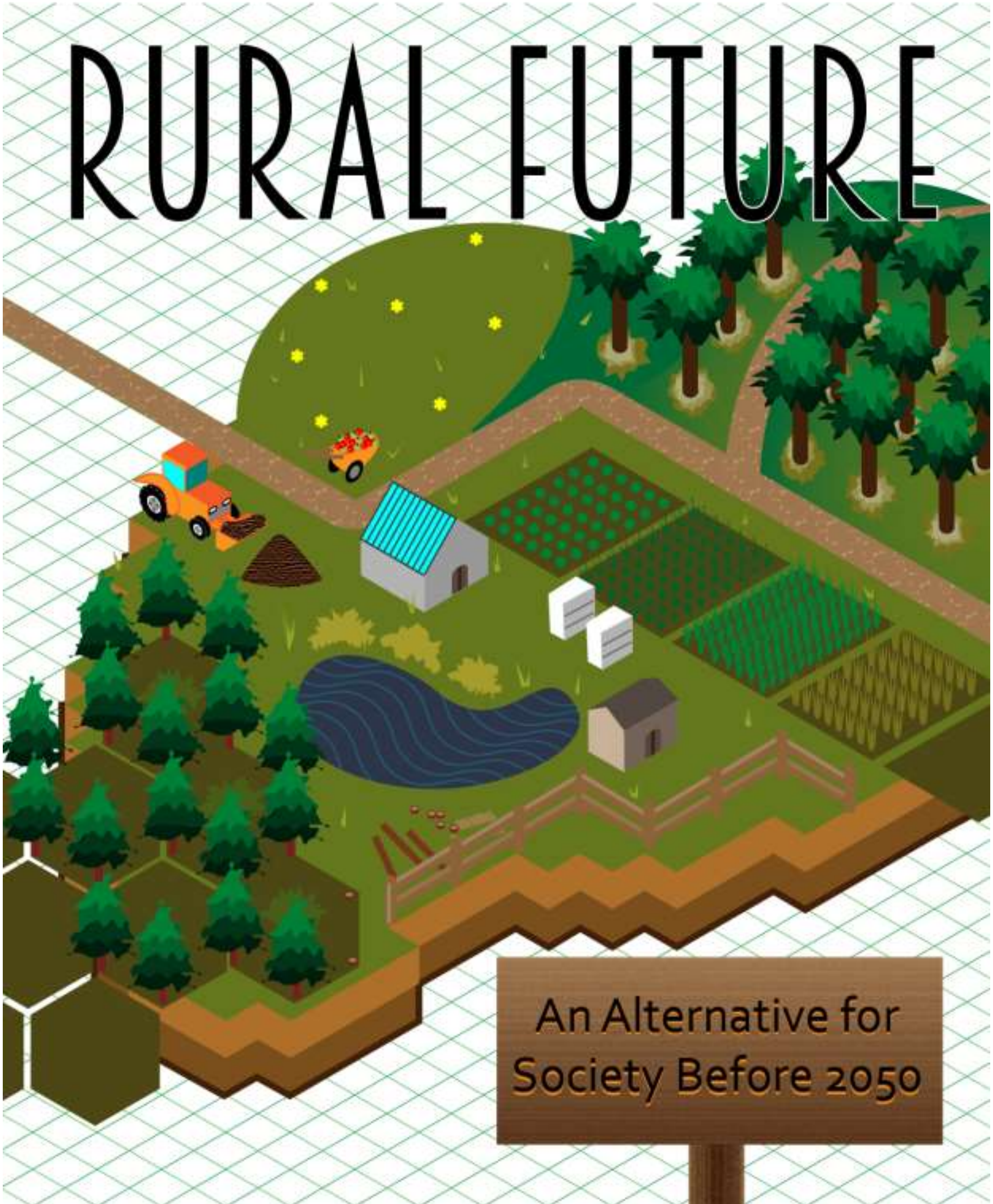
RURAL FUTURE
An Alternative for Society Before 2050

Rural Future

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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);[1,2]
3. Soil improvement;
4. Intergenerational land-value enhancement;
5. Timber harvest and future-energy forest creation;
6. Improved local forested-land taxation;

[1] 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).
[2] 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.[3]

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."[4] 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.[5] 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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[3] 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.
[4] 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.
[5] 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[6]
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).

[6] 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[7,8])
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.

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[7] Ries E. 2011. The Lean Startup. Crown Publishing Group.
[8] 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.[9]

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."[10] 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.

[9] 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.
[10] 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."[11] 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.

[11] 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:[12]

> 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;

[12] 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.

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.

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