now possible and most likely within the context of a new corporate rural structure. I do not want to do research. I do want demonstrations of the results of literally millions of dollars of unused research findings. I propose to bring all the power of the computer that I can to realistic and relevant use for parts of the region. This will include using that power already achieved by investments of resource agencies. I propose a system, subject to the law and to reasonable issues of cost, propriety, and community acceptance, that achieves such objectives.”

A colleague of his once said that Dr. Giles can come up with more ideas in an hour than most people can in a lifetime. His creativity is exceeded only by his humanity. Raised in Southwest Virginia, Dr. Giles knows the struggles of people in Central Appalachia, impoverished after the collapse of coal and tobacco industries. He has visited rural areas of Africa (Nigeria, Senegal, Uganda), China and India, and is well-educated in the sufferings of people in poverty worldwide.

Dr. Giles is a systems thinker. He believes that the problems faced by environmentalists and those of interest to humanitarians are interconnected, and that a system of problems must be met with a system of solutions. His career, his values, and his innovative capabilities make him

uniquely suited to tell the story of how a for-profit systems approach can best solve the rural problems of a progressive, capitalist society.

Contact information:

Robert H. Giles, Jr., Ph.D.
509 Fairview Avenue
Blacksburg, Virginia 24060
United States of America

Publisher:

Handshake Media, Incorporated
http://www.handshakemediainc.com
contact@handshake20.com