Chapter 6
Who’s got your back?
Responsive redundancy

An adult tiger grows old and dies,
Our government is old, decaying, and ready to die.
Our revolution is young and bound to grow. These are the laws of the universe.

*Everything has back-ups in resilient systems. Who will manage your farm or business if you get sick? Do you rely on just one supplier or one market? What if they disappear? Will anyone take over your farm or business when you retire or enter the Ω phase? Are you so focused on efficiency that you’ve forgotten about back-ups to get you through a crisis? Do you find it easier to just do the job yourself, rather than train someone else to do it?*

**Two central aspects of redundant systems.** Resilient ecosystems reproduce themselves and have overlapping subsystems which perform the same functions in multiple different ways. These are the two central aspects of what ecologists call redundancy. As managers of social ecosystems, how do we create systems which back each other up, bolstering our businesses? How do we build redundancy into agriculture and what does that look like? In creating an ecologically resilient system we must create designs similar to living ecosystems—which all contain myriad redundant systems. We discuss in other chapters the interconnectedness and interdependence of nature through symbiotic relationships and partnerships, trading nutrients and moisture to ensure that the whole system is resilient.

We see this redundancy in the overlapping functions of different insects and other species. Many different agents in the resilient ecosystem perform the same function, but are so dissimilar in other respects that disappearance of both simultaneously is improbable. Woodpeckers and carpenter bees alike drill holes into wood for either food or shelter and as the wood deteriorates those holes are steadily filled with mushroom spores and other bacteria that colonize the wood. All these different species all perform the function, in their own way of deteriorating the wood and continuing the adaptive cycle of the forest. The power of backups in ecological systems is that if the woodpecker becomes extinct, the carpenter bees will still fulfill the same purpose, developing holes in the wood for mushrooms and bacteria to colonize the old trunk.

The key element to redundancy in these natural systems is the ability for the process to continue without one, or more, individuals or species present. This is due to the amount of different ways that one task is achieved by many different species in the forest, farm or other system. There are many ways to skin a cat, what’s important is that the redundancy is accomplished.

In our own systems we can look for ways to build this kind of multipurpose function into our projects and our processes. Take the average apple orchard worker, how many ways can we build redundancy into the work that is done? If all the orchard workers, regardless of their primary tasks, are looking for
pests and disease, water line damage, or deer damage, you have increased resilience by increasing redundancy. Moreover encouraging people to fix those issues as they arise by supplying the tools for the job further enhances resilience through redundancy. The more functions that one person or piece of equipment can perform, the higher your redundancy; just as in the forest.

This kind of multi-angle approach lends opportunities for ingenuity and adaptation as people become more adept problem solvers. Adaptation is key to ecological resilience in times of disturbance and it is up to you, as the manager, to leave room for innovation and inclusion of new and more effective systems. Nature does the same thing every time a certain insect or species is removed, creating a disturbance. The system adapts to fill the void with existing species all performing the function, in slightly different ways. This approach echoes the principals of complementary diversity and conservative flexibility, urging us to look for ways to diversify our knowledge with complementary concepts and accumulate tools to construct flexible systems that are also field tested.

As manager you must move past the notion that backups are extra or somehow fundamentally unnecessary to ensuring the continued life of our systems. As we build backups of tools, equipment, people and partnerships we create a buffer around ourselves to absorb unexpected shocks. Those unexpected shocks like illness, natural disaster, market collapse or equipment failure represent the disturbances that require us to innovate, be flexible and change—to reorganize and grow from our experiences.

The only way that nature recovers in the wake of a forest fire or flood is due to backups of seeds, deep dwelling microorganisms, trees and external inputs from birds and other creatures depositing new seeds and fertilizer back into the soil. The seeds in the forest analogy are like your tools, equipment and physical infrastructure, while the transitory birds, wind, sun and other creatures are more like your community partnerships that aid in your recovery from the outside.

What is your perception of backups? Do you consider yourself to have ample backups? What do they look like? What items can you replace easily? What people would you call if you faced something unexpected?
**Redundancy at larger scales.** Societies with low fertility rates will be replaced by societies with high fertility rates as we’ve seeing in North America, Europe and Australia today. At a slightly less expansive scale, if there are no new farmers coming into a particular area, the agricultural system cannot last. As the accompanying graphic shows, in much of the country, especially the South, the average age is amazingly high. Even worse, the number of beginning farmers seems to be dropping in nearly every state. Twenty percent fewer beginning farmers (those farmers who have been farming for ten years or less) were tallied in the 2012 Ag Census than in 2007.

The South had highest declines in new farmers from 2007 to 2012 as illustrated in Figure 2.

![Figure 8 Average age of principal operators by county according to 2012 Agricultural Census.](image)

![Figure 9 Average age of principal operators by state according to USDA Agricultural Census 2007 and 2012.](image)
There are pockets of young farmers near major urban areas. The counties surrounding New York City (NY), Boston (MA), and Ithaca (NY) have some of the youngest farmers across the nation, including an average age as low as 37.4 years. The average in most Southern states is close to 60. Our case studies and other anecdotal evidence indicates similar pockets of new and younger farmers exist in the South, but are not large enough to move the state averages significantly.

The lack of redundancy at the state and national scale is being addressed by various Beginning Farmer programs which are well-documented and will not be explored in this chapter, though some links and organizations have been listed in the building physical infrastructure chapter. Instead we will focus on aspects of redundancy that can improve as a manager in your farm or business. We’ll begin at a very basic level.

Consider physical items like tools, equipment, scrap metal or replacement parts. Do you have just one of everything? Are you a minimalist in your tool and equipment sheds? Though this minimizing can help decrease clutter and wasted space, it is important to weigh the benefits of having some extra tools on hand and replacements for common tractor parts.

As with every factor of ecological resilience, you can take this philosophy as far as you care to; horses and carts in case your tractor fails to hand pumps on your well in case of a power outage. Though as we discussed in Building Physical infrastructure, it helps to be aware of our scale and what that scale requires. If we build physical infrastructure that are ill suited or clutter our spaces to a point of deteriorating function, they are no longer physical infrastructure. It is similar with backups, that for them to be of use to us, we must consider how many we have and whether they encumber or support.

Our goal is not to suggest that you should have 2 or more tractors, 5 shovels and rakes, 10 children growing up to be farmers and an absurd amount of screws and nails lying around. Though, if that’s reasonable and appropriate for you given your scale, skills and situation, do it! Ecological resilience is case specific, custom made and always adaptable.

Now, consider a broader definition that is less definable that encompasses yourself, your organization, your neighborhood and your community. These are all examples of redundant systems around you that can offer a perceptible amount of support. You yourself are a dynamic human being that is prone to innovation through your ability to plan for the future. Your system, whether it is a farm, marketing system, distribution center, or any other layer of agricultural business must have redundancy built into its management scheme.

Redundancy is a term common in many other professions, though its application is often different depending on the task at hand. Ask any computer programmer about redundant systems, and they’re very familiar with the term because they build computing systems that must not fail. In order to assure continued performance from their programs, they build in back up functions and latent programs that are dormant unless something else fails. For programmers, failure is expected and accounted for in the original design.

Similarly in engineering, parts and processes are provided with a ready duplicate as fail-safes in case of equipment failures or errors. The difference between the redundancy common to programmers and
engineers versus ecological redundancy is the nature of replacements. In ecological systems that are
resilient, the backups and redundant systems are often similar but are never the same. In the wake of a
forest fire, the forest will often mature to the same types of trees, shrubs and herbaceous layers, but
the layout and exact proportions will never be the same. Innovation and expansion are the keys to
redundancy in ecological systems, including you own.

Do you have any back up plans for your business? As our economy, planet and culture continues to shift
and change, it behooves businesses to be able to respond to those changes with speed and efficiency. In
times of unexpected change, do you have time to think of a new plan? It’s quite stressful to manage the
passing of a failing system while coupled with the need to design a new one.

These backup systems can be simple, or complex, ranging from keeping bees as a source of potential
income, keeping an array of different seed varieties that you can use in case of crop failure, to having a
few different business plans in the filing cabinet that you know you’re good at and can launch in a timely
manner given the physical infrastructure that you have.

Planning for the future

“The world is right when the old man plants a
young tree knowing that he will never sit in its shade”- Unknown

Whatever you’re building, what’s the plan for the future? How large to do you want to grow? How fast do you need to
get there? What considerations can you make now that will support the future? This kind of long term planning,
insinuated in the quote at the beginning of this section, suggests that we need to think beyond our own short life
span if we really want to build a resilient system. Consider this stance as you build the infrastructure around you.
Succession occurs in stages over a period of time and it is up to you as the innovator to create a road map for success.
Also consider that future conditions will certainly not be as they are today. Insure you have alternate routes built in,
ready to go.

In our model of ecological resilience, there are many cross overs between factors, one factor relating to
many others. This is still the case with backups in that the most resilient models we saw in our study of
the South boasted strongly diversified markets that developed multiple tiers of production that were
complementary. In complementary systems, redundancy is implicit in the design, as redundant systems
are made of complementary processes. Let’s say you want to start, or currently operate, a dairy farm.
What else can you do besides sell milk directly to an outlet or to consumers? What about your “waste”
products, can they be turned around into a useful and marketable product? Whether it is excess manure
from your cattle, the cream from your milk, or the occasional bull that is born to your breeding heifer,
there are opportunities for alternate markets throughout the operation. The same can be said for any
kind of product, though some things like honey are more prone to multiple value added products than others.

**Consider Your Scale**

How large is your operation and what are your goals for the future? Scale begins now and into the future with consideration for how and what you want to produce. If you intend to produce 2, 3, or 4 times more than you do now, it would be wise to plan on building to suit your future needs, rather than present. While you are planning for the needs of the future, how can you build in redundancy and backups? Perhaps you think you need 10 stalls for your livestock, consider building 15 or more. The last thing you want to do is to limit your growth by building too small.

On multiple occasions with our interviewees we saw that the structures and systems they built for their businesses soon became too small for their growing demands. Take L. C. Ratchford in the Searcy case study. This buffalo producer in Arkansas constantly felt the barn he was building was too large and he would never use the space. Just a few short years later as his business has grown, he has run out of space. This happened over and over again during our study across the Southern states.

The same applies for hiring employees, consider how many hands and people you will need to complete a harvest or certain task on your farm in the future. Take that amount and consider the amount of time needed for each employee; are you going to produce enough to cover the cost? If your crops have issues do you have any alternate opportunities backing up your operation to make money to pay your staff and continue to build your business?

Moreover, as you are organizing people to work with you consider who you can call in an emergency. When we begin to work with others we are presented with opportunities to grow our businesses and networks, at the added expense of the chaos of other people’s lives. Whether its children, illness or the need to get away for vacation, everyone –including yourself– needs to be able to figuratively and literally call in sick. The ability to step away from the farm is perhaps one of the most critical components of redundancy in today’s agricultural climate. Everyone is susceptible to issues outside of their control that require them to leave their property. Do you have the capacity to leave for a day? What if you are required to leave for a week? Who knows what needs to be done at your farm and how quickly can you train someone? Even without an emergency, it is healthy and necessary to be away from the farm to attend social gatherings and celebrations that enliven the spirit. It is clear from research that everyone needs that ability to step away and have a different experience from their work from long vacations to sporadic weekend getaways and seeing close friends. Perhaps the most critical issue today is the aging populous of farmers in America and around the world who are at a higher risk for injury or illness requiring them to leave their farms.

If you look around farms across the United States, almost half of farmers are over the age of 60 with some well into their 70's. Many don’t have anyone to take over their farms and no exit strategy. With accumulated debt from purchasing tractors, fertilizer and pesticides every year, many large scale farmers are in debt. Older farmers are by nature at a higher risk of injury or fatality than their younger counterparts. It is imperative that a farm, especially if it is run by an aging operator, to have trained staff to manage duties that may become too challenging physically or mentally.

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204 USDA, National Agricultural Statistics Service, Average Age of Principal Farm Operators, 12-M123.
Another way to think of this future disturbance is building in accessibility and operational ease to your system at the get-go. What small ways can you make tasks easier on yourself during day to day tasks?

Integrate Handicap Accessibility

Let’s say your business is up and running, you’re generating products and getting them to market to develop an income. What happens when and if you break your leg, develop a debilitating flu, or pull a muscle in your back? Will you still be able to operate the critical processes that keep your business going? Organizations exist to help farmers get back to work from debilitating accidents like paralysis and amputation when they become disabled. The principles that these organizations use to make their work possible are often simple, ease of access adjustments to existing infrastructure. Whether it is a lift to get you into your tractor, raising your gardening beds or using dolly’s to move heavy feed, how can you make your operation more physically accessible?

As you walk around your operation, or as you are planning for one in the future, consider what things you feasibly could do with a broken leg. If you find that there is no way you could do a certain task, how could you plan for the possibility? Is there a 4 wheeled cart that you could use instead of your more maneuverable wheel barrow? Do you strain yourself every time you open a certain gate? If so, is there a way you could make that one motion easier for the future? There will likely always be tasks that require an able body, but what can you account for today that could aid you tomorrow?

The Tightrope of Efficiency

As you begin streamlining your operation to be more accessible in case of injury or unknown circumstance keep an eye out for the tight rope of efficiency. You want to build something that is physically more efficient while maintaining alternative approaches.

This also applies to your social and marketing networks. It may be easier to keep track of only one supplier but the risk is greater of shortages and problems in the future. In recent years in the wake of a tsunami in Japan a product supplier was wiped out causing massive shortages in one industry across the world. Though production, distribution and marketing were extremely efficient, the supply chain totally failed to account for challenges of the future. It could be a tsunami, tornado, drought or problem with management that depletes your supply of feed, fertilizer, equipment or anything else. It is imperative to have some backups in your supply chain and avoid efficiency for the sake of efficiency.

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Community and Social Backups

When you think of the word community, what images come to mind? Your business partners, friends, social organizations, community gathering spots like the town community center, local churches, maybe the leader of your local 4-H group? These are some examples of outlets within your community that you can reach out to for support. Whether you need products, services, a helping hand or some emotional support in tough times your community can offer you a safety net when you yourself have run out of options.

So often in rural areas, and cities alike, we can become isolated, working by ourselves, potentially suffering creatively for it. When we gather and work with others we increase our capacity for adaptation and innovation based on the knowledge, physical infrastructure and accumulated skills of your community. This community can be local or distant, made up of close connection or a loose ties, and as large as you can reasonable manage.

We cover community and networking in our modular connectivity chapter, but we must mention some specific aspects here because redundancy relies so completely on connectivity, community, and networking.

Developing Marketing and Distribution Opportunities

When we’re developing markets it’s important to remember the value of having backups in our clientele. Just as it is important to keep backups in our supply chain, we need to ensure that there is always a client to provide for. In agriculture if you don’t have a supply chain coming to and from your farm, what kind of value are you generating? These alternate markets can be small or large, maybe it’s a few business cards that you keep in your desk to call on in hard times.

No matter how much you secure those backup markets, it’s important to ensure that your products can make it into the market no matter what your current purchaser does. Too often large amounts of produce end up rotting on distribution floors because the market has shifted and the demand has been reduced\textsuperscript{207}. It’s not a formality to take business cards from potential partners, it’s an integral practice to ensure the viability of your operation.

More broadly, you may find opportunities you hadn’t considered before that can add value to your existing products. Consider canning and preservation groups that can take your excess produce to

\textsuperscript{207} Refer to “Little Rock in a Large System: A Case Study on Resilience in Little Rock, AR”
develop salsas, sauces, or pickled items; Groups and businesses that primarily juice vegetables and are often less concerned with appearance; Bakeries that may be interested in lard from animals.

You may find that as you open yourself to more market opportunities that you can start developing competitive price markets with some purchasers offering more for your products than others. These networks take time and creativity to develop but it’s worth bearing in mind as your business develops.

Interns, open houses and workshops. Tools for inspiring and engaging the next generation.

While you’re acquiring business cards to develop extra market opportunities, consider what other civic opportunities exist. Within most communities there are organizations that bring farms together with the community, like Slow Food International or Farm to School programs. Consider your goals for the future while asking yourself how you could open your farm to others? Some businesses go so far as to have farm days where people can come by in tour buses to view there operation, others host workshops where people learn to build a barn or plant trees. Depending on how open you are to having numerous people on your farm can determine how much you can achieve with the volunteer labor of your community.

In another light, consider also what kind of economic opportunities you can provide through your farm to ensure the next generation of farmers. With farm land dwindling, the average age of farmers increasing and general lack of capital sufficient to start a farm, many young people are looking for opportunities to develop their skills and work the land in creative ways.

Today, beginning farmers and ageing landowners are looking for unique ways to make the land transition from one generation to the next, especially for aging farmers that don’t have a retirement savings, plan, or heir to their land. This presents most farmers with seemingly insurmountable challenges for passing on their land. Nonetheless, with some creativity and a willingness to share skills and resources people are coming together to develop land transfer plans that benefit the aging operator and the oncoming farmer.

In some cases landholders will essentially lease their land to new farmers while remaining in their home thereby generating a retirement income. This is most economical if housing is very close to the farm or if there is a home on the property for the oncoming farmer. Overall it is agreed that housing new farmers in the existing home with the current landowner often doesn’t work out. Whether its personality issues or a difference in housekeeping it is highly suggested to live separately.

One organization working diligently on land transfer is the Land Stewardship Project based in Minneapolis, Minnesota. They work independently on projects like the Farm Transition Toolkit as well as collaborating and supporting statewide efforts like the Farm Beginnings Collaborative. Their efforts are inspired by the recognition that over the next 20 years (2015-2035) 70% of land will transfer hands in the United States alone. If nothing is done to effectively aid the land transfer movement it is likely that many corporate farms will simply buy up more land, expanding their mono-crop, soil mining practices.

http://landstewardshipproject.org/morefarmers/farmtransitiontools
http://landstewardshipproject.org/morefarmers/fbotherregions
By offering real toolkits to aid farmers in creating the financial plans, and legal backing to transfer their land, real opportunities are being created. The internet itself has opened the doors for countless aspiring farmers by offering technical training through satellite internships like what you can receive from The Virtual Grange\textsuperscript{211}, a program sponsored through the Stone Barns Center in New Jersey. Through online forums, videos, articles and listings for real apprenticeships, new farmers are learning about the field before they ever enter a real one.

If you’re considering offering internship opportunities like those that WWOOF\textsuperscript{212} or WorkAway\textsuperscript{213} offer, consider this housing issue very seriously. It will be best for you and the incoming intern(s) to have adequate accommodation. These two programs can offer a great service of helping to supply a workforce for your farm. These 2 services require you to supply room and board to oncoming interns which, depending on your productivity, may be easy to supply.

Interning doesn’t actively pass land onto coming generations but it does offer a way for growers to pass on their knowledge and skills. The more people who critically know how to farm the more resilient our cultural and world food supply becomes.

What internships, volunteer opportunities, workshops and open houses all have in common is the capacity to share information and raise cultural awareness of our food supply. Many children, particularly in city centers are largely ignorant of where their food comes from and how it is produced. When shown a carrot, potato or peanuts many inner city and some rural children don’t know that they’re all grown underground. They know even less about healthy soil, clear air or the importance of microorganisms and fungus. On the other hand, you as a business owner have the capacity to share what agriculture is with oncoming generations.

To list just a few organizations that can spur your interest and bolster your know how, take a look at these organizations: The Land Stewardship Project, The Stone Barns Center, National Young Farmers Coalition, the Agrarian Trust, Land for Good and countless other organizations like local Extension Agencies who are doing their part to fill in the gaps. Take some time online to research these and other organizations who are all making land transfer their top priority.

Consider seriously how you can pass your land on to the next generation of land stewards. It takes a willingness to develop relationships and spend the time to create a real plan for retiring land. It is easier to work with a realtor and simply sell your property to the highest bidder, but the long term view that ecological resilience requires shows us that it is imperative to ensure continued stewardship and development of rural farmland. Either physical or informational, your business contains knowledge that is critical to the development of our food system into a resilient and robust one.

\textbf{Building redundancy also builds innovation.} Redundancy builds out of networks. The resilient system is always using modular connectivity to build redundancy. A side benefit of these networks is often an increase in innovation which leads to increased success for members of the network. A vast literature

\textsuperscript{211} \url{http://www.virtualgrange.org/}
\textsuperscript{212} \url{http://wwoof.net/}
\textsuperscript{213} \url{http://www.workaway.info/}
exists on the success of networks of small and medium-sized enterprises in coordinating manufacturing and marketing to increase profitability. This literature is discussed in the modular connectivity chapter, noting that prominent examples of transformation of regional economies through such networks are the Mondragon region of Spain, north central Italy, the dense social networks of East Asian economies such as Japan, Korea, Taiwan, China, Silicon Valley, Route 128 in Boston, Toulouse, Baden-Wurttemburg, Bavaria, Jutland, and many others.\textsuperscript{214}

Such observations have led to a significant increase in policy strategies which seek to build such networks. The political impact on regional rural development policies extends far beyond the marketing, processing, or credit ventures which were the original goals of the networks.

Where rural networks of small enterprises have transformed local economies, consistently present is an atmosphere encouraging competition of ideas and innovation and cooperation between entrepreneurs. The social atmosphere which encourages innovation, competition of ideas, and cooperation between entrepreneurs requires is seen to explain success of various ethnic groups including Chinese in the Mississippi Delta, Lebanese in West Africa, Armenians in Europe and US, Koreans in US inner cities, Indians in New Zealand, Palestinians in California and many others.\textsuperscript{215}

Beginning farmers can produce redundancy and innovation. The system redundancy which results when older farmers mentor younger farmers also leads to innovation on both sides. The older farmer often changes his practices through the lens of life long experiences, weeding out tactics that the farmer knows unequivocally won’t work. Meanwhile the young farmer necessarily learns much from the practical experience of the older farmer while bringing sometimes revolutionary ideas and practices to the table. Our case of the Hardins\textsuperscript{216} shows this clearly with the father gradually adopting many new organic practices from the son who fully respects the experience and wisdom of his families practices. The father now does things he would never have conceived of without the input from his son, a much younger farmer.

It is important to value our ability to support a new generation of farmers as well as their coming knowledge. Much has been, and continues to be, discovered over the last 50 years about organic practices that were largely forgotten and disregarded during the age of chemical fertilizers. What many older farmers don’t immediately understand is that the practices that many “new age” farmers are bringing to the farm are in fact “age old” practices with a bit more research and perhaps a new name. We cover this topic more thoroughly in the chapter on conservative innovation, but it is worth noting the value that a new generation can provide by bringing both new versions of old practices and revolutionary ideas to the table.

Physical Backups

What items are critical to your operation? Are those items in working condition? How often do they break or fail? Can you rely on them indefinitely? Of course no tool or piece of equipment will last forever of its own accord but can you repair it? What is your plan for upkeep on those tools?

\textsuperscript{214} See Chapter 2 on local self-organization for details.
\textsuperscript{215} See Chapter 2 on local self-organization for details.
\textsuperscript{216} Case Study “The Glue that Can’t Unglue: The Hardin Family”
What if you can’t repair them? All your handles and tools are plastic or your machines are such that you don’t know how to troubleshoot problems. These are some of the reasons to weight the value of keeping backups. In agriculture it is imperative to have the right tool when you need it at peak harvest and throughout the growing season. It is impossible to make too many suggestions in this text suffice to say that it is a valuable consideration to make when purchasing tools and equipment.

Moreover, consider what is easily replicable locally and regionally. Wood is something that you can harvest easily and can be used in diverse ways like tool handles or wedge construction requiring no nails or fasteners. Though, not appropriate for all purposes, wood construction and tools can offer relatively easy replacement that is highly renewable.

What fails to be renewable is often repairable though, with the right skills and tools. Whether it’s taking welding classes, woodworking, or getting to know your local machinist and mechanic, it’s a valuable physical infrastructure to know how to work with your equipment. You also want to keep your eyes open for tools and equipment that are more fail proof, offering metal parts over plastic and perhaps even a lifetime warranty like those of Hoss Tools\(^\text{217}\) or Sears. Companies that offer lifetime replacement make their tools to last a lifetime rather than many other companies that, though significantly cheaper, will have you buying their products again and again as they continue to break due to wear.

As you acquire tools also keep in mind the advantage of having another shovel, a few extra pairs of gloves, or a straw hat for the sun. These extras not only increase your ability to keep farming in case your tool handles break, they also open the door for more help and more hands on your farm. You want to back up your production with tools and your whole operation with minds and bodies that can do the work. We cover this topic more extensively in the building physical infrastructure chapter and wish here to provide a mindset and perspective to help you choose tools, equipment and people with a greater willingness to invest time and money into the long term.

Agro-Ecological Backups

Earlier in this chapter we discussed the notion that nature produces backups by having multiple species that are all performing the same tasks. Your agro ecological system will again benefit from the principle as you begin to integrate different aspects into your farm, looking for opportunities of cross over and mutual benefit.

Take waste as an example, an issue for many farmers producing vegetable and commercial products alike. How many ways can you handle waste? Say you grow watermelons that require companion planting like many seedless varieties do. Could you turn around and feed those companion plants to hogs that you sell later at market? Perhaps you could operate a mid-sized composting business using the waste? Maybe you produce cotton or rice and you’re left with the waste from processing; that can be used as bedding for a poultry business or industrial mushroom cultivation.

\(^{217}\) [http://hosstools.com/](http://hosstools.com/)
Redundant systems can resemble what are referred to as “closed loop systems” where operations feed into one another, the waste of one becoming fuel for another. Therefore your agricultural products and by products become part of the ecology of your business helping foster growth and productivity.

**Developing Ecological Redundancy on your Land**

The methods to develop redundancy in your landscape are covered extensively in the Working with Nature chapter, but it is worth considering the fundamental idea and importance of developing a diverse, responsive and redundant natural ecosystem adjacent to your property.

Consider two species of native bees, each of which specializes in pollinating one species of legume, a lupine. One species is an Andrena and nests in the ground; its populations are subject to periodic wipeouts in this environment by floods and heavy rains. The other is a species of Megachile that lives in dead twigs; it suffers wipeouts whenever there are forest fires (or even cool burning). The redundancy of these two species is in pollination of the same species of Lupine. It is unlikely that both a flood and a forest fire would occur in the same year, so the redundancy of the pollination function maintains resilience of the system. The two bees are redundant in the pollination function, but they are not redundant in the other aspects of their lives in the ecosystem.

With this system in mind, consider your common pests and their natural predators. If you wipe out all predators with a single pesticide you’re left with swarms, totally unmitigated, forcing you to use more of the initial pesticide. This single solution approach has developed super bugs, resistant to even the most insidious chemicals that require us to spray more and in turn, pollute our waterways and ecological systems.

Long term success of your agricultural system is reliant on ecological backups in the form of pollinators, microorganisms, fungi, and many layers of the animal and bacterial kingdom. In addition to those kingdoms you can bolster your resilience by taking a closer look at your seed and fertilizer backups.

**Seed selection provides crop protection**

Are you saving seeds? If so, you’ve just added to your redundancy score! Saving seeds does more than just ensure your seed supply, it also means that your crops are acclimatizing to your conditions. Whether it’s your soil biota or particular climactic conditions, saving seeds has loads of benefits. Here at the home of the Resilience Project we’re located in a unique valley of the Ozarks hills. This North-South aligned valley has benefits and limitations and as we grow crops and save seeds from the best of our production we enhance our potential for success. Every year seeds evolve by selecting for traits that are adapted to our sun saturation, water availability, soil composition, wildlife, and even hormone secretions. As our climate shifts, it’s imperative that we develop seed varieties that are capable of thriving in a myriad of conditions rather than relying on one or a few producers who are developing mono-cultured seeds with low resistance and tolerance.
For further success, reach out to your community. Often there are opportunities to share seeds to help promote resistance in your own crops and of others. It is helpful to have a variety of seeds that carry different traits and resistance than others. Moreover, to save seeds on a greater scale for larger farms it may require some capital investment to purchase a machine\textsuperscript{218} to remove seeds in mass.

**Animal populations and redundancy**

Animals are intuitively redundant, continuing to breed and reproduce with the right care and housing. It is worth noting the value of maintaining a breeding stock to keep your farm going, adding income and fertilizer to your soil over time. Each animal offers its unique capacity to fulfill these roles; Some tilling the soils others eating pests.

It was once common knowledge that keeping animals on the farm was not only valuable but crucial to maintaining soil health and crops. They are the ultimate waste managers, land clearers and provide a nice side income for almost all operations. Whether your operation is only large enough for 1 pig and a few chickens, or large enough to require working with an animal producer, it is worth either building the infrastructure or making the connection with your community to process on farm waste and generate valuable fertilizer for fields.

**Fertilizing into the future**

Now, what about your fertilizer supply? Do you have any contingent plans in case your supplier runs out? Have you considered producing your own by channeling your own waste and/or the waste of your community? Producers can, and do, spend thousands of dollars each year on fertilizer for their fields. A necessity as we pull nutrient from the soil, so how can we ensure that we deliver those nutrients year after year? There are many ways to accomplish this goal and it helps us to be aware of more than one option. If you use chemical fertilizers, what would happen if the plant producing your fertilizers is subject to natural disaster? Who can you contact for alternate chemical or organic fertilizer? Bear this in mind as you’re making your connections and building your networks.

**Becoming the Backup**

Finally, how can you become the backup? As part of a network of producers, distributors and marketers, how can you become a better backup to your peers? If you’re new to farming and reading this material as an intro to building a resilient system, you’re taking the first step to co-creating a vibrant agro ecological transition to a new way of farming. The dominant agricultural system is reliant on a small number of highly productive farms, many of whom are increasingly vulnerable to plant and animal disease and drought as their managers render their soils to be less and less resilient. You have the opportunity to be an example of a cooperative, whole systems approach to agriculture that is vital in transitioning to something different that transcends sustainability.

If you’re a farmer, it’s up to you to heed the suggestions in this book and build a more responsive, adaptive and therefore resilient system. Your willingness to adapt will inevitably pave the way for other

\textsuperscript{218} A short selection provided by one company: 
http://www.seedquest.com/machinery/expo/from/seedprocessingholland/separators.htm
farmers to alter their systems and become more resilient themselves. In this way alone, you are a backup to your peers, by your willingness to exhibit these principles and share them with others.

Over the course of the next century most models predict massive changes in our natural landscapes due to drought, rises in temperature and sea level, and a booming population to feed and provide shelter, fuel and clothing for. It is the role and duty of agriculture to respond to these warnings in a responsible and holistic way. As you become a beacon for fellow producers you are altering the course of history, and not only by suggesting that there is another way. You are becoming the back up to the current system.

Where farming has become dominated by large producers, the infrastructure to support mid to small scale farming has been all but eliminated. Smaller farms pursuing innovative ideas, are handicapped by the lack of farm supply stores and equipment providers. As we rely on the outputs from a more and more limited group of producers, the whole system becomes dependent on their ability to respond to changes and stresses, while innovative new systems are being slowly developed. This reliance on a single, or limited number of providers, places us at a high risk. It is important that we work together to rebuild this infrastructure and create the demand for more markets and more suppliers to increase our backups and the resilience of our systems. Without backups in the marketplace we risk fallout which can and will create cascading effects throughout our supply chain and eventual system collapse.

**Self-assessment of redundancy.** Following are questions which our research shows are good indicator of farmers high on the redundancy factor of resilience. How do you score on these questions?

1. Do you farm with relatives or alone?
2. Are your children interested in farming?
3. Do you have someone to take over your farm or business if you get hurt and can’t run it?
4. Do you have a plan for passing on your farm to another farmer?
5. Are there other farms like yours close to you?
6. Do you have ready access to replacement parts and equipment?

**Secondary databases illuminating redundancy.** Two indicators of redundancy are available in county level databases. These variables, from the National Agricultural Census are farmer age and decline in number of farms. The inverse of each indicates resilience. The rankings by state are show in the following chart. For details on methods see Appendix. County-level scores for each measure are summarized in Table 6.

One measure of the responsive redundancy quality of resilient systems is age of farmers. More resilient systems will have younger farmers. Non-resilience is indicated if age of farmers is extremely high. Without young farmers coming into agriculture, agricultural systems cannot last.
As shown in the adjacent box, Kentucky counties had higher scores than any other Southern State. 65% of Kentucky counties scored in the top quartile of all Southern counties. Arkansas, Oklahoma and Louisiana comprised a second tier. A high proportion of counties in these states have younger farmers than other counties across the South. Oklahoma and Arkansas scored much better on this measure than on the overall SRI, both entering the top three states.

In contrast to their overall SRI, dropping out of the top tier on this measure were Virginia, North Carolina, South Carolina and Florida. South Carolina dropped the furthest, from 4th in SRI rank to 12th on this youth measure.

Mississippi and Texas remained in the lowest three, while Alabama moved up a few notches.

<table>
<thead>
<tr>
<th>Youth Rank</th>
<th>Overall SRI</th>
<th>State</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3</td>
<td>Kentucky</td>
<td>65.0</td>
</tr>
<tr>
<td>2</td>
<td>8</td>
<td>Arkansas</td>
<td>52.0</td>
</tr>
<tr>
<td>3</td>
<td>10</td>
<td>Oklahoma</td>
<td>45.5</td>
</tr>
<tr>
<td>4</td>
<td>6</td>
<td>Louisiana</td>
<td>42.2</td>
</tr>
<tr>
<td>5</td>
<td>2</td>
<td>North Carolina</td>
<td>27.0</td>
</tr>
<tr>
<td>6</td>
<td>1</td>
<td>Virginia</td>
<td>23.5</td>
</tr>
<tr>
<td>7</td>
<td>7</td>
<td>Tennessee</td>
<td>23.2</td>
</tr>
<tr>
<td>8</td>
<td>9</td>
<td>Georgia</td>
<td>19.5</td>
</tr>
<tr>
<td>9</td>
<td>12</td>
<td>Alabama</td>
<td>16.4</td>
</tr>
<tr>
<td>10</td>
<td>5</td>
<td>Florida</td>
<td>14.9</td>
</tr>
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<td>11</td>
<td>11</td>
<td>Texas</td>
<td>13.4</td>
</tr>
<tr>
<td>12</td>
<td>4</td>
<td>South Carolina</td>
<td>13.0</td>
</tr>
<tr>
<td>13</td>
<td>13</td>
<td>Mississippi</td>
<td>11.0</td>
</tr>
</tbody>
</table>

Responsive Redundancy: Inverse Average Age of Principle Farm Operators
(Quartile Ranks, Lower Ages = Higher Scores)

States with counties most in need of improvement on this measure of resilience are Georgia, Mississippi, Texas and Virginia. All had more than 30% of counties scoring in the lowest quartile across the South.
The above map shows graphically the county level data on this measure of responsive redundancy. Counties which are darker show more resilience on this indicator.

**Table 6** also shows the change in number of farm operations. More resilient counties and states are not losing farms, but gaining them.

The top three states on this measure of responsive redundancy (South Carolina, Florida and Texas) ranked near the bottom of our other measure of RR as shown in the adjacent box.

They were joined in the top tier by Virginia, Louisiana and North Carolina. Five of the top six states on this measure were also in the top six for overall resilience.

However, Kentucky, ranked 3 overall and 1 on the youth measure of RR, fell to near the bottom on this indicator. Loss of farms is highest in Kentucky, Alabama, Tennessee and Oklahoma. These four states are losing farms much more quickly than other Southern states.

The map below shows graphically the county level scores on this measure of responsive redundancy. Counties which are darker show more resilience on this indicator.

<table>
<thead>
<tr>
<th>States ranked by % of counties in highest quartile saving farms across South</th>
<th>Saving Rank</th>
<th>Youth Rank</th>
<th>Overall SRI</th>
<th>State</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>12</td>
<td>4</td>
<td>South Carolina</td>
<td>52.2</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>10</td>
<td>5</td>
<td>Florida</td>
<td>46.3</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>11</td>
<td>11</td>
<td>Texas</td>
<td>40.2</td>
<td></td>
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<tr>
<td>4</td>
<td>6</td>
<td>1</td>
<td>Virginia</td>
<td>35.7</td>
<td></td>
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<tr>
<td>5</td>
<td>4</td>
<td>6</td>
<td>Louisiana</td>
<td>34.4</td>
<td></td>
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<tr>
<td>6</td>
<td>5</td>
<td>2</td>
<td>North Carolina</td>
<td>31.0</td>
<td></td>
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<tr>
<td>7</td>
<td>2</td>
<td>8</td>
<td>Arkansas</td>
<td>17.3</td>
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<tr>
<td>8</td>
<td>8</td>
<td>9</td>
<td>Georgia</td>
<td>16.4</td>
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<tr>
<td>9</td>
<td>13</td>
<td>13</td>
<td>Mississippi</td>
<td>13.4</td>
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<tr>
<td>10</td>
<td>1</td>
<td>3</td>
<td>Kentucky</td>
<td>9.2</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>9</td>
<td>12</td>
<td>Alabama</td>
<td>9.0</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>7</td>
<td>7</td>
<td>Tennessee</td>
<td>8.4</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>3</td>
<td>10</td>
<td>Oklahoma</td>
<td>7.8</td>
<td></td>
</tr>
</tbody>
</table>
In summary, we underscore how important it is that you have and be backups in your community and food system? How can you support the transition to a new and more resilient agriculture? This can take the form of starting a new enterprise, offering a meeting place to develop cooperative marketing within your community, sharing your skills with others, or offering land that you’re not using to new farmers who want a chance to work with someone experienced. Community and connectivity are essential to redundant, backed up systems by offering a network of responsive and engaged individuals and businesses.

Redundancy is a mindset and a perspective that prompts us to look outside of ourselves and our current situation to seek opportunities and new possibilities. A resilient system seeks safety and security in numbers, has a willingness to realize its limitations, and develops networks and infrastructure that anticipates failures.