Whole Farm Systems Design: An Introduction

Long before I was a farmer or worked for Oregon State University Extension, I was learning about farming, studying it, trying it out on a small scale in my backyard, working at a local student farm and immersing myself in all things related to farming. Through all of this came a sense and urgent need to become a farmer, to know and be involved with all the intricacies of farming. There was one particular experience that led me to that decision. Part of my time at the student farm included tours to other farms throughout the season to learn what other farmers were doing and how they applied various sustainable farming methods. One of the visits was to Lifeline Produce Farm in the Bitterroot Valley of western Montana. It was this short visit to this highly diversified small farm that had a profound impact on me as a student of farming.

I still remember the smell of the hot dirt near the barn and the sheep grazing on green pasture and the farmer with suspenders leading us through the various fields and structures of the farm. Located in Victor at the base of the Bitterroot Mountains, a stunning backdrop for this organic farm, Lifeline Produce (run by Steve Elliot and Luci Brieger) is an extraordinary example of a highly diversified farm – nine acres of vegetables, herbs and flowers, 29 acres in pasture, 8 acres in hay with greenhouses, hoophouses, chicken, ewes and cattle. I remember walking their farm on that hot August morning and listening to Steve talk about the cycles of the farm, the interconnectedness of all things that grow and live on the farm and their efforts at creating and enhancing a biologically diverse and complex farm. Steve talked about their goals of trying to grow all the feed for their animals on the farm and creating a closed loop farm where very little inputs came from somewhere else. He talked about enhancing the soil with cover crops and sound crop rotation. I saw happy grazing animals, rows of flowers in bloom and diverse pockets of vegetables and healthy stands of grass and cover crops. What struck me the most was the diversity of their farm, their intuition as farmers working with the land and their profound deepness and connection with their place. It was through their own passion and dedication to diverse farming systems that captured me.

What Lifeline Produce represents and what this manual attempts to relate is the extraordinary nature and complexity of the whole farm system. How it is a departure from the industrial agriculture that dominates many places in the U.S. How whole, diversified farming takes into consideration a farming pattern that is based on diversity – biological, economical & social. Whole diversified farms are places where bluebirds nests, where diversified markets support the farm and family, where the community is connected to the farm’s life and longevity. The whole farm is supporting the landscape, communities & farm families in healthy, intelligent and sustainable ways that integrate the strong connections between farming and nature.

In this manual, we try to take you through all the most important components of a whole farm – we undoubtedly miss something, but we hope to give you a strong overview of all the strategies and components that go into designing a whole farm system. What doesn’t take place here on these pages is the importance of the individuality of every farm – how each farm has its own nuances, challenges,
successes and deep complexities which all work together (or not) to create a functioning whole farm organism. As well, creating a whole farm is a process, a road map to follow and many of the whole farms I have visited over time have been working for years on their farm design and implementation. A new farmer working on this whole farm design cannot possibly compare their experience to a farmer who has been farming for twenty or more years, but you can take inspiration, advice and ideas to build on your own farm. There are so many examples of whole farms abundantly available to draw from. This manual really gives the new farmer an introduction and starting point to what a whole farm system is and how you as a farmer may take these pieces and apply them to your own place, farm and experience. -MM

Setting Goals

The first step in whole farm systems design is to set goals for your farm. Goals are fundamental to the success of your farming enterprise as they steer the direction of your farm. Their function in your whole farm should not be underestimated. Goals must be based on your values. Values include such things as friendships, spending time with family, having leisure time to explore hobbies, health and wellness, quality of life and happiness. For example, finding at least one day of the week to rest is a quality of life goal. As well, eating healthy food that you grow on your farm is another example of a quality of life goal. Goals for the whole farm are also based on your land stewardship values and economic values. See Figure 1 for a list of possible goals. It is important that you write down your goals. Some farms will also display their goals on the wall where they will see them often, so they can be reminded of their initial pursuit.

The following questions can help you identify some of your goals:

- What is it you want from your life and for your family?
- How can you make farming enjoyable?
- What would you like for your children and your community?
- Do you want to produce your own food, or do you want to sell products from the farm?
- What land management practices are important to you?
- Will the farm supplement your income, or do you want a full-time farming career?
- How much money do you want the farm to make?
- What financial obligations do you have?
- What do you want to produce?

Goal setting is a process. It is something that you must come back to over time. Goals shift, evolve and change over time. It is important to assess your goals and reference them whenever making decisions. It is important to identify both short-term goals as well as long-term goals for your entire farm & family (five to ten years).


Figure 1. Sample Goals

<table>
<thead>
<tr>
<th>Sample Short-Term Goals</th>
<th>Sample Long-Term Goals</th>
</tr>
</thead>
<tbody>
<tr>
<td>I want to live rurally on 10 acres.</td>
<td>I want to improve my water by installing ponds.</td>
</tr>
<tr>
<td>I want to grow 1-acre of vegetables for the farmers market.</td>
<td>I want to create a conservation easement for my farm.</td>
</tr>
<tr>
<td>I want to improve the soil conditions of my farm.</td>
<td>I want to retire on my farm.</td>
</tr>
<tr>
<td>I want to have free time to enjoy my family and explore hobbies.</td>
<td>I want to be debt-free on the farm.</td>
</tr>
<tr>
<td>I would like to certify my farm as organic.</td>
<td>I want to expand my herd to 100 head of cattle.</td>
</tr>
<tr>
<td>I want to take a vacation once a year.</td>
<td>I want to install solar panels for all my electricity needs.</td>
</tr>
</tbody>
</table>

Overall success on the farm happens when all farm partners can come together around a specific set of values and goals. They may not always be accomplished, but having a road map in place helps the decision making process.

Maud and Tom Powell of Wolf Gulch Farm took a long time exploring their goals for their farm when they started farming in 1999. They currently grow about 50% seed crops, 40% annual vegetables and 10% perennials. Their goals were to steward the land, have a profitable business that would increase their food self-reliance and create a healthy, happy environment for their family.

They decided to grow seed crops because they needed less water than most annuals. They also have very good isolation for the seed crops, and they require no marketing once they have the contracts, which fit into their personalities very well. They grow annuals because they like to contribute to the local food supply and they are a good way to make money. They designed their farm using permaculture principles, which emphasizes perennial crops, so they plant a lot of trees every year. This is just one example of a farmer taking into consideration the importance of their goals in designing their whole farm system.

Social Capital

Farms, like rural schools, provide a nexus for communities. They offer a venue for social interaction to take place in, and a set of values and products that bind people together. Many people refer to this as “social capital.” The term “social capital” can be traced back to L.J. Hanifan’s 1916 article regarding local support for rural schools, and refers to social cohesion and personal investment in communities. Hanifan defines social capital as

"goodwill, fellowship, mutual sympathy and social intercourse among a group of individuals and families who make up a social unit... The community as a whole will benefit by the cooperation of all its parts, while the individual will find in his associations the advantages of the help, the sympathy, and the fellowship of his neighbors."

Whole farms have myriad opportunities to demonstrate social capitalism at its best. Social capital can be generated between farmers as well as with other members of a community.

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Within a farming community, members will often rely on one another for help and support. Farmers may borrow equipment or tools from one another, or even invest in equipment together. A group of poultry producers in Southwestern Oregon formed a limited liability company, pooled their money and bought equipment to process their poultry more easily. Members of the group have taken it upon themselves to regularly clean the equipment, track scheduling for use of the equipment, and maintain a savings account for money collected. As well, during crisis periods, such as wildfire and floods, farmers readily help each other out.

The concept of Community Supported Agriculture, in which individuals or families buy a share of a farm for the season, is another excellent example of social capital. While CSA members pay money for their share in the harvest, they are also rewarded with less tangible benefits. Many CSA farms invite their members to participate in work parties, in which they can learn about farming and gain a greater appreciation for agricultural work. Other CSAs provide weekly updates about the farm operation, giving members a sense of belonging to something larger than themselves and a greater connection to their food.

Cities and towns have seen a huge growth in the number and size of local farmers’ markets. These markets not only provide opportunities for purchasing wholesome, delicious products, but also offer a cultural and social experience for both customers and farmers. People go to farmers markets to see their friends, listen to local musicians, observe the change in season through the products offered, talk to farmers about their products, and learn a little more about the agricultural history and diversity of their bio-regions. The personal exchanges, along with the monetary transactions that take place between farmers and customers, represent a great deal of social capital.

Whole farms generate social capital that reaches beyond the agricultural world. Farms that are embedded in their communities often become a hub of social activity. The rise in agritourism highlights farms as a place for social gathering and a return to rural activities: many farms host harvest parties, cider pressing events, square dances, craft circles, and food preservation gatherings. Full Circle Bison Ranch hosts a barbeque and ranch tour every June. This gives members in a community an opportunity to genuinely interact with their neighboring ranchers building social capital that can remain for years to come.

A farm tour can be a great way to build social capital. Photo: Khaliqa Rogmans

Farmers that are interested in increasing the social capital they both produce and have access to should take stock in their farm operations and in the communities around them. Farms can provide communities with a range of opportunities and experiences that will enrich the lives of individuals and generate social capital. For example, farms can offer healthy food, a venue for community events, a place for children to learn about gardening, a library for people interested in beekeeping, a
place for people to share skills with one another, and seasonal jobs. In return, the community can offer farmers a loyal customer base for their products, non-agricultural skills like web site development and tax preparation that can be traded for agricultural products, extra labor, and appreciation and respect.

While farming may not be considered a financially lucrative career, farmers have ample opportunities to generate social capital. The farm itself can represent an incredible resource to the community: a place of beauty, productivity, inspiration and demonstrations of sustainable practices. The products that come off a farm can also generate social capital by providing people with a deeper sense of connection with their sustenance and environment. Finally, the farmers themselves can generate social capital through their knowledge of agricultural systems, and their passion and vision. Increasingly, farms, like schools are being reinstated as central to the social fabric of the communities in which they are situated. How your farm may generate social capital is something you can sketch out and decide in your goal setting process. It is often the social capital that is generated between farmer and community that is one of the most rewarding parts of farming.

![Farmers markets are emerging as strong social capital tools. Photo: Tracy Harding.](image)

**Economic Viability**

Economic viability is fundamental to the whole farm whether or not you are a business or a hobby farm. Either way the farm must be an economically viable pursuit if you are to remain as a farmer. Harvey W. Wiley once wrote, “It is a fundamental error to suppose that farming is neither a business nor a profession. It is a business which requires the highest business talent, it is a profession which requires the best technical skill...No other profession requires such a variety of learning, such an insight into Nature, such skill of a technical kind in order to be successful, as the profession of farming.”

There are various components to economic viability and many of them are interconnected, but some of the key components include: ability to meet your family’s needs including food, health, and insurance expense; quality of life and other benefits of an economically viable farm; profitability of crops and livestock; a healthy debt to asset ratio; a return on the

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farmer’s investment. Overall, these indicators contribute to a sustainable whole farm system.

Farmers need to make a living just like everyone else. It is important to identify financial goals and targets including how much you need to pay yourself and the amount of the family’s expenses you want the farm to cover. Preparing a budget can help enormously. It is best to identify your personal costs first. It will also work to set a number for how much you want to make per year and go from there. Diversified streams of income can also help. Off-farm income from another family member can balance the farm’s economic viability if that income is contributing to the quality of life of the farm family.

There are certain things on the farm contribute to overall farm economic viability, but that cannot be measured or do not usually get included in any sort of profit and loss statement for farms. This includes such things as food consumed from the farm by the farm family, wood from the farm’s woodlot, bartered items between farms. As well, community relationships can also contribute to the economic well-being of farm. A University of Minnesota study found that a farmers’ positive attitude toward the farm contributed to an overall strong economic picture for the farm.3

They are many ways to achieve profitability, but many people ignore this important aspect of a whole farm. Putting together solid plans, records and enterprise budgets can help you in achieving profitability as well as help you make informed decisions when a crop or animal is losing money on the farm. Obvious indicators of profitability on the farm include increasing gross sales and a net profit from the farm at the end of the year. There may be things on the farm that are not exactly profitable, but these things may have more than financial value to the farm. They have other benefits like fertility or pest control. For example, Persephone Farm in Lebanon, Oregon raises organic laying hens for eggs. They have figured their true cost of producing eggs somewhere around $8 to $9 per dozen. While they may not set their egg prices at this value, they do find inherent value in keeping poultry on the farm even if they break even on the eggs. Another example in the profitability equation is growing crops that might not be entirely profitable, but that attract customers to your farm. Broccoli or corn are examples of crops that may not be profitable on their own, but they can contribute to the overall profitability of the whole farm. Figure 2 lists some questions to consider when improving profitability for a whole farm.

Tracking your enterprises on the farm to find their profitability indicator can be tough, challenging, not to mention time consuming. Recordkeeping templates are useful in this exercise. Various templates and programs are available to help you with your recordkeeping, but generally, you will want to track your income and expenses related to the farm including purchases of assets, sales by product, etc. The extra effort you put into measuring your profitability will only assist in the long run.

A healthy debt to asset ratio means that you do not owe more than fifty cents of every dollar of your assets to a creditor. This ratio also relates to the ability to liquidate your farm assets quickly if for some reason your farm runs into trouble. Having adequate cash flow and working capital also contributes to a healthy

economically viable business. Do you have working capital to run your business? What are ways that you can plan to adequately cover your farm expenses in times of a cash flow crisis?

Finally, it is important to think about the investment you have made into your farm and whether you are seeing a valuable return on that investment. Is the farm growing? Are you able to reinvest into it every year? How does your farm investment compare to other types of investments? Is your farm value increasing?

Direct marketing contributes to economic viability in the whole farm system. This is the place where the small diversified farm makes the most of the value of their product and that which contributes to the bottom line of the whole farm. Many whole farms are integrating several direct marketing approaches including farmers markets, CSA, restaurants, grocery stores and cooperative marketing. Some are even exploring online markets as a potential viable direct marketing channel. Whole farms are typically skilled at seeking out niche products that the market is not already currently supplying and which makes them more competitive on a local and regional level. These all contribute to the long term economic viability of the whole farm. These markets are also based on good community relationships and are a key factor in maintaining viability. For example, Thompson Creek Organics is a small, family owned organic orchard in the Applegate Valley. They produce organic apples and organic apple cider for sale in the Rogue Valley. They do most of their marketing through direct channels and have added value to their business by pressing their apples into cider. They take advantage of their niche product by selling at the highest dollar they can receive directly from the customer. They are also reinvesting in their business continually and enhancing community and business relationships as their farm grows.

The Role of Perennials

Perennial crops should be given strong consideration from the outset of any thoughtful farm design process because their virtues are manifold. Perennials:

- can increase yields inversely proportional to their maintenance over time.

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Johnson, Dale. Fact Sheet #539: Assessing and Improving Farm Profitability. 
http://www.smallfarmsuccess.info/FactSheet_539.cfm
are generally less represented at farmers markets, in CSAs and other direct marketing channels.
• are more resilient against climate and seasonal vagaries.
• provide erosion control and wind abatement.
• provide habitat for beneficial insects.
• afford yields that benefit other elements of a system such as fodder, nitrogen fixation, wildlife habitat, woody material, mulch, medicine, nectar flow, shade and more.

Short lived perennials such as strawberries, cane berries, artichokes, asparagus, currants, and culinary herbs should definitely be considered as cornerstones of a well rounded farm system and can be integrated in a way which does not detract from other elements of the farm. Rather the opposite can be true if attention is given to proper assessment and design and these perennials are placed on rocky ground, or areas that are inconvenient for row crop farming. Longer-lived perennials such as blueberries, fruit trees, nut trees, grapes, and kiwis have an equally important role within a whole farm design. Their time to establishment curtails their inclusion in many farm designs; however, their ability to positively affect the farmer’s bottom line should not be overlooked. This is particularly true when one considers weaving these crops into a CSA or direct marketing program and serving the local consumer base more abundantly.

Integrating perennials into a whole farm can come in many forms. For example, once main field blocks are planted out, opportunity areas emerge to plant fruit trees or other perennial berry bushes between fruit trees. You can plant nitrogen fixing medicinal berry bushes as a livestock paddock border row, or plant every 20th row in a row crop system to apples with the long term goal of diversifying yields, minimizing long term labor inputs and greatly increasing the net biodiversity of life and food coming from the land. Seven Seeds Farm in Williams, Oregon has also made extensive use of perennial nitrogen-fixing legume sod in their vegetable rotation system, using plants such as red clover, alfalfa, and birdsfoot trefoil. Their rotation is a 6-7 year cycle, wherein intensive mixed vegetables are grown for 4-5 years then the area is followed by a cereal grain and perennial legume pasture mix. The yields of this aspect of the rotation can include grain, straw, hay, grazing pasture, nitrogen and organic matter for soil improvement. This mix is allowed to flourish for two years giving that soil a great rest period that is followed by another 4-5 years of intensive mixed vegetables. Integrating perennials is a tremendously worthwhile endeavor that can greatly enhance any farm system.

Growing Annuals for Profit

One of the many benefits of growing annuals is that it provides quick crops for sale to maintain an economically viable whole farm. It provides cash flow that is necessary to reinvest in the farm. The nice aspect of integrating annuals into a whole farm system is that it is an enterprise that a farmer can get started on right away. From seed to plant to harvest and maturity, it only takes a short time (depending on what annual crop you choose) before the product is ready for sale. Annual crops can be anything from nursery and bedding plants, vegetable starts, seed crops, fresh market vegetables, culinary herbs, and flowers. Most of these can be started in the spring and sold continually on an on-going basis throughout the
Many vegetable farmers use succession planting as a way to continually have vegetables for sale throughout the growing season (for instance, carrots).

Another benefit of growing annuals on a diversified whole farm is that it provides food and nourishment to the whole family as well as farm partners and employees. It can also add aesthetic value to the farm by adding bedding plants and gardens as well as some annual flowers and herbs that attract beneficial pollinators and other insects to the farm, contributing to the farm as a whole.

Annuals work well in rotation with cover crops and grains. Many vegetables have certain maturity and growth dates and many can be harvested and then that ground planted into another crop whether it is a winter cover crop or winter grain. Some annuals grow so fast, like radishes and other spring crops like peas, that a summer cover crop can follow the annual crop. This adds to the whole farm by building soil organic matter and quality as well as adding another enterprise for sale like wheat or barley.

Many farmers are experimenting with integrating perennials with annual crops which can be designed in several ways. Some farmers will plant a bed of chard and lettuce and then have a row of apple trees in between their next row of annual crops. Or you can add perennials around borders of annual crops to provide pollinators and other aesthetic benefits to the garden. Like perennial fruits, annual crops fetch a high dollar at retail markets like farmers’ markets, farm stands and CSA programs, which allows the farmer to take that income and provide for his/her family as well as reinvest in the farm.

Potential challenges in growing annuals on the whole farm is that most annual crops are labor intensive, so they require more attention and management during the whole growing season where as perennial crops have higher points of maintenance at various times of the year. Consistent and on-going irrigation can be a challenge as well, so this is something to consider when thinking about designing your whole farm system. Understanding water management, flow and energy can help in deciding how to integrate multiple and diverse enterprises onto the farm.

Finally, growing annuals adds to the social capital of the farm by providing the community with ample opportunities to experience life on a diversified, whole farm. Families have opportunities to come out and pick peas in the spring, or plant potatoes, or eat sweet corn straight from the farm. Having annuals as part of your diversified farm can have a great many benefits while helping to finance the farm operation as a whole.
Figure 3. Benefits of Annual Crops

<table>
<thead>
<tr>
<th>Annual Crop</th>
<th>Benefit</th>
<th>Days to Maturity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vegetables</td>
<td>Cash flow, food for farm family &amp; harvest crew</td>
<td>Depends on vegetable and variety, but anywhere between 25 – 130 days</td>
</tr>
<tr>
<td>Flowers</td>
<td>Cash flow, aesthetic value for the farm, pollinators</td>
<td>Depends on flower and variety, but anywhere between 50 – 100 days</td>
</tr>
<tr>
<td>Herbs</td>
<td>Cash flow, added value opportunity, niche product</td>
<td>Depends on herb and variety, but anywhere between 25 – 130 days</td>
</tr>
<tr>
<td>Nursery Plants</td>
<td>Early start to the season, diversified market booth, pollinators</td>
<td>Depends on nursery plants chosen, but anywhere between 40 – 100 days</td>
</tr>
<tr>
<td>Seed Crops</td>
<td>Diversified cash flow and enterprise, niche market, pollinators, extended season</td>
<td>Depends on seed crop and variety, but anywhere between 90 – 130 days</td>
</tr>
<tr>
<td>Vegetable Starts</td>
<td>Early start to the season, can be planted if not sold</td>
<td>Depends on vegetable and variety, but anywhere between 25 – 130 days</td>
</tr>
</tbody>
</table>

Incorporating Grains

Farmers grow certain crops as an integral part of their farm business, but some enterprises are important to the small farm only when part of a longer rotation. Grains are a terrific example of an enterprise that can be integrated into a whole farm system. Small grains gross considerably less in sales compared to vegetables or perennial fruits and nuts; however, grains are less labor intensive to grow and can be a valuable part of a rotation when the field needs rest from annual vegetables. Grains can be grown without irrigation because spring rains are usually adequate for plant growth; once seed heads form, the plant is done growing and needs only to dry. It is possible to extend the productivity of more marginal fields by growing small grains oversown with clovers or alfalfa, which also helps to control weeds and minimize soil erosion. Also, hard red spring wheat can be harvested as early as the end of June, leaving plenty of time to turn that field over for a late summer planting. Typically, grains need about 110 days to mature, and then another thirty to sixty days to sufficiently dry for storage.

Wheat as a part of a vegetable rotation in southern Oregon. Photo: Neil Subhash
When choosing which grains to grow, consider the other needs on your farm: do you have livestock that benefits from straw bedding, or do you use straw as mulch? If so, a tall grain like wheat might be a good choice. Easy as it is to grow, wheat is a high yielder (expect a harvest of 40-60 times the amount of seed sown) and therefore labor-intensive in the threshing and winnowing stage of production. Corn is perhaps the easiest grain to grow, and requires less work to harvest than wheat or barley. Consider as well the dietary preferences of your family. If you enjoy polenta and corn bread, dent corn would be an excellent choice, particularly if you also have animals to feed on the farm. Corn has a reputation as a heavy feeder, but Ryan Dolan of L & R Farms in Williams, Oregon believes that this reputation is overstated: “Sweet corn is maybe a heavier feeder, but in my experience, dent corn is not that heavy a feeder.” Dolan grows dent corn as feed for his hogs, as well as for homestead use in the form of cornmeal and polenta. He plants corn in rotation after a nitrogen-fixing cover crop like fava beans or vetch.

Grains in rotation can contribute to soil sustainability by breaking the cycle of intensive tilling and cultivation required by vegetables, and more diversity generally means fewer pests and diseases. Soil-building legumes should be a part of any rotation. Different grains are interchangeable in rotation, so one could easily substitute wheat or barley for dent corn in the small grains part of a plan. When considering adding grains to a crop rotation plan, consider your acreage and the potential uses of your fields. More marginal land may alternate between alfalfa and grains only, whereas fields with more productive soil may include row crops or vegetables, legumes, and grains.

**Figure 4. Sample Crop Rotations**

<table>
<thead>
<tr>
<th>Type of Farm</th>
<th>Year 1</th>
<th>Year 2</th>
<th>Year 3</th>
<th>Year 4</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Dairy Farm and Hay</strong></td>
<td>Corn with winter cover crop of rye &amp; vetch</td>
<td>Corn with small grain and new seeding of alfalfa</td>
<td>Alfalfa</td>
<td>Corn</td>
</tr>
<tr>
<td><strong>Produce Farm 1</strong></td>
<td>Sweet corn with winter cover crop of rye &amp; vetch</td>
<td>Early Potatoes followed by buckwheat cover crop</td>
<td>Squash then oats/red clover plow-down</td>
<td></td>
</tr>
<tr>
<td><strong>Row Crop Farm</strong></td>
<td>Tomatoes</td>
<td>Oats</td>
<td>Broccoli/Fallow</td>
<td>Lettuce</td>
</tr>
<tr>
<td><strong>Dairy Farm 2</strong></td>
<td>Corn</td>
<td>Oats</td>
<td>Hay/pasture</td>
<td>Soybeans</td>
</tr>
<tr>
<td><strong>Produce Farm 2</strong></td>
<td>Row crops</td>
<td>Oats – Red Clover</td>
<td>Row Crops</td>
<td>Row Crops</td>
</tr>
<tr>
<td><strong>Herb &amp; Seed Farm</strong></td>
<td>Annual herbs</td>
<td>Annual herbs</td>
<td>Annual herbs</td>
<td>Oats, interplanted with clover</td>
</tr>
</tbody>
</table>

Grains can be an economical way to reduce the feed costs for poultry as well. Some farmers cut the mature grain and leave it in the field for chickens to harvest themselves; however, some cereal grains, barley in particular, can be
makes pantry. Community homesteading market originated ecosystem and better sufficiency flora. You can find seminal measure. Intact Livestock biological flora, plants and animals work together to complete ecosystem processes, such as nutrient cycling, seed dispersal, plant succession, vegetation community dynamics, energy capture, and maintaining predator-prey populations. These services can render farms both more sustainable and more profitable.

Livestock on any farm should play a key role in the nutrient cycle, and should build and sustain soil fertility. Animal manure, when mixed with a carbon source such as straw or wood chips, makes fantastic compost. Manure and compost applications improve soil organic matter, biological activity and potential disease suppression. This improved “soil health” will manifest itself quickly and includes improved soil nutrient cycling, improved soil structure, better water holding capacity in droughty soils and improved tilth and drainage in heavy soils.

Grazing animals such as cattle or sheep can mow cover crops, or forage crops grown in rotation with vegetable crops, while manuring fields. Chickens in portable pens or “tractors” are very effective at grazing cover crops, insect control, and bed preparation in smaller fields and gardens. Pigs can mow and plow in cover crops prior to planting vegetable crops, and/or “hog off” crop residue in a corn field in preparation for the next crop in the rotation. Cattle (or hogs) turned into a pumpkin field in November can find a rich source of nutrition and clean up a field for the farmer.

Cattle consume grasses and forbs only a ruminant can process, and return approximately 70% of what they consume to pastures in the form of manure, assisting plants in capturing the sun’s energy and incorporating it into the nutrient cycle. As they graze and move on, ruminants help spread seed and maintain plant diversity around the farm.

Grazing animals can be important tools in perennial vegetation management around the farm, improving or maintaining a diverse herbaceous pasture community, or controlling weed species and restoring natural area plant composition through timed grazing as well.

5 Sticky Droppings: A Feed Related Poultry Problem. Mount Vernon Research Center http://cru.cahe.wsu.edu/CEPublications/fs002e/fs002e.pdf
Sheep, for example, can control star thistle in dry grasslands and goats can be used to control Himalayan blackberries in riparian areas near streams. In orchards and vineyards, sheep, turkeys and chickens can mow and fertilize the orchard or vineyard floor.

Chickens can be used to control parasite populations when grazed on pasture following cattle or sheep, and while there will provide additional fertilizer for pasture plants. Similarly, ducks can provide natural pest control in greenhouses and gardens, and weeder geese can keep a garlic fields free of grasses.

When livestock and plant crops are integrated, farmers can realize more production per acre with fewer inputs, increasing profits and reducing costs. These benefits, combined with the ecological benefits of integrating livestock and plant crops on farms, make mixed farming systems an excellent approach to sustainable farming.

**Figure 6. Integrating Livestock**

<table>
<thead>
<tr>
<th>Livestock Species</th>
<th>Benefits to the Farm</th>
<th>Considerations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cattle</td>
<td>Manure, meat, pasture management</td>
<td>Fencing, breeds, acreage, minerals, health program</td>
</tr>
<tr>
<td>Pigs</td>
<td>Meat, use of vegetable and food waste,</td>
<td>Housing, breeds, site location, feed</td>
</tr>
<tr>
<td>Chicken</td>
<td>Meat, eggs, parasite control, weed control, tillage</td>
<td>Housing, predators, breeds, feed, fencing</td>
</tr>
<tr>
<td>Turkeys</td>
<td>Meat, parasite control</td>
<td>Housing, predators, breeds, feed, fencing</td>
</tr>
<tr>
<td>Sheep</td>
<td>Meat, wool, manure, weed control, pasture management</td>
<td>Pasture, fencing, housing, breeds, acreage, minerals, health program</td>
</tr>
<tr>
<td>Goats</td>
<td>Meat, milk, manure, weed control</td>
<td>Browse, fencing, breeds</td>
</tr>
</tbody>
</table>

**Farmscaping for Beneficials**

Many insects, spiders, birds and bats will eat crop pests and weeds. Providing the basic food and shelter for these useful animals can help keep pest species to a minimum. Providing on-farm resources for beneficial organisms is called farmscaping for beneficials (FSB) and is an active component of functional agricultural biodiversity. Functional agricultural biodiversity is the ability to reap the benefits or “ecological services” that increasing farm biodiversity brings. Examples of functional agricultural biodiversity include increased on-farm populations of wild bees that can increase crop pollination, increased diversity of soil flora and fauna that can decrease the incidence of soil-borne crop diseases, improve crop plant vigor and increase nutrient content of crops by making soil nutrients more available to crops and having active breeding pairs of barn owls on the farm that can decrease on-farm mice, gopher and vole populations.

Farmscaping for beneficials is done at the whole farm level. It begins by understanding that your farm is a unique, ecologically dynamic unit that is part of a larger ecological system. What you
do on your farm affects the larger eco-system and the larger eco-system affects many things that occur on your farm especially in terms of beneficial and pest organisms. An important initial step in the farmscaping process is to create a habitat map of your farm. This map should include production fields, field margins, on-farm riparian areas, farm roads including all non-cropped on-farm areas and most adjacent off-farm habitats. The map provides a graphic representation of existing habitat and areas of habitat enhancement possibilities for your farm. The next steps of farmscaping are to identify which beneficial organisms will prey on your crop pest and what their basic needs are. For instance, there are many predators and parasitoids that will feed on aphids. The parasitoids will need nectar and pollen as adults to lay their eggs producing larvae that will feed on the aphids. The true bug predators require some prey throughout their entire life cycle before and after the aphid feasts occur. Generalist predators such as spiders, and some beetles will also prey on aphids but need shelter to stay on the farm, undisturbed by tillage or pesticide sprays.

The key to successful farmscaping for beneficials is maintaining a balance of on-farm beneficial organisms by planning habitat enhancements that fit within your own farm production plan. If there is no time to plant habitats they will not grow and attract beneficials! It also helps to start with simple habitat enhancements and monitor their effects to learn which plants and which beneficial and pest interactions are working best and why. You can increase the complexity of the FSB practices as your monitoring skills and knowledge of the specific functional biodiversity of your farm develops. For instance, a simple way to increase on-farm populations of beneficial insects and wild bees is to make blossom happen all season long. Insectary plantings, plants that provide available pollen and nectar in their flowers, are a common FSB practice that serves that function. There are many configurations of insectary plantings that vary in complexity to implement. Native, perennial, end-row insectary plantings may work well in orchards, between-row, annual, flowering cover crops can work well in grapes, whereas, annual, in-field groups of insectary plants can be transplanted along with the crop in vegetable farming systems, serving the dual purpose as variety markers, cut flowers for direct market or even a flower seed crop. Some commonly used FSB practices and their associated ecological services are listed in Figure 7.

Spirea hedgerow at Kenagy Family Farm. Photo: Gwendolyn Ellen
Figure 7. Common Farmscaping Practices, Benefits, and Ecological Services Provided

<table>
<thead>
<tr>
<th>Practice</th>
<th>Habitat Benefit</th>
<th>Ecological Services Provided</th>
<th>Alternate Crop Potential</th>
</tr>
</thead>
<tbody>
<tr>
<td>Within Field Insectary Plantings</td>
<td>Provides shelter and food near crops for insect predators, parasitoids and native pollinators</td>
<td>Crop pollination, insect pest management</td>
<td>Yes- Cut flowers, herbs and flower seeds</td>
</tr>
<tr>
<td>Insectary Hedgerows</td>
<td>Provides on-farm floral diversity, shelter and food for insect predators, parasitoids and native pollinators and insectivorous birds</td>
<td>Wind protection, erosion management, weed seed dispersal and pesticide drift prevention, crop pollination, insect pest management, small mammal predation</td>
<td>Yes- Native plant propagation material native seeds, nuts, berries, willow for baskets, herbs and other potential alternative crops</td>
</tr>
<tr>
<td>Within Field Beetle Banks</td>
<td>Provides shelter for generalist insect predators, spiders, native bees and insectivorous birds</td>
<td>Crop pollination, insect pest management, predator bird activity</td>
<td>Yes-Native grass seed</td>
</tr>
<tr>
<td>Flowering Cover Crops</td>
<td>Provides shelter for generalist insect predators, spiders, native bees and insectivorous birds, competes with weeds, adds nutrients and organic matter to soil</td>
<td>Erosion, weed, soil fertility and soil health management, crop pollination, insect pest management, small mammal predation</td>
<td>Yes- Cover crop seed</td>
</tr>
<tr>
<td>Bat and Bird Nest Boxes</td>
<td>Provides on-farm nest sites</td>
<td>Insect pest management, Rodent management, Pest bird management, Bird watching recreation</td>
<td>Yes-Bat guano</td>
</tr>
</tbody>
</table>
Farmscaping for beneficials can have long-term positive effects on the biodiversity of your farm and the habitats that surround it. At the same time it increases the ecological services of beneficial organisms on your farm, diversifies your integrated pest management toolbox and can help you meet certified organic and eco-label biodiversity standards. FSB practices can be esthetically pleasing, dynamic and interesting to implement and help you reach personal goals of environmental quality, farm diversity and quality of life. As third generation farmer, Dave Buchanan, of Buchanan Family Farms in Corvallis, Oregon points out, there are three components that keep farmers farming: that they are economically sustainable; that their farming is stimulating and interesting to them; and that they can pass their farms to the next generation. He concludes that it was the ecological conservation practices that his father did to preserve the creeks that border the farm that brought him back to farming, not the dairy cows. Buchanan Family Farms continues to restore over 250 acres of their 360 acre vineyard and hazelnut orchard to oak savannah, wetland and optimal riparian habitat. Farmer Dave, besides being an expert conservationist, farmer and professional ichthyologist is also the proud father of fourth generation Buchanan family farmer, Merilee.

**Soil Fertility, Organic Amendments and Cover Crops**

A soil management plan that maintains or increases soil organic matter content will improve the profitability and environmental performance of your whole farm over time. The best soil improvement strategy depends on the resources that are locally available, and the techniques that suit your production system. When you sell agricultural products, you are removing biomass from your farm. If you don’t replace that biomass, soil is gradually depleted. Soil is maintained or improved when organic amendments are applied in sufficient quantities to replace the organic material that is harvested. Cover crops can build soil organic matter, prevent soil erosion and improve soil fertility if your cropping system has niches that allow for good cover crop growth. Application of raw organic amendments or compost can also increase organic matter, and if used appropriately they can improve soil fertility. With your soil building strategy in place, you can use soil tests and fertilizer guides to choose supplemental fertilizers and determine application rates for optimal crop quality and yield.

Cover crops can improve soil quality without requiring the transport of large amounts of organic material. This makes cover cropping one of the most efficient long term soil building strategies. Legume cover crops (i.e. peas, clovers and vetches) also provide a source of nitrogen. Bear in mind that summer and fall planted cover crops often need overhead irrigation for good stand establishment. Cereals and other non-legumes often establish relatively quickly in the fall and can take up residual soil nitrogen, thereby keeping nitrogen in your system and protecting water quality. Legumes fix atmospheric nitrogen with the help of symbiotic soil bacteria in root nodules (*Rhizobia* spp.), and can reduce the amount of fertilizer needed. You may need to inoculate legume seed with the correct *Rhizobia* spp. if that legume has not been grown in the field recently. Several resources describe the traits of different cover crop species and will help you choose cover crops that will perform well under your conditions. The OSU Organic Fertilizer and
Cover Crop Calculator\(^6\) have been developed to help you estimate the management cost and nitrogen contribution of cover crops. In Oregon, winter cover crops usually do well when seeded in September. Many late harvested vegetables can be under sown with cover crops earlier in the summer just before final weed cultivation. It is a good idea to discuss cover cropping strategies with experienced local farmers and extension agents.

Since cover crops don’t always perform well it is wise to find other sources of other organic amendments. It is usually more efficient to learn how to use readily available local materials well than to pay for organic materials imported from further away. Raw organic amendments can be divided into three categories based on their C/N ratio and their effects on soil fertility: 1) hot stuff (C/N <15:1), 2) cool stuff (C/N 15-50) and 3) woody stuff (C/N >50). Hot stuff includes materials such as chicken manure, feather meal, blood meal and other specialty fertilizers. It is very easy to over apply these materials so they should be used as fertilizers and only applied at agronomic rates (see below). They increase soil fertility, but do not generally increase organic matter. Cover crops, separated dairy solids and many other manures, spoiled hay, lawn clippings and vegetable crop residues are all examples of cool stuff. They decompose relatively quickly, releasing nitrogen as they decompose. These sorts of materials can be applied in larger quantities and can increase soil fertility and organic matter. Woody materials can build organic matter and improve soil fertility, but they decompose more slowly and can immobilize nitrogen as they decompose. To avoid tying up nitrogen needed for good crop growth, woody materials should be applied well before planting crops. In many cases the fall is a good time to apply these sorts of materials which include horse manure, straw, woody yard debris, wood chips, sawdust and waste paper.

Composting can transform raw organic materials that are not convenient for agricultural use into a high quality soil amendment. Proper composting requires a similar level of effort and attention as it takes to successfully grow a new crop. The composting process can reduce weed seeds, plant or human pathogens, odor, and other concerns, so the effort is often justified. The feedstock, or raw materials used for composting should be well mixed and combined at ratios that provide a good initial C/N ratio (20-40:1), moisture (40-65%) and density (<1,100 lbs/\text{yd}^3). The WSU Compost Calculator\(^7\) will help you develop good compost recipes. Composting equipment should be chosen to fit the scale of your operation and the composting technique you choose. Be sure to understand the standards and environmental regulations relevant to your composting activities.

**Equipment and Infrastructure**

It is important to assess your equipment and infrastructure and other physical resources when designing a whole farm. Location, size, expense, and need are all things to be considered. It is often a good idea to draw a map of your farm, so you can plan your infrastructure development. Building upon existing infrastructure is a great way to start and most likely, your first few years will be


\(^7\) Compost Mixture Calculator. http://www.puyallup.wsu.edu/soilmgmt/CompostMixCalc.htm
Features

Ideal:
- fencing.
- farm.
- capital

Investing and goals.

Another concerns about producing including livestock fencing or wildlife fencing (in wilder areas where deer are a concern for perennial and annual crops.)

The next obvious consideration is to think about the equipment you will use on your whole farm. Farmers use various models including highly mechanized systems to draft horses to low maintenance and hand tools. You’ll want to consider your scale when purchasing equipment. Typical on-farm equipment that is crucial is a tractor, mower, loader and tiller, which are sort of the basics to get started in farming. Cost again plays into this and looking for ways to share equipment with other neighboring farmers is one way to lower costs and build social capital at the same time.

Many small, diversified farmers designing whole farms use what is already available on the market or at the farm and use innovation when designing tools or reusing materials. There are numerous examples of homemade harrows, hilling discs, electrically converted tractors and old time equipment being used on a modern whole farm today. Farmers tend to value innovation and reuse and making an incredibly useful tool for very little cost and energy. There is a lot of material to work with out there and other farmers are your best source for innovation in tools and equipment.

**Figure 5. Choosing Equipment**

<table>
<thead>
<tr>
<th>Task/Function</th>
<th>Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>Essential:</td>
<td>Essential:</td>
</tr>
<tr>
<td>Ideal:</td>
<td>Ideal:</td>
</tr>
<tr>
<td>Dream:</td>
<td>Dream:</td>
</tr>
</tbody>
</table>
Water Management

Managing water on a whole farm begins with a careful assessment of both the available water and your farm goals. The first step is to visit your local Watermaster and determine whether or not you have a water right on your property, and if so, the details of the right. Your water right specifies how much water you can use, and during which months. This information is critical to designing a water management plan for your farm.

Once you have determined how much water is available to you and when, consider your need for water as it relates to your farm goals. If you are planning to grow annual or perennial crops, find out how many inches of water each crop needs. If you are raising animals on pasture, research the amount of water needed to keep your fields green. Keep in mind that your soil type may influence the amount of water needed for your various enterprises.

Now, look at your water availability and your farm goals side by side and see if they are compatible. Will you have enough water throughout the growing season to keep your crops and pasture adequately irrigated? If you find that you do not have enough water from your water right, you may also want to consider winter storage of rainwater. Consult your Watermaster about regulations on storage. You may be able to build a small irrigation pond, or store rainwater in tanks to be used during the late summer. Think of water as you would in a yearly cash flow statement: do you have enough water for each month of the year? If not, you need to have a savings plan to cover the drier months.

If you do have enough water to proceed with your farming plan, the next step is to consider the most efficient water delivery method for your farm. The most common irrigation systems are flood, overhead, and drip. The amount of flow you have will help determine the most appropriate system. For example, overhead systems require more water at higher pressure. If you are new to a property, you probably inherited an irrigation system. Before you revamp the system, take stock in what already exists. You may not have the most efficient system, but the process of installing a new system may wind up being more work and trouble than justifies the improvement. If you are developing an entirely new system, consider how you can best make use of the water available to you.

Water conservation has become an increasingly important component of whole farm planning. Water and soil are closely connected, so using conservation tillage and soil-building practices will enhance the efficiency of your irrigation systems. For example, planting green manure and cover crops and applying compost to your fields increases the organic matter in your soil. Soils high in organic matter both retain soil moisture better and drain more efficiently, which moderates the effects of flooding and drought in your soils. In other words, building up the organic matter in your soil enables crops to utilize the water available to them more easily. Plowing on contour is another conservation tillage practice that helps prevent erosion and keeps water in soils for longer. Some farmers also plant hedgerows in an effort to retain more soil moisture and mitigate water loss through evapo-transpiration.

Finally, when designing a water management plan for your whole farm, consider how your irrigation system will impact the watershed you live in. For example, if you are pulling too much
water from a creek, you may see significant tree
dieback along the riparian zone during a
drought year. If you are flood irrigating a hillside
without using any conservation tillage practices,
you may cause soil erosion that will impact your
creek. Whole farms are not isolated from the
landscape in which they are situated.

Successful water management on a whole farm
involves a careful, honest assessment of the
water available and the water needed. Once
availability and need are reconciled, designing a
system involves taking into account the health
of the soil, plants, and animals on the farm, and
well as the watershed as a whole.

Conclusion

Designing a whole farm system takes many
years of planning, experimenting, learning and
continually reinventing. The farm is such a
dynamic place and there are so many factors
involved including Nature that the farmer finds
herself balancing so many forces including
economics, environment and community
dynamics. This short manual is intended to spur
thoughts, inspire and inform those trying to
design a whole farm – a place that is diverse,
healthy and sustainable. Remember to always
place yourself back on the farm, think about the
evermous resources and learning opportunities
available to you on your farm and proceed
forward with continual innovation, diversity and
sustainability in mind. Good luck!
Resources for Your Whole Farm

Setting Goals


Social Capital


Bowling Alone  www.bowlingalone.com

Indivisible.org  www.indivisible.org

Economic Viability


Small Grain Production

Growing Grains on a Small Farm. OSU Extension Small Farms Program, Central Point, OR. (Available for $10 in the OSU library).

Nutrition problems in poultry from certain types of grain: http://cru.cahe.wsu.edu/CEPublications/fs002e/fs002e.pdf


Equipment & Infrastructure


The Growing Farms Reader: Read It! OSU Small Farms Program. (Available for lending through the OSU library).


**Farmscaping**

*Bringing Farm Edges Back to Life: Landowner Conservation Handbook* Yolo County Resource Conservation Handbook 221 West Court St., Ste 1, Woodland, CA 95695 530-662-2037 x5  
[www.yolocrd.ca.gov](http://www.yolocrd.ca.gov)

*Farmscaping to enhance biological control.* Rex Dufour 2000 ATTRA, Fayetteville AK  


**Hedgerows**


**Perennials**


Turner, Newman. 1956. *Fertility Farming.* Faber and Faber, Ltd. (or reprints from Acres, USA, 2009).

**Soil Fertility**

References and Additional Resources:

1. Soil Sampling for Home Gardens and Small Acreages (EC 628).
2. A List of Analytical Labs
4. Using Cover Crops in Oregon
5. OSU Organic Fertilizer and Cover Crop Calculator.
6. WSU Compost Calculator
7. Fertilizing with Manure (PNW 533).
8. Oregon DEQ Composting site
9. Building Soils for Better Crops
10. Managing Cover Crops Profitably
11. UC Cover Crop Database
12. NRAES On-farm Composting Handbook
The OSU Extension Small Farms Program is thankful for the support of the USDA Risk Management Agency.