site development with design questions that include these: What aspects of the existing forest cover are functioning toward resilient, regenerative, and productive ends? What species, what characteristics of the water flows, human interaction with the system are most limiting to the promotion of a more diverse and biomass-producing condition?

Resiliency and Regeneration Principles

While giving a tour of the research farm recently, I stopped by the rice paddies, as I do on most walks of the farm. A student in the group asked questions I hear often: "How often do you water the paddies, how deep should the water be, and how do you know when to add water?" I began to think of the answers, and within seconds was inundated with various potential answers. I almost began to provide what have been the varied answers to these questions, including the state of the rice; the temperature of the day; the past days' weather and the forecasted weather ahead; the time of the season; the condition of the rice as evidenced by color, size, and overall vigor; how busy I am; and many other factors. Then I realized that all I could say was, "It depends."

What to do in a given situation when working with land always depends on the conditions one is facing, and the conditions are always myriad. Those conditions are also in a state of dynamic flux. This is acutely challenging for most people who are products of the industrial schooling—often an unlearning—system, which trains people to follow discrete sets of instructions when addressing a problem. Life, people, and the relationships between them, however, are far too complex, dynamic, and nuanced for rote instructions to be effective most of the time. Habit is not sufficient to solve problems, though it can be useful; it must be coupled with awareness and novel responsiveness to novel conditions.

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The land system is not a machine—it doesn't function in merely mechanical ways, though it is in part mechanical. This is probably why people are easily confused and end up habitually managing land as they would a machine. The rub is, however, that it also functions in far more complex ways beyond the patterns of a machine, or nonliving system. The land system is *alive*; thus, in a constant state of flux, evolving, responding, adapting, adjusting. It is never the same thing from one month to the next, one day to the next. Thinking it is the same thing leads us to conclusions that are at best ineffective, at worst dangerous. Relating in a way that truly appreciates and accounts for the complexity of the living land system is not mysterious or difficult—it is no different from relating to another human being. Healthy people recognize the complexity and changing nature of other humans: We wouldn't say the exact same thing to one another every morning over breakfast, act in the same manner to one another each day, year to year. Of course not, as people's needs, desires, and overall contexts change. Healthy interaction is *responsive*—always based on the conditions of the moment and on past patterns and future goals.

Healthy interaction is dynamic, elegant, soft, improvisational, but not robotic. Most of us know this on a human-to-human level. Yet when it comes to land interactions, we tend to think repetitive actions are appropriate, as if the land system is the same from day to day, year to year. Truly, at its root, the idea that we can figure out some aspect of the land system and think that management needs should stay the same from year to year is insane. No complex system works that way—and such an approach is completely blind to the in-flux nature of reality as a whole. Modern industrial schooling and the unlearning process it tends to facilitate are highly effective at patterning people to act in this way, however.

The following principles and strategies represent some of the guiding directives that I have identified in the work I have been practicing. The list is not complete—therefore, please do not be limited by them. There are dozens more that apply less often in my

practice or that I have left out for brevity. There will likely be many directives that need to be identified in your own endeavor that do not appear here—especially if your climate, scale of work, focus, and other contextual aspects vary significantly from my own. The process of discovering these directives is a rewarding one, and I encourage you to continue that journey in your own life; it's a personal one, and the only way to amass plenty of clues in this process is by getting your hands dirty. Enjoy the process!

Resiliency and Regeneration Design

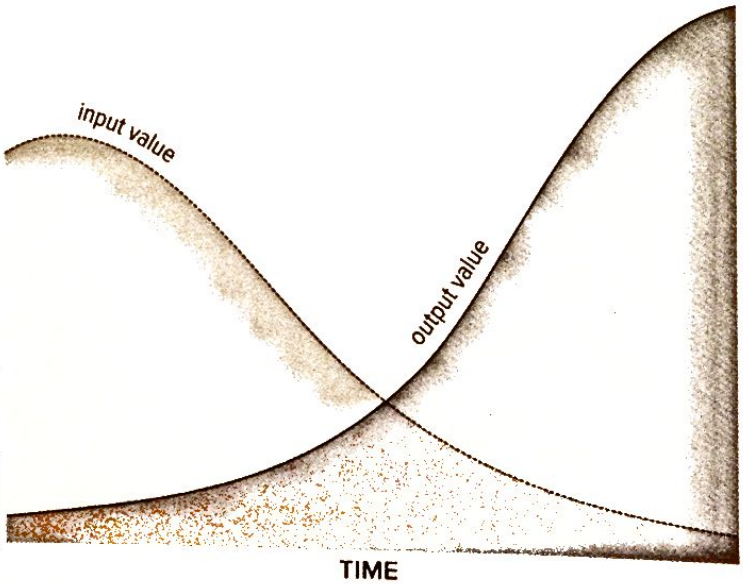
1. Maximum Outputs for Minimum Inputs

The optimal system yields the most value—in quality and quantity—with the fewest inputs. Our task always involves maximizing the ways to grow the most value while reducing dependence on off-site resources to do so.

2. Transform Dead Matter into Living

Regeneration relies upon the upcycling of matter, ultimately based upon a foundation of bedrock, atmosphere, water, and the elements. Our task is to facilitate the conversion of rock to soil, soil to plant, plant to animal, animal to soil. And the cycle continues, each time accumulating a net gain in value—with more organic matter existing than the round before. In this way we can think of the entire regenerative land-use practice as an attempt to transform inert material into as much living, breathing, organic material as possible—the earth itself as one huge compost pile upon which we grow.

REGENERATION AND RESILIENCY DESIGN GOAL



Maximizing outputs while minimizing inputs across time

3. System Establishment versus System Maintenance

The needs of a site during the early months and years of establishment vary greatly compared to the needs of the system over decades and centuries. It is often sensible to use tools, materials, people, and other resources in the present moment for system establishment that may not be available or desirable in the future for system maintenance; for example, an excavator to make rice ponds or paddies.

4. Biological Complexity, Technological Simplicity

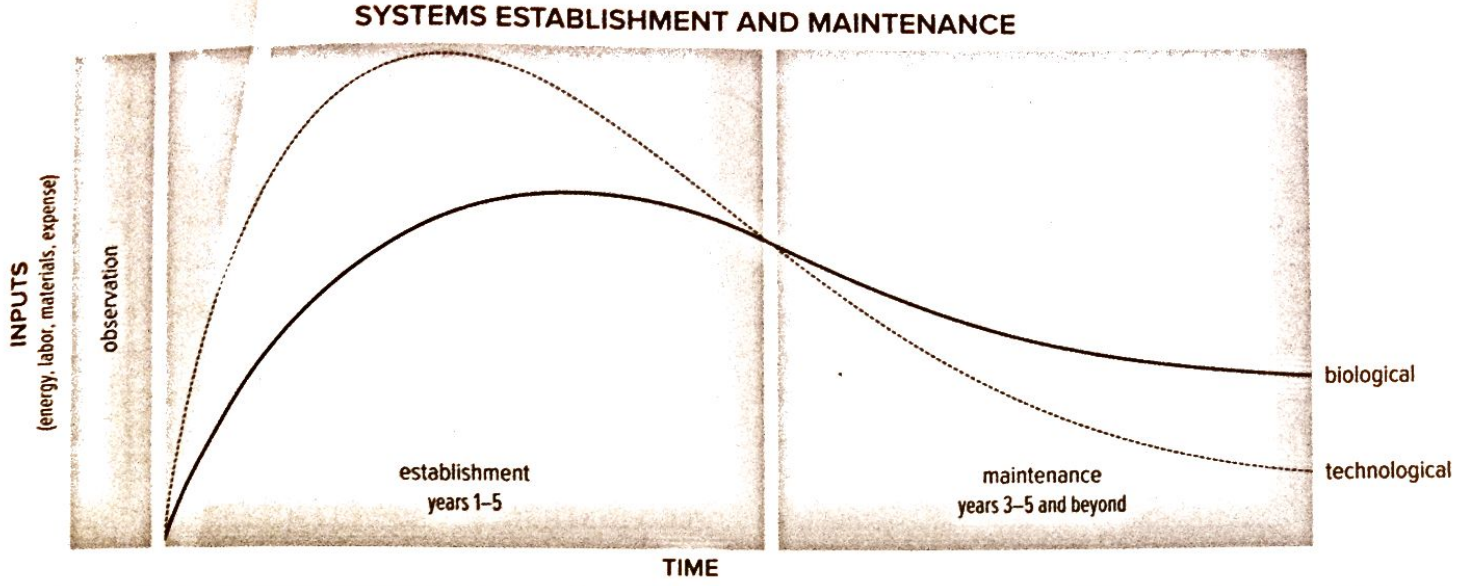
Resilience is greatest when living aspects of a system are complex, diverse, and connected, while the nonliving aspects of the system are simple. This is rooted in the fact that technical systems are constantly prone to entropy and are always moving toward failure, whereas living systems actually tend to build higher levels of order over time. Living systems amass sophistication, durability, and productivity. As resiliency seekers we aim for a system in which ever less time and energy are spent on infrastructure maintenance so that time can be dedicated to cultivating and optimizing the living systems on-site.

5. Resilience = Diversity × Redundancy × Connectivity × Manageability

The ability of a system to recover from disturbances is highest (1) when the system is composed of a high diversity of elements; (2) where there are backup elements to all crucial components of the systems; (3) where the connections between each component form a web with as many connections and modularity as possible, but (4) where the system is simple enough to be legible, manageable, and accessible for human participation—where the system's needs for optimization do not overwhelm the capacity of the human occupants to help meet those needs.

6. Regeneration Metric = Biomass and Biodiversity

Though impossible to simplify into any single formula, the most concise way I have been able to define



A high level of inputs is needed during the establishment phase to create a sharp rise in the biological activity and infrastructure that will last and add value over time.

whether an action is regenerative or not is to evaluate the answer to the following question: "Is the action increasing biodiversity *and* biomass?" Conventional farming, of course, is focused solely on biomass production, while conservation biology and ecological restoration is focused on biodiversity preservation and increases. Permaculture aims to increase the interdependency upon each other.

7. Facilitate the Vital Force

No hard line exists between living and dead matter. There is an animating presence in all living beings that seems impossible to isolate. This animating force makes regeneration possible, and our work is always to encourage its expression and to align ourselves with it, to receive its gifts—for the force is abundant and what it provides are most accurately described as gifts.

8. Human Management = Primary Limiting Factor

I have found that even on just ten acres, space, soil, water, infrastructure, and skills do not constrain the optimization of the site more than the capacity of the human inhabitants of the site to provide time, labor, and awareness services in the development and maintenance of the site. This principle is closely connected to Bill Mollison's "yield is theoretically unlimited" statement. Indeed, the yield of a system, since it is the synergistic product of air, water, soil, and many other components, is not limited by any one, and only one component leverages them all together—human management.

9. Stress as Stimulus

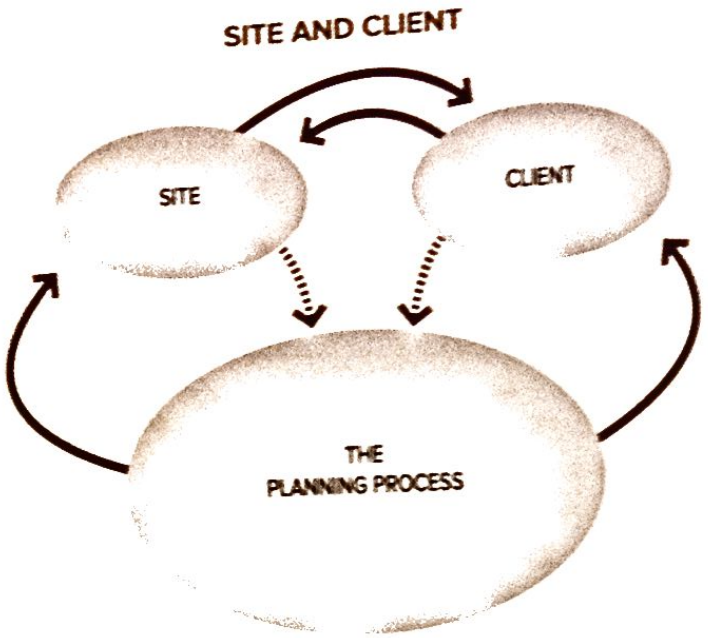
We are after the rhythm between rest and stress that promotes the most biodiversity and biomass.

10. Responsiveness, Not Habit

As mentioned in other areas of the book, the most effective actions, though sometimes stemming from positive habits, are not limited by habit but are informed by habit. Such habits promote awareness. This awareness allows us to see what novel ways of responding to conditions are required. Responding to new and emergent conditions (always the case) demands that we can act in ways we have never acted previously.

11. Human Resource × Site Characteristics = Ideal Site Design

An "ideal" site design, though hypothetical, is a useful goal. This selection of elements and their positioning in the landscape is never the same from site to site because they must be wholly responsive to conditions (of both humans and nonhuman components) that always vary from location to location. Therefore the "ideal" design



Both the site and the client feed a planning process that in turn feeds back into the site and the client through implementation.

must be completely referenced from the site's characteristics and the human resources in place, which include number of people, interests, skills, ages, and other factors. Give five groups of people the exact same site, and their five designs should not be the same—no one design is correct in such a situation—and the best one is so because it is suited in part to the humans inhabiting the place, not just the other site conditions. In this way there is no "correct" design for any one site. What's true for you is going to be different from what it is for others. Plan on it. So don't simply copy another's approach thinking it will give you the same results, as, likely, it won't.

12. All Design Should Be Modular

Since the future of both land and person(s) is unpredictable and guaranteed to change, good design and developments must be able to be added to, subtracted from, moved around, and adjusted constantly over time.

13. Structural Diversity Begets Biological Diversity

Biological diversity is often most limited by the physical three-dimensional structure of a space. This is a commonly cited principle in marine ecology that is highly visible in the example of a sunken ship landing on a bare sandy sea floor. Life flocks to such a situation where little existed before. So, too, is this phenomenon in effect in terrestrial systems seen especially at the edge between field and forest, in swale-mound systems versus flat fields, and other situations where three dimensions of complexity exist rather than simply two. Promoting this positive effect encourages us to develop structure, whether it is buildings, swales and other slope elements, trees within fields, or other such spatial changes. Organisms exploit edges and structure constantly—when you add structure you see the results quickly.

14. Attitude Affects All

The outcome of any action is highly determined by the mental frame of reference used by the actor. One has the power to shift this without dependence on outside events, people, money, or other resources, so one's own attitude management is highly empowering.

15. Spread Pulses

The most resilient systems spread intensities across time for maximum value absorption into the system. Examples of this include slowing, spreading, and sinking water via swales, terraces, ponds, and paddies; thermal absorption in high-mass materials such as stone and water for release when ambient temperatures are lower; fertility spreading via keyline ditches from concentrated areas such as barnyards to low-fertility areas; and delayed processing in the harvest season when crops can be put aside for processing because time is more plentiful.

16. Disperse and Extend Fertility

On all sites there are zones of nutrient concentration and/or high productivity. It is the job of the regenerative designer-maker to spread such fertility from areas of concentration to areas lacking fertility. This strategy includes both dispersing fertility across space and extending fertility across time; for example, space: biomass harvested from a productive pasture moved to feed animals while they are in less fertile paddock; and time: using humanure/urine generated in the winter to water and feed plants in the growing season. This principle ties in closely with the principle of spreading pulses.

17. Land as Value Distillation Tool

The land system as a whole and all elements in it (including people) is useful to view as a tool for concentrating the most beneficial yields, including medicine, food, fiber, materials, and fuel. A landscape should be thought of as a net that is constantly being cast, through which the gardener–farmer–solar energy angler reaps the most positive interactions among sunshine, soil, rain, wind, plant, animal, and fungal activity. The regenerative and resilient designer-maker is a facilitator in this interplay between forces, the overyield of which can be stored, shared, and accrued as fertility to be cycled (banked) back into the system to continually bolster the principle over time. With the principle constantly being increased, the interest (yield annually) offered by the system can also continually increase over time.

18. Multiple Functions from Single Expenditures (Always Do or Get Two or More Results)

A primary permaculture principle—all elements and actions/processes ideally always yield more than one desired result: A duck fertilizes, reduces pests, and makes eggs and meat; urinating outside allows you to see the status of a plant, health of an animal, or a pest eating your basil, while offering fertility to the site. If anything you are doing seems to yield a single result, closely evaluate if there is not a better way.

19. Moving Things Is Entropy

It's easy to get multiple results from some single actions—think of planting a tree: You're fertilizing the soil, weeding, inoculating, being healthy, and putting a new plant in the ground all at once. Moving something from one place to another, however, tends to yield less value than it costs in time, energy, or materials. Hauling a bucket of water from one spot to the next or driving a cord of wood from one area to another offers little benefit except the result of a material in a new location. Simultaneously, it carries a cost of energy, time, and usually money being spent while compacting soil where one walks, potentially hurting one's back, killing something in the path or road, and so on. The most optimized sites

Every element of a system should serve multiple functions; a duck fertilizes, reduces pests, and makes eggs and meat.

The most optimized sites reduce wherever possible the need to move materials from one place to another.

reduce wherever possible the need to move materials from one place to another. Where moving needs do exist, they are done as passively as possible. Granted, we all need to move things actively: I move a lot of firewood, but every time I move firewood, I realize that the same effort I put into such a task could be applied to tree planting, soil inoculating, plant or animal tending, sowing, or innumerable other regenerative actions. Given this reality, it is important to continuously evaluate what you're moving and why, and how to reduce moving needs so that energy spent there can be applied to more regenerative actions.

20. Value across Time

The most potent values in a system are yielded across the greatest length of time; for example, nut pines such as *Pinus koraiensis* and *Pinus cembra* take twenty or more years to begin bearing but yield for four hundred or more years. Plums and peaches bear within five years and yield for thirty to forty years. Nut pines are made up of mostly rich fat and protein; plums and peaches are tasty but offer mostly only sugar and basic vitamins. The best soils in the world weren't built overnight but over thousands of years. A chestnut can outyield a cow in terms of nutrients without needing any food to be provided for it, but it takes a decade or so to begin bearing, whereas a cow starts bearing quickly.

Examples of durable abundance and vigor in human cultures are always most manifest in examples of people living in close contact with one another and their physical places for many generations. The best things usually require a wait. Working on a longer time horizon than is typical in the early twenty-first century on Planet Earth is crucial to developing individual, community, and land health.

21. Essential Functions Provided by Multiple Elements

If it's essential, ensure that you have multiple ways of provisioning that need; for example, I can get water from the well via pump in normal conditions; via the well via pump via generator when the grid is down and the generator or pump is broken; via a spring and tubing when the grid is down or via rooftop catchment into barrels; and via a 50-gallon storage tank in an attic or ponds and buckets if all else fails. Barring something too extreme to plan for, I am going to have water.

22. Simplest Solution Is the Best Solution

There are numerous ways to solve almost any challenge, but the simplest approach involving the fewest steps and least energy, materials, and time is always the most effective, long-term, viable solution.

23. Efficiency Does Not Equal Resiliency

Simply because a system transfers energy or materials quickly or with little waste does not mean that such a transfer is durable in the face of shifting conditions. For example, watering multiple five-hundred-foot rows of tomatoes with manufactured fertilizer injected into water and distributed via drip lines is highly efficient at what it does *on the farm*. Take any one of the inputs needed to make this system work out of the equation, however, from shipment of fertilizer to pumping of water and you'll see how brittle the system is. Highly efficient systems often actually come to us courtesy of compromised resiliency. Often, we must make a choice between durable, adaptive but somewhat inefficient systems (in the short term) and systems that offer extreme efficiencies in the short run but at the cost of brittleness in the long run. Resiliency necessarily carries with it an extended time horizon.

Resiliency necessarily carries with it an extended time horizon.

24. Increase Diversity, Don't Reduce it

The task of the resilient homesteader is nearly always one of promoting diversity. This becomes particularly challenging when pest issues arise. The conventional response is to remove a biological element when

pest problem occurs—in permaculture we generally try to figure out what to add instead. Asking the question "What eats this?" is often one of the most useful approaches to such challenges.

25. Quality-Quantity Relationship

In general the smallest production system can produce the highest quality yield, while quality is usually reduced as production scale increases.

26. Scale and Proportions Are the Most Difficult

In the design of any space, remember that it is most often the overall size of a space and its proportions that are chosen badly, not the quantity, type, and position of components in the design. It is often very difficult to get the proportions of a space optimal, and a desirable result is a dynamic product because no two spaces are the same: You can't just copy the proportions from a space you know and have the system work out in exactly the same way in a different location. This is where the "art" of design often comes in. It pays off in spades to get experience into the equation at these junctures in the process.

27. Oil Intervention

As discussed earlier, rather than not using currently available and inexpensive fossil fuel, one can use the existing flow of such a resource to establish systems that do not require fossil energies to operate perpetually. Think of a swale as an example: It requires forty hours of labor to dig, say, two hundred feet of swale or thirty minutes of excavator use and eight ounces of diesel fuel. Not using this eight ounces of fuel (or call it a hundred ounces of fuel with a pro rata of embodied energy in the machine) won't undo the fact that such fuel will be burned up in other avenues such as by the US military or your neighbor in his SUV making an unnecessary trip to go shopping. The point is simply this: Use it or lose it. Intervene in the oil flow, and apply the potent energy to establish long-term systems. Choosing not to simply means that you'll be digging for many years and the systems' overall development will take many times longer than would otherwise be the case. Imagine our children digging paddies and ponds and swales and wondering why we didn't establish these systems while the digging was so easy.

28. Probability × Impact = Risk

The likelihood of an event's happening times the severity of that event if it occurs defines risk; for example, economic recession versus a comet striking Planet Earth or getting the flu versus contracting the Ebola virus. Sound planning is risk based.

29. Niches in Time

Good planning and action always make use of an opportunity in time—the "moment." There is always an optimal time to perform any action—never is it as good to perform an action "whenever." Often, an action is *only* appropriate in very small windows of time.

30. Zone 1 Site Mimic

Given that awareness, time, and labor are the limiting factors to maximum realization of abundance and health on most sites, and that many sites are simply too large or complex to tend with complete diligence, mimicking the entire site as much as possible in zone 1 enables the human inhabitants to survey the entire site by inspecting zone 1; for example, planting a few of every species in zone 1 lets you know what is fruiting in more distant zones of the landscape that are easily missed. I often miss the first honeyberries ripening because I have no honeyberry in my zone 1—the only plants are in a zone 3-ish area that I do not frequent. A few "barometer" honeyberries such as I have with seaberry, currant, and mulberry tell me when I need to walk a few hundred yards into zones 2-3-4 with a bucket to harvest.

31. Past Is Precedent

Exceptions to the general pattern of history are rare. When planning actions the regenerative and resilient designer-maker must aim for the highest and most beautiful possible outcomes while simultaneously being aware of the most likely future scenarios. This resilient designer-maker uses history, rather than pie-in-the-sky fanciful visions as a guide in this work.

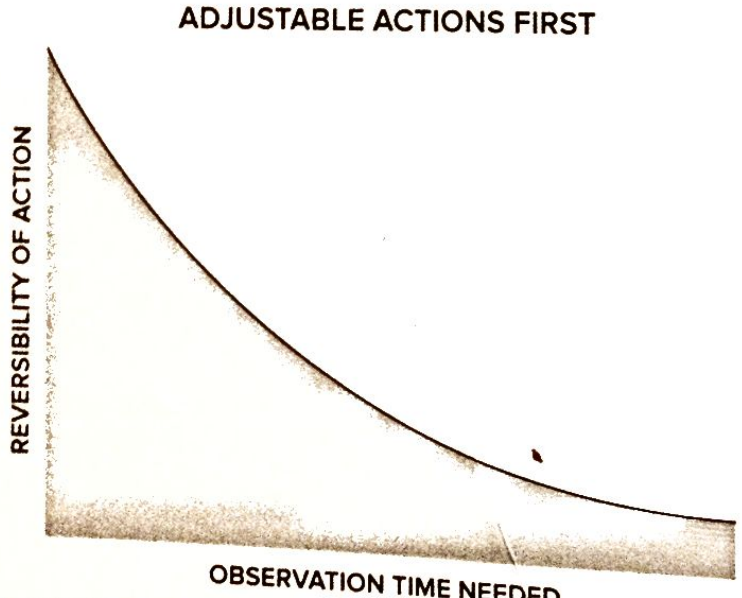
Resiliency and Regeneration Habits of Mind

32. Good Design Always Empowers

Any system that promotes regeneration, resiliency, and adaptability empowers the human beings, plants, animals, and other forces acting in the system. All good design facilitates the free, conscious, and subconscious actions of members within the system and encourages the *manifestation of instinct* by all members of the system. Good design allows rather than restricts, encourages rather than suppresses. Good design is suspicious of "rules" and sees regulation as an indicator of an area in need of attention and improvement. This does not always mean that an optimal system is completely nonhierarchical, though in general it is relatively nonhierarchical. Good design always facilitates the manifestation of all the genius latent in each member of the system, and usually, rigid hierarchies do hinder that.

33. Passive versus Active Observation

Permaculturists are fond of the dictum, "Observe, then do." While passive "observation before action" is necessary, so, too, is observation through action. Much of what is necessary to learn in human habitat development and management can only be learned through experimentation with various approaches over time. Many aspects cannot be learned through passive observation alone, and attempting to figure out a challenge without doing is often impossible. We must begin planting, building, *acting* to learn about the system more thoroughly. I learned far more about the soil and its variations on this site in two weeks of planting trees than in three years of observation through walking and looking. In retrospect, this should not be surprising—getting one's hands on the material at hand (soil, plants, water, and so on) is the most direct route to actual seeing. This should not discourage deep detective inquiry through reading the landscape's plants and other ecological indicators, but should remind us of the limits of indirect contact.



The most reversible or changeable actions should be carried out earliest in site establishment, while the most irreversible should be carried out after more passive observation.

34. Observation Action Chronology

In reference to the previous principle, it is important to note that the most irreversible actions should be conducted following the most passive observation while the most changeable actions should be conducted earlier in the development time line.

35. Two Is One, One Is None

Elements fail; crucial elements must always be backed up. Things fall apart. Rust never sleeps. Entropy is. If you need it, back it up. Ensure that it is redundant and, ideally, alive; for instance, the most durable food storage is chickens in the yard, cows in the barn, vegetables growing in the garden, kimchi in pots underground.

36. Character of Work over Time of Work

When deciding how to allocate time, it is easy to forget that the type of work involved in a task is often more important than the time needs of the task; for example, digging holes for a couple of hours is less desirable work for most than splitting wood for four hours; pruning for a day is more practical a task than hauling slash for just four hours. In general, heavy, dirty, or toxic jobs should be planned out of the equation as much as possible in place of jobs that may require more time but less brute strength. Personally, I'd rather mow with a scythe for half a day than run a weed whacker for two hours, for instance, all things being equal.

37. Immerse in Abundance

The vital force tends to produce abundance. Since our task is to facilitate this abundance, we must immerse ourselves in it to know it, to encourage it. Immersion in abundance also serves to expand our perspective and allows us to work from a frame of "enough," not of scarcity. When we work from a reference point of scarcity, there is never enough to go around. Without harnessing abundance as our guide it is unlikely that we will cultivate truly regenerative and resilient systems.

38. Maximize Site Awareness

Take advantage of all opportunities to increase sight-line distances and clarity of that distance. The area that you can hear on a site and the acuity with which you can hear activity in this area is of crucial importance to managing a site well. And all ways of sensing what is occurring on the site at a given moment are helpful. See expanded explanation of this principle in the grazing section of chapter four.

39. Embedding Skills and Practice in Daily Routine

Life gets too full and time too limited for all the important skills of a land-based lifestyle to be practiced enough if they require many hours of practice in addition to daily needs and chores. Therefore, integrating the skills we'd like to develop into the regular daily rhythm is crucial to actually practicing them. This occurred to me clearly one day as I found myself in the middle of a few-week period of making my morning coffee on a mini wood cookstove that I use for camping and emergencies. I made the fire with a fire steel using no match or lighter. This took maybe a minute longer than it would have with a lighter but allowed me to practice an important fire-starting skill while accomplishing a normal daily task. Such rituals can also be highly satisfying.

I have found similar opportunities to embed skill development in my daily routine and always seem to find that they often take a little longer than the easiest, least skill-intensive method but far less time than dedicating specific nonroutine time to them; for example, taking an hour to work out when I can haul firewood by hand instead of using my truck or jogging to the mailbox instead of driving. This principle is also connected to the concept of designing in challenges to one's daily life, such that vigor and skills are maintained during the day: I use ladders instead of proper staircases to go between floors in my studio-shop. Sure, stairs would be easier, but the steep ladders keep me more nimble, healthier, and probably happier, too. Ease should not always be the goal, and it is often actually counter to maintaining the most vigorous, aware, and satisfied existence. This is not to say that having easier backup ways of getting around in the case of injury or friends and family to help would not be a good idea.

40. Skills = Most Durable Resource

Beyond land, tools, money, even friends and family, your own skills—including those soft and hard—from growing a potato to making a friend, are your most dependable asset. Your land may be taken from you or your job downsized. Some of your friends and family will certainly leave this life. Your tools will rust or break and can be stolen or lost. But your own aptitudes are there for you to rely on no matter the condition of the world in which you find yourself. And with the right skills you can make every other resource from the world around you. Skills are the foundation on which the rest of your life value is cultivated.

41. Awareness Limits Action

Action is only as productive as one's awareness allows. You can't do more than you can see, hear, feel, know. Therefore, sensing as much as possible is key.

42. Environment Limits and Manifests Action

In the same way that ecological succession is informed by the seedbank available, disturbance forces acting upon the site, and other factors, so, too, does personal mental evolution depend on factors in the environment. We need to stack those factors such that our design aptitudes are enhanced over time. In this way we need to be our own continual health-care (mental included) practitioners. Our surroundings limit or empower our minds. The resilient and regenerative homesteader therefore must enhance her own surroundings for her

to actually be able to carry out the work of imagining and implementing positive solutions. A poor environment retards this ability.

43. Solutions = Alignment

Solutions tend to emerge from alignment with, not opposition to, forces—not from resistance but from transformation. This is how water works.

44. Figure It Out: Try Stuff

Many of the most needed solutions and approaches have not been figured out, and if they have been, they have been in different places, periods, and groups of people. We each need custom solutions specific to the uniqueness of our lives and places. These always vary. Because they vary there is no instruction book we can follow to gain all the necessary solutions. Trying a wide variety of approaches is crucial to finding the best solutions specific to your unique situation. Fear and lack of confidence retards this. Be confident. Try stuff. Those who have figured out important approaches most often happen upon them by simply trying a variety of tactics.

45. Miracles Everywhere

Stepping back for a moment amid our daily routine, we can sometimes see that each flower, each animal, raindrop, and breeze, is itself actually a miracle in disguise. I say "in disguise" because our minds tend to quickly come up with answers as to why and how something exists—whether it's the moon, a rainstorm, or a snowflake. Yet when we probe and trace the lineage of anything as far as we can, we indeed find that each thing is linked to every other thing and a source for each thing cannot be determined. Everything arises, emerges. At its core this seems clearly unexplainable, both in scientific and other terms. The practical implication here is clear: the moment we believe that we have the full explanation of why something happens is the moment we begin limiting our vision as to the phenomena at hand. Remembering that we are only seeing part of the vast and mysterious processes underway in each phenomena around us actually allows us to see, learn, and do more as designers. The concept of miracles, therefore, is a highly practical one.

FOOD AND FERTILITY

46. Constant Organic Matter Accumulation

Aiming to build soil fertility and nutrients, suppress weeds, decrease drought vulnerability, and produce a constant stream of garden soil, the homesteader and farmer should be in a constant state of collecting organic matter. We harvest from neighbors' driveway edges when the leaves build up in the fall, from under pine stands for the blueberries, from local arborists when they've got a truck loaded with chips. Any and all sources of organic matter are good as long as you ensure a low level of toxicity in the material.* *You can never have too much compost.*

47. Paths as Biomass Producers

At more than very small scales in cold-temperate climates, paths will eventually be grass and other herbaceous plants—even if they start as gravel, woodchips, or even pavement. Such pathways should serve as biomass and soil production for other areas by composting and mulching with harvested plant matter (hay).

48. Seed Often and Lightly

Since successful germination of seed in land renovation requires consistent moisture (not a deluge or a drought), the most successful strategy we've used is to seed lightly but very often in land renovation/enhancement work. This means we seed starting in late March—frost seeding of clovers—even while snow melts back. We continue to seed areas that are in poor condition (abused and abandoned) from three to ten times per season, aiming to seed especially before July, when seed can best establish and moisture is most reliably available.

49. Passive Forage-ability

The entire landscape should be managed as an intensive foraging zone—this means "stocking" the site with the most multifunctional beneficial plants (and fungi,

* Avoiding leaves from oft-used roads is key to reducing collection of benzene and other toxins. When collecting bagged leaves in a local town, we avoid yards with Norway maples or black walnuts in them—those trees produce leaves with toxic compounds We also avoid manure from farms whose practices we don't know and trust to preclude pharmaceuticals in the material.

sometimes even animals) (a) for which the habitat is made, structurally and biologically; (2) that are managed to balance as an overall system and maximize biodiversity and biomass; and (3) that are harvested passively while one moves through the landscape doing active or recreational activities. The most productive sites relative to the amount of inputs needed into the system offer yields to the forager within the landscape; one does not need to find food only in a garden bed or planted perennial zone. As an edible ecosystem matures, human food self-seeds and begins to colonize the site even in areas where it was never planted or sown. In this way there is human-ecosystem coevolution occurring. This relationship should be fostered wherever possible.

50. Plant as Densely as You Can Afford To

Because plants sometimes die and you can't go back in time, in addition to the fact that trees are much faster to cut down than to grow (you can get intermediate yields from dense systems before thinning), plant as densely as possible, with thinning happening later on. This is no different from seeding two to three or more times the vegetable seed you need in a bed and thinning the extras. Seed is cheap and you can save your own.

Plants can be as well. You cannot go back in time and put a thirty-foot walnut in where one died, in between two walnuts twelve years after planting when they were spaced forty feet on center to begin with. We try to plant at two to three times the "horizon"/final desired spacing with the intent to thin if no one dies in the meantime. We'll also see yields as the trees reach maturity but before they get too crowded. For example, we plant a bur oak silvopasture system that is ideal with spacings of thirty to fifty feet on center when fully grown (years fifty to three hundred or so) at ten- to twenty-foot spacings. We are already getting nut yields in years five to six and will continue to get some yields, most likely, for another ten to twenty or more years before thinning is needed. And then we'll have nice oak posts or other building materials.

51. Animals above Plants

Because plants are limited by nutrients—especially nitrogen—provided in large part by animals and their by-products, and because gravity never ceases, placing animals above the elevation of crop plants in a landscape is a primary approach to maximizing productivity. The best sites have an access road high in the landscape where a zone 0/1 exists, including home and barn. These nutrient sources are then easily fed via gravity and water (fertigation) downhill to plant-based cropping systems. At the WSRF we have positioned our rice paddies, many veggie gardens, and nut tree systems downslope from residences and the barn. Ponds, too, if you are growing fish, represent a nutrient source that can fertigate plants below. Animal by-products should flow into plant systems so that these by-products (N, P, K, and many other nutrients) fertilize plants. The direction of material flow should never be animal to animal, as nutrient overconcentration occurs in this configuration. Plant-into-animal-system flows are to be avoided because fertility is exhausted quickly in this scenario.

52. Pee on Plants (or Next to Plants)

Closing the fertility cycle between humans and the systems that feed us is fundamental, and there's no other opportunity to reciprocate the giving nature of plants so readily as urinating. Doing so is simply returning what was given in the first place, cycling, giving back, being in reciprocal mutualistic relationship.

53. Swales Everywhere

Swales are fundamental to a landscape that aims to reduce the constant effects of erosion and entropy. Swales stop the flow of water downhill, force the water to be infiltrated, make more soil-air interface (on the mound), and make more land, literally.

Ecology and Management

54. Disturbance Stimulates Yield

Resilience and regeneration tend to be highest when the evolution of the system is stimulated by disturbance (stress) events combined at the right interval with rest events to build biological vigor. An example of this is clearly illustrated by the way intensive rotational grazing works: Plants grow tall and deep, grazing occurs rapidly, plenty of rest is applied to allow full plant

ecovery. The biological deepening of the system is naximized by a correct tempo of rest-stress–rest-tress, similar to the way fitness and muscle building ccurs in the human body, not from all exercise all the ime, not from all sitting on the couch all time.

55. Succession Determined by Disturbance and Its Aftermath

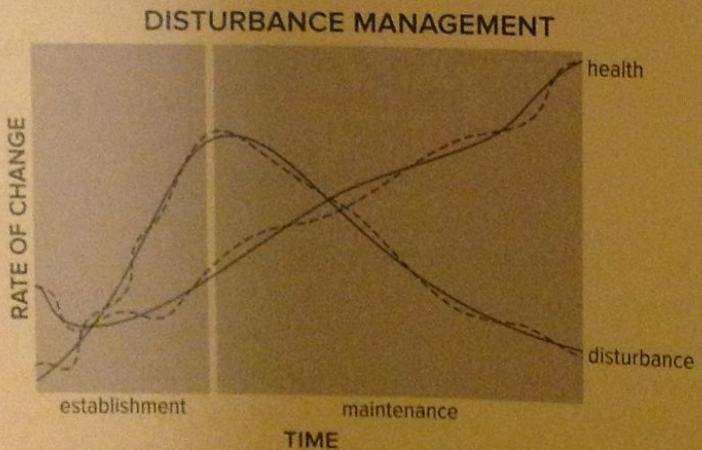
Because disturbances open niches for life to inhabit, ecosystems shift quickly immediately after disturbance. Disturbance creates opportunity and challenge: opportunity if the opening in the ecosystem is seized, challenges if the ecosystem is left to succeed "randomly."

56. Fill Open Niches Immediately

Whenever disturbance is applied, be ready to fill open niches created; for example, plant, graze, seed. Biology must follow technology (where technology is the excavator, fire, or the chain saw, and biology is plants, animals, seeds).

57. Systems Establishment Overshooting Management Capacity

There is a strong tendency for humans to develop systems that are too large or complex for successful management over time because of the future availability of time, labor, finances, intelligence, skills, or energy. In other words, the system-establishment phase tends to bite off more than the system-operation phase can chew.



An increase in disturbance during the establishment phase often helps system health increase rapidly.

58. Technique in Place of Technology

Wherever possible replace mechanical elements with biotic, living components—they last longer and yield side benefits such as soil, meat, milk, and fiber. They also reproduce and make more of themselves, whereas nonliving elements in a system are always decaying and need replacement.

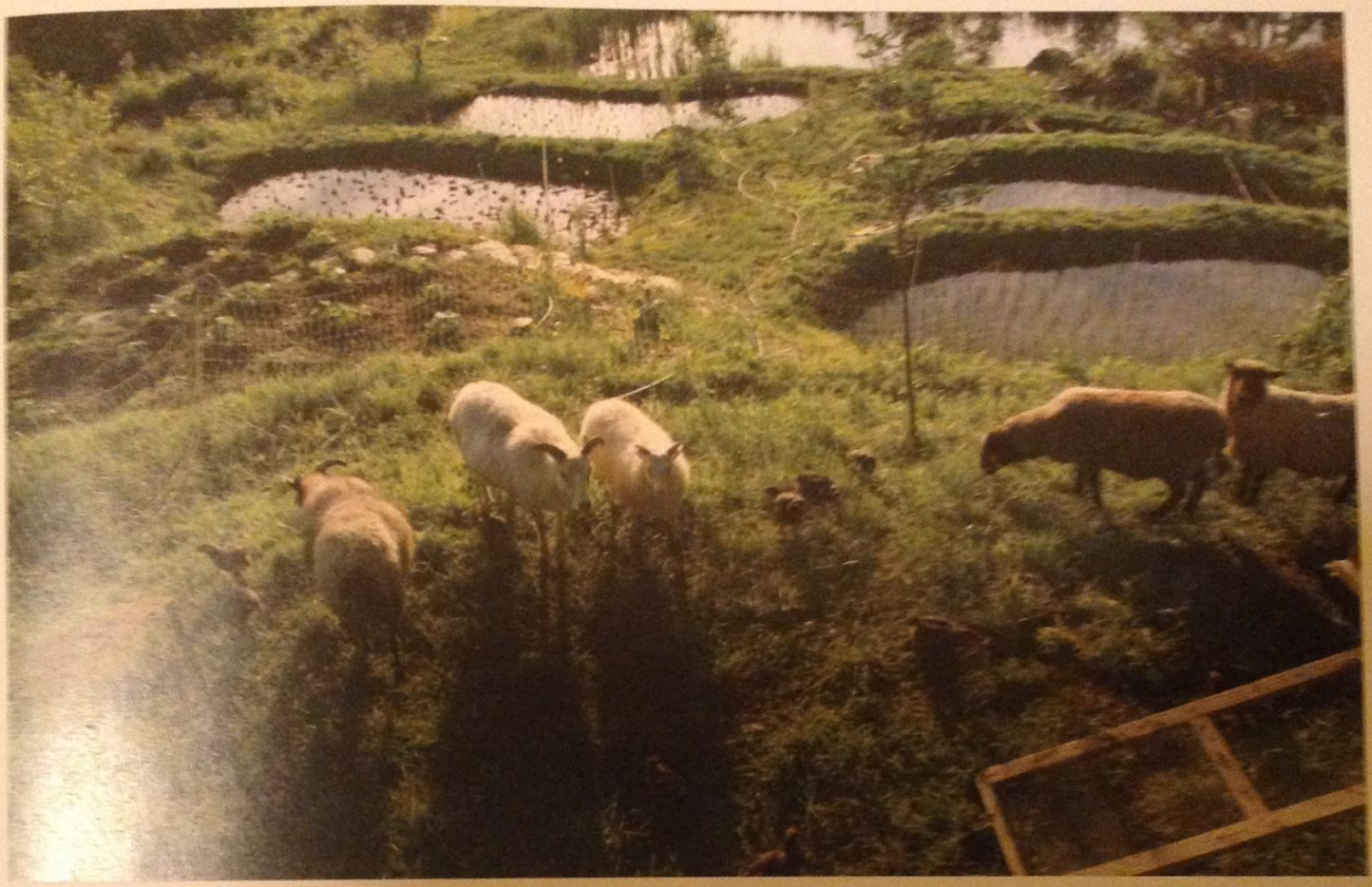
59. Annual-Perennial Balance in System

In general, the more growing space available, the more brittle the climate, the steeper the slope, and the less fertile the soil, the more crucial the role of perennial food plants; whereas, the less space available, the less brittle the climate, the lower the slope, and the more fertile the soil, the greater the role annuals should play in an agroecosystem, if they play a role at all.

60. Modularity and Agility

Remember that planning and planners are inherently imperfect. We can only imagine and solve for so many possibilities. Lives always unfold in unpredictable ways: Conditions change (climate, economy, society, family), goals change, our health changes. The future is always being made in ways that vary from our vision of it. Therefore, wherever possible develop systems to be adaptable over time: Insulate the house with cellulose instead of foam so you can remove a wall and add on; stub out plumbing in that wall just in case; expose the wiring and plumbing when you can (you *will* renovate, nearly all of us do eventually if we stay in a home long enough); photograph and map utilities in the ground or in the walls; and so on.

People tend to hold tight to a specific vision, especially when real effort has been made to plan a project carefully. But the same planning that can empower can and does often blind. I witness this in the professional world of planning all the time. It's especially easy for planners and designers to cling to a specific vision, for they've thought it through. But we'll always only have a partial picture. Therefore, respect the changing nature of the future. Hedge your actions, and keep systems as adaptable as possible. Decide and make only as much as you need to. Defer decisions when you can reasonably. When wrestling with a difficult design decision,



Designing and constructing elements in a human habitat is the easy part; integrating them to optimize the function of the whole system and doing so in a manageable, not overwhelming manner is the real challenge. Photograph courtesy of Whole Systems Design, LLC

"We don't have to decide that now" is one of the wisest things people can say.

61. *Ecosystem Partnering, Not Stewardship*

Stewardship implies dominion, whereas partnership implies coevolution; mutual respect; whole-archy, not hierarchy. A partner is sometimes a guide, always a facilitator, always a coworker.

62. *Partnering with Vigor*

One of the regenerative designer-doer's primary tasks is to facilitate vigor and vitality in the ecosystem she is partnering with, identify that vigor, bolster vitality in areas where vigor is low.

63. *Sculptable Landscape*

As an edible, multifunctional ecosystem matures into a multilayered annual, perennial, and grazed system, the need to prune back plants becomes significant, both to continue allowing sunlight penetration and for optimal soil building. We need to plant systems very densely to do the rapid soil/water/site enhancement necessary and to promote maximum yields. Root dieback events caused by pruning/coppicing/grazing are crucial in this regard. Grazing can provide this service in the understory, but to cut back plants too significant to graze, we need to prune/pollard/coppice. Developing a landscape as a three-dimensional sculpture of sorts becomes a clear need as the system moves into "the pruning phase." We primarily prune black locust, alder, willow, and seaberry in this capacity. In the tropics there are dozens of species—mostly N-fixers—used in this way.

64. *Native to When*

When using the term "native," what year do we use to determine whether a plant is "from here" or "alien"? If