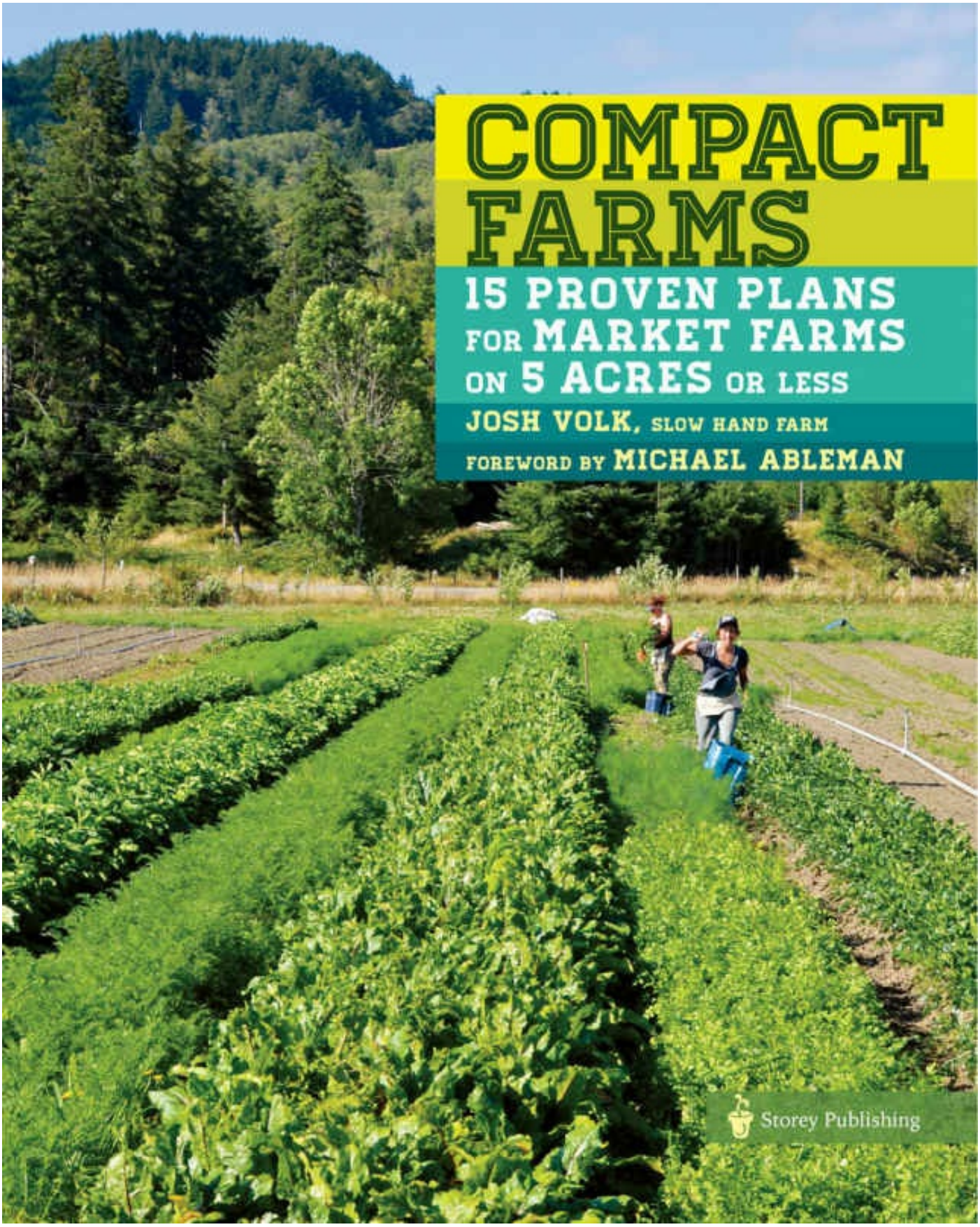
DETAILED FARM LAYOUTS for Productivity and Efficiency

COMPACT FARMS

15 PROVEN PLANS FOR MARKET FARMS ON 5 ACRES OR LESS

JOSH VOLK, SLOW HAND FARM

FOREWORD BY MICHAEL ABLEMAN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Storey Publishing

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For those who dream of farming small

FOREWORD

I'm not sure I've admitted this to anyone before, certainly not in a public forum, but there was a time when I suffered secretly from farm size envy. Throughout the 1980s and 1990s I managed a 12.5-acre farm that floated in a sea of tract homes and shopping centers in Southern California. It was referred to as the "little farm that could," for at its peak it employed thirty people, fed hundreds of families, and produced an extraordinary diversity of fruits and vegetables. My "small farm" inferiority was fueled by the cultural perception at that time that 12.5 acres was too small to be viable and that any success we were experiencing was an anomaly.

This was just after then US secretary of agriculture Earl Butz proclaimed that farmers should "get big or get out," and long before the local, farm-to-table, farmers' market, foodie, arugula, French-breakfast-radish craze had found its footing. In spite of all this, that little farm gained a reputation around the country, trained a number of new farmers, and even managed to generate some serious dough. None of that assuaged my sense of relative inferiority. I grew up in the 1950s and '60s and "bigger is better" had lodged itself in the deep reaches of my psyche.

And so after more than twenty years on that farm, I moved 1,200 miles north to start over again, this time on 120 acres, ten times the size of that little farm in California.

And while I value being on land big enough to grow grain, plan longer-term crop rotations, and raise animals larger than a chicken or a rabbit, I now commute to the city a couple of days a week to run a small urban agriculture project as well. This farm, a "whopping" 5 acres of food production on pavement, now employs 25 people (most of whom are managing some form of addiction or mental illness) and produces more than 25 tons of fresh food per year, thus providing meaningful work and food for dozens of marginalized folks.

Small is not just beautiful, I have learned through this work, but it can also be economical, highly nutritional, and extremely powerful.

We all hear the constant harangue about what is wrong with the industrial food system: the chemicals, the genetic manipulations, the loss of topsoil, the pollution of groundwater. These are all critical issues that we need to consider, but I suspect that the real crisis is not a "food crisis" but a crisis of "participation." When less than 2 percent of the population is producing the fundamental nourishment for the rest, it requires

chemical and industrial methods that are depleting the soil, polluting the water, and making us sick.

Small farms have the unique ability to engage more people in the process. More eyes and hands per acre allow us to be more present and attend to the myriad of biological, ecological, and social details that are so easily missed as scale increases. Gardens and small farms are the incubators for so many good ideas and techniques that can then be adopted and adapted for any size farm. And well-run small farms are often far more productive per acre than their larger counterparts.

We need the fertile, productive, physical examples of these well-run small farms. We need to see these models and witness how they integrate with their local communities.

Mid- and large-scale farms fulfill an essential role in the broader food system. But to secure our food future we must also rethink what we see in our mind's eye when we think "farm," and we must question the culturally embedded idea that "bigger is better." We need to embrace the idea that there is real power in the small, the intensive, the scale that a neighborhood or community can relate to and adopt as its own.

This book will take you on an intimate journey to visit some of the best models of "little farms that could," clearly demonstrating the skill, ingenuity, resourcefulness, creativity, and attention to quality and detail that naturally evolve when hands and eyes and hearts are laser focused and fully present.

— Michael Ableman

Farmer and author of *Street Farm: Growing Food, Jobs, and Hope on the Urban Frontier*

ABOVE: *Kji and Josh packing CSA shares at Slow Hand Farm*

PREFACE

"Small is beautiful."

— Leopold Kohr

This book is about very small farms. How small is very small? My own farm, which I profile in this book, produced vegetables and herbs on less than a quarter acre. John Jeavons — an early influence, whose ideas I reference throughout this book — always spoke of 4,000 square feet (less than one-tenth acre) as the minimum amount of land needed to support a family. He suggests that for someone working by hand, anything larger than 10,000 square feet (slightly less than a quarter acre) is too much to handle alone.

"Compact" is an alternative word to describe these farms. Their farmers choose to keep their production spaces modest, intensively working limited areas, as opposed to spreading out their efforts over vast acreages.

When setting out to find farms to feature in this book, I went a little larger than Jeavons's ideal. I sought all kinds of successful farms with less than 5 acres of production and found not just a new wave of urban farmers, but also an old guard of seasoned veterans carrying on long traditions. Some work their land primarily by hand, but many use tractors of one size or another, and one even uses horse power (although the horse pasture takes up as much space as the production area!). All of the farms have more than one person working on the farm during the main season, although sometimes that means only two.

The point is that it doesn't take a large space to be productive or to make a decent, sustainable living. Across the country, from urban rooftops to rural holdings, farmers are proving there is more than one way to farm successfully on a small scale, and it can be done just about anywhere with decent soil, water, and people.

I didn't come from a farming background. I grew up on the edges of cities. My parents had vegetable gardens that I mostly ignored. When I went away to college and started cooking for myself, I became more interested in where my food came from and how to grow it. That interest grew, inspired by books on small-scale food production. There weren't many writers on that topic then, and it wasn't so long ago.

This book is for those who dream of farming small. I hope it is both inspirational and practical, with useful foundational materials and ideas to help you plan your own compact farm. The 15 farm profiles offer a range of possibilities; the planning section provides a framework for getting started, as well as strategies to consider; the financial section outlines the earning potential; and the appendixes deliver additional resources for learning the nuts and bolts of farming.

The best part of writing this book was the opportunity to experience so many wonderful compact farms. I found many more than I had time to write about, and I know I saw just the tip of the iceberg. I am extremely grateful to the farmers who generously took the time to talk me through the details of their operations. I hope I have captured the essence of their approaches in the few short pages devoted to each farm. I could easily write an entire book about any one of them, and I would love to spend a season or two apprenticing with each and every one to learn more.

My hope is that this little book will inspire folks who have never planted a seed to try it, motivate gardeners with bigger aspirations to start growing for their communities, show overwhelmed farmers that scaling down is an option, and encourage people who are already farming small to keep up the great work.

ABOVE: *Slow Hand Farm in the summer*

ABOVE: *Slow Hand Farm in the winter*

PART 1

WHY FARM SMALL?

COMPACT VALUES AND STRATEGIES

Compact farms are human-scale, approachable, and easily manageable. I enjoy being able to walk the entire production space, checking in with all of the plants, animals, and structures in the course of a few minutes each morning. Other benefits are not exclusive to compact farms but are characteristic of them:

Hands-on farming. Compact farms can and frequently do utilize machines, but the nature of small spaces means that many tasks are far better suited to hand tools (or even just hands) than to tractors. I'm mechanically inclined, but I don't want to be a full-time driver or mechanic, spending my days working on big machines. I enjoy working with hand tools, which are quiet, fume-free, and relatively easy to maintain.

Community magnet. Compact farms build a sense of community centered around food. It's much easier for most of us to relate to small local farms than to large distant ones.

Partnering with natural systems. Compact farms almost always rely on a diversity of crops instead of a suite of synthetic sprays and fertilizers. Small plantings of diverse crops have the potential, through myriad natural symbioses, to reduce pest and disease pressures. Some of those natural symbioses also provide fertility, increasing production and changing "waste" products, potential environmental pollutants, into soil-building amendments. It may appear easier to manage a big monoculture (the planting of a single variety, which is typical of large farms) and become an expert on the needs of just one crop rather than thirty. In fact, those single-crop plantings can require more intense management of nutrients, pests, and diseases precisely because they are working against, not with, natural and diverse systems.

ABOVE: *Setting vole traps in spring plantings of greens at Our Table Farm*

Limiting outside costs. Since large monocultures are easily mechanized, they appear less costly to run than more labor-intensive, small, diverse farms that are better suited to

the incredible flexibility of hand labor. In fact, many of the actual costs of large monocultures, such as groundwater pollution and soil erosion, are externalized and are not included in the price of the produce. Further, repetitive stress injuries during field work are more common in larger enterprises than on small farms, and those injuries externalize the costs to workers in another way.

Variety in plantings also means variety in tasks, and from personal experience I can say this definitely helps reduce physical wear and tear.

Limiting startup costs. For farmers just starting out, one of the obvious benefits of starting small is lower initial costs. This is often amplified because, as mentioned above, compact farms typically use more labor and less machinery. Both labor and machines can be expensive, but machines typically require cash up front, whereas labor on a very small operation can often be paid for in sweat equity.

Adding value. In a time when land prices are relatively high and food prices relatively low, it can be tricky to make the jump into a business requiring lots of land and equipment to produce a low-value product. Compact farms reverse this equation, reducing the land needed and increasing the value of the produce. In the long run, of course, you reach success by keeping expenses lower than gross revenue, a difficult task no matter the size of your outfit.

The dictionary considers the term *market garden* a British version of the French-derived *truck farm*, from *troque*, French for "exchange" or "barter."

KEYS TO SUCCESS FOR COMPACT FARMS

In this book, I've profiled 15 farms from different parts of the United States and Canada, a small sampling of the many folks farming very small acreages. This group showcases the range of approaches, geographic areas, crop selections, production techniques, and markets available to small-scale farmers — and even the way the farms were started. I've visited countless farms and I've had the good fortune to meet a lot of really fantastic farmers — not only good growers, but good and generous people. I'm continuously reminded on these visits that there isn't just one way to farm well.

PAYING ATTENTION

Good farmers pay attention to their land and to their markets; through the filter of their own unique personalities, experiences, and resources, they then create productive systems and continuously improve them. Farms are incredibly complex and dynamic places, a mix of physical elements — minerals, water, and organic materials of all sorts — combined with a stunning array of biological elements, all continuously interacting, changing, and reacting to weather and even the movement of the earth, moon, and stars. You can learn from books how to grow crops, but there is no substitute for the physical, experiential learning that happens with season after season of planting, nurturing, and harvesting crops, caring for livestock, and dealing with the innumerable factors that contribute to the harvest.

Good farmers pay attention to the land, which means they pay attention to everything connected to it: the soil, the plants, the animals and insects, the microbiology, the water, the weather, the sun and the seasons, and on and on. Curiosity and observational skills are key traits for learning to farm, and learning to farm well is a lifelong pursuit.

Good farmers also pay attention to markets; it's a skill that separates compact farms from oversized backyard gardens. As a farmer, simply producing good yields of high-quality product is not enough; you must also be able to make a living — or some semblance of a living — from it. The farmers profiled in this book all not only produce food, they also sell it. Many use multiple channels, diversifying their customer bases as well as their crops. Diversity in marketing, or in crop production, may appear to complicate the tasks of selling and growing. The benefit may not initially be clear, but that diversity adds resilience, reducing the farm's reliance on any one buyer or the success of any one crop.

SETTING YOURSELF APART

Creative marketing approaches allow farmers to set themselves up as "price makers" as opposed to "price takers": sellers who have the ability to sell their produce at a price they set, versus sellers who must accept the price the market offers them. By selecting appropriate crops, connecting with customers, and adding value in all sorts of small ways, these small-scale growers set themselves apart from their larger counterparts.

DEVELOPING SYSTEMS THAT WORK

The ability to systematize the daily tasks on a farm is another way to distinguish between most home gardeners and farmers. On all of the farms in this book, systems of production and marketing are constantly evolving. Farmers all have systems in place, but those systems are always in flux and are hard to pin down. Ask a farmer about one aspect of their operation, such as bed preparation, and you'll get a long discourse about how they are preparing beds, only to be interrupted with an explanation of how they used to do it, followed by an outline of how they are planning to improve it in the future.

Most farms are, however, well thought out, with relatively stable systems refined over the years. In many cases, the individual systems are tied into other systems: for example, some farmers' planting methods might be connected to how they prepare their beds, or how they want eventually to harvest the crop. All of these things are almost certainly tied to the soil type, climate, equipment availability, and personality of the farmer. The individual elements aren't necessarily "drag and drop," or universally interchangeable. By summarizing each profiled farm's full set of systems, I hope that I can give you a better view of the big picture for each operation, and a sense of how all of the elements interrelate.

ABOVE: *Preparing beds for eggplant*

"What about the seventh generation? Where are you taking them? What will they have?"

— Oren Lyons

SUSTAINABILITY AS A CORE GOAL

The farm profiles in this book focus on a group of farmers who tend toward organic methods, favoring ecological approaches over sterile synthetics. Many of us take this for granted, so much so that we can forget that most of the food in this country is still produced using synthetic fertilizers and chemicals to control weeds, pests, and diseases. Many of those same synthetics are available not only to "trained" applicators on farms but to the general gardening public as well, and both use them for the reason for which they were ostensibly developed: to make growing crops easier.

On the face of it, these synthetics may seem to have simplified problem solving on the farm, but now that the more complex, longer-term negative impacts of systems that rely on synthetics are more widely understood, it astounds me that we aren't prioritizing the development of alternative methods. There are many examples of food production systems that work with complex biological processes, without synthetics, to produce more food per space and energy input, and to return more good to the producers themselves and to their communities.

DEFINING OUR TERMS

Sustainability, by definition, means employing practices that can be maintained indefinitely. In an ecological sense this is often stated another way: don't harm the environment. Sustainable agriculture uses methods that don't deplete the soil over time and don't pollute the water, air, or soil — although this last point is usually less an absolute and more a case of "relative to systems that are heavy polluters." For example, many "sustainable agriculture" projects still use tractors, and it's hard to argue that tractors don't pollute. As a society, however, we tend to see a certain level of pollution as acceptable, and in some sense, it probably is true that the environment can absorb and process, sustainably, a certain level of tractor pollution.

THREE PILLARS OF SUSTAINABILITY

Effective sustainability isn't just about ecological concerns, however; it's also about the financial stability of the farm and the social impact on both workers and the larger community. This is frequently referred to as triple-bottom-line thinking, taking into account **people**, **planet**, and **profit** — the three pillars of sustainability.

When thinking about sustainability on the farm, I consider the internal workings of the farm and how the practices we're using to produce food are impacting not only soil health but the habitat for all of the creatures on the farm as well — from birds and coyotes to insects, worms, and even bacteria and fungi. I also think about my own well-being and that of the folks who are helping me. And, since I do not have vast financial resources, it's impossible to ignore the need to make the farm profitable.

Here are some examples of triple-bottom-line thinking on the farm:

- I'm careful to rotate crops to avoid pest and disease problems, rather than using pesticides and fungicides that not only kill the "problem" but also destroy beneficial insects and soil organisms. This approach is more ecologically sound, saves me the

expense and time of application, and doesn't subject me, farm workers, or the community to toxic chemicals.

- I'm careful to set my prices high enough that I can make a living without having to take shortcuts that harm the environment and without working excessively long hours.

CLOSED AND OPEN SYSTEMS

Focus first on what you can control on the farm. Rudolf Steiner, best known in this country for developing the Waldorf education system in the early twentieth century, also set the framework of biodynamic agriculture, a precursor to both organic agriculture and the concept of sustainability. A fundamental principle of biodynamics is to view the whole farm as a system, and as much as possible to keep that system closed, importing as little as possible. Biodynamics focuses on creating ever more productive systems — ecological, economic, and spiritual — within the farm itself.

Yet even in biodynamics, it is recognized that the system will never be fully closed. Just as produce is sold off the farm, some resources must be imported onto most farms at some point. We need to think beyond the farm boundary and ask questions: What effect do we have on how the imported tools, supplies, and raw materials are produced? What is the impact of the materials, soil, water, and produce that leave the farm? These processes must be evaluated for their ecological impacts and their social and financial outcomes.

SEEKING BEST OPTIONS

Rather than fixate on absolute numbers measuring sustainability, I find it more realistic in daily practice to pick my best options and then work to improve them. When I started my own farm I delivered my produce with a regular car, not worse than any typical commuter, but then I was able to reduce my impact by switching to a cargo bicycle with electric assist. This wasn't just an ecological improvement, but it also made my day more fun and fulfilling. Farmers are always working toward improvements, hoping they help move the leading edge of what is possible.

THE BIGGER PICTURE

Sustainability is a core value for all of the farmers profiled, and yet not one of them would say they aren't still trying to improve in that realm. For this reason, we need to go beyond the word "sustainability," which implies a static state that can be maintained

indefinitely, and adopt new terminology that encompasses the intention of the sustainability movement. It's not that we seek a static state, or even that we never do anything that won't be able to be repeated sustainably, but that we leave at least as much for future generations as we had when we started.

We need to add to sustainability the concept of continual and conscientious improvement. The compact farms here illustrate that value in numerous ways. These are farms that seek to improve the places where they are, to improve their communities, to help their neighbors, and to leave more than they have taken.

The white board is an essential planning and communications tool on many small farms.

PROFILE

John Jeavons and Ecology Action

In 1972, John Jeavons and several compatriots began Ecology Action, a multifaceted ecological action program in Stanford Industrial Park in Palo Alto, California. He brought to the group his past interest and work at the U.S. Agency for International Development and began to focus public attention on how to feed the world and do it sustainably. After a brief mentorship with the great

horticulturalist Alan Chadwick, Jeavons launched a half century of learning, research, and teaching about the Biodynamic French Intensive System of gardening and farming.

His first book, *How to Grow More Vegetables, Fruits, Nuts, Berries, Grains, and Other Crops than You Ever Thought Possible on Less Land than You Can Imagine*, was published in 1974 and is now in its eighth edition, with sales of more than 600,000 copies in nine languages. Jeavons's ideas took the work of his contemporaries, such as J. I. Rodale, to a new level, predating the NOP (National Organic Program) by 20 years. For many of us, the book has been a compass, providing a day-to-day manual and an ongoing source of inspiration.

Jeavons's work, and that of Ecology Action, has focused attention on issues of fully sustainable soil fertility and not simply the "clean food" idea of the NOP. For an unparalleled four-plus decades he has worked to learn how to grow food with the highest nutritional value, in the least amount of space, with the fewest resources (i.e., water, energy, human labor, additional amendments) and the least impact on the natural world, emphasizing closed-loop fertility. He has helped create food systems that address food security and sovereignty for people, families, and communities.

Jeavons had a three-decade head start on the current sustainability movement. Numbers are important, and Jeavons knows this. Using his systems thinking, he and his associates at Ecology Action have addressed such thorny issues as complete diet, compost crop design, and energy and water use. His original book *How to Grow . . .* has been complemented by more than 200 other books, booklets, and information packets he has produced on a range of sustainable and resilient approaches to mini-farming.

Early in the community-supported agriculture movement (mid-'90s) I decided to start a CSA. With little information at the time, I used the master charts in Jeavons's *How to Grow . . .* and doubled the U.S. consumption of the particular vegetables I intended to grow (assuming that CSAers ate much more than the U.S. average). Then, using the planning forms, I backtracked through the relevant biointensive potential yields to the number of plants I needed. This also gave me the number of flats, meaning bench space for transplants and grow-out space, length of harvest, and a whole host of additional information. This proved to be just the information I

needed to get started. Later, I needed very little adjustment other than accounting for an overall share increase as the CSA moved from 60 initial members to the target of 140 by the second year. Jeavons's book was a lifesaver for my CSA.

For a whole host of reasons, his work has long been recognized by small-scale farmers and gardeners. As the world better grasps the current food, environmental, social, economic, and political challenges of the future, however, it is becoming increasingly clear to those in the United Nations, World Bank, International Monetary Fund, and other organizations that small-scale farming has been and is feeding the bulk of our 7.4 billion people. These entities clearly articulate a belief that such approaches can feed up to a projected 9 billion people.

It is an awesome responsibility, and a challenge to do so *sustainably*. But Jeavons never tires, falters, or wavers. Biointensive methods, adopted by more than 150 countries, have succeeded in virtually all climates and soils where food is grown — for example, by an estimated 2 million-plus biointensive-trained farmers in Kenya and elsewhere in sub-Saharan Africa and by more than 3 million farmers in Latin America.

All are points of hope for now and in the future.

— STEVE MOORE

Steve Moore is vice president and associate executive director of Ecology Action and director of agroecology at Elon University in North Carolina. He and his family have farmed organically for over four decades, and he has been a pioneer in solar greenhouse and high tunnel production for more than 25 years.

ABOVE: *John Jeavons demonstrating ergonomic double-digging techniques in Kenya*

PART 2

FARM PROFILES

"5% theory, 95% practice"

— Sri K. Pattabhi Jois

In the following pages you'll find profiles of 15 farms from across the continent. I start with the story of my own little operation, Slow Hand Farm, and what got me there. I tell my story to give you, the reader, a sense of where I'm coming from, my own particular experiences in growing, how I made my decisions, and, perhaps, my biases.

The profiles that follow my story belong to a collection of impressive and well-established farms and a few new-generation upstarts. Some of these farms have been quietly plugging along, fixtures in their own communities but little known beyond. Others are well known and much written about but worth revisiting, as they are constantly updating their methods and provide a nice framework of reference for the other farms.

These profiles are snapshots in time. The farms are continuously changing as farmers find and develop new tools and methods, making little tweaks to their markets, adjusting their crop mixes, and learning more about their piece of land, the changing climate, and the people who work with them.

These farms are all in very different parts of the country, with different climates, soil conditions, access to tools and supplies, access to markets, regional customer preferences, competition, and influences. It is a varied group, but there are commonalities, and these commonalities are the things that work well.

ABOVE: *A splendid harvest at Full Plate Farm*

Farm Like a Chess Master

Keep in mind that the tools and techniques used on these farms are parts of systems. This book is different from many farming and gardening books that look at just one system. In some ways, farming is a like a big game of chess, where every move leads to another, and you can't say in advance what the best fifth move will be without knowing what the fourth move is. How these farmers prepare beds is tied to the way they plant, the way they control weeds, and how they harvest. When considering your own compact farm or market garden, take ideas from these farms, but remember that if you want your fifth move to have a certain successful outcome, you need to set it up with your first four moves.

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SLOW HAND FARM

ABOVE: *The fields in February, with the last of the winter harvests and the first new plantings for the year*

THE BACKSTORY

"Slow" comes from the Slow Food movement, celebrating Good, Clean, and Fair. "Hand" reflects work at hand-scale and highlights the importance of people.

JOSH VOLK

Space in Production: 0.15 acre

Location: Peri-urban — Sauvie Island, Oregon

Crops: Mixed vegetables and herbs

Markets: CSA

Year Started: 2009

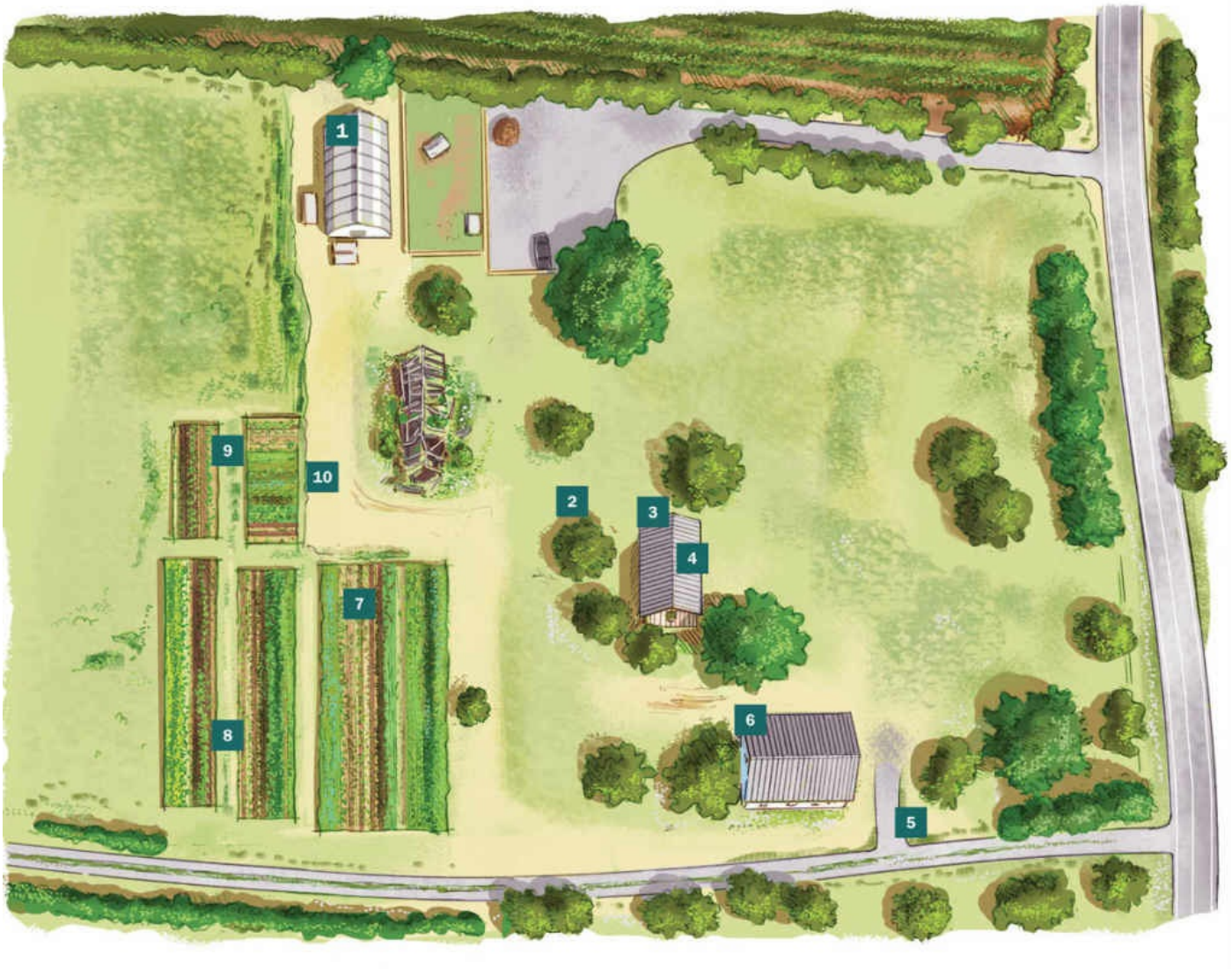
ABOVE: *Harvesting arugula with a well-worn field knife*

Slow Hand Farm was my own compact farm. In 2013 it was incorporated into a larger farm (Our Table Farm), but for the four years prior it demonstrated to me the potential for success in a small hand-scale operation, even in an area with competition from very good market growers who used tractors.

I started out on a little, flat rectangle of ground borrowed from a fellow I met at a Farmer-Chef Connection event in Portland, Oregon, in 2008. Even though it took me a year to figure out how to start, I had been turning over ideas in my head for a farm like it for at least 15 years prior to that.

SLOW HAND FARM

MAP



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KEY

1. Hoophouse
2. Fruit trees
3. Wash corner
4. Barn

5. Driveway
6. Tool storage
7. Slow Hand Farm field
8. Edible Horizons field
9. House garden
10. Water hydrant

LEARNING FROM A MASTER

It's hard to say exactly when I started thinking about a small farm, but in the summer of 1996 I took two workshops from John Jeavons through the Ecology Action garden store. The first was on double digging and the second on making a profit from what you grow.

It's one thing to sell your produce, but to make a profit adds a new layer. Jeavons's basic framework was to start with a personal budget and then work backward. Choose crops for the amount of space you have in order to yield the total gross returns you need to cover your personal budget and the cost of materials for growing the crop. Simple.

This straightforward approach, and the spreadsheets contained in his book, *How to Grow More Vegetables than You Ever Thought Possible on Less Land than You Can Imagine,* resonated with me. For the next 13 years I learned from working on farms, playing with my own versions of spreadsheets, and gardening in my spare time. I took ideas from his paper spreadsheets and moved them into various computer programs, imagining perfect little farms with mixes of vegetables I liked to eat, exotic new varieties to try, and little trials of small grains and dry beans.

The year I took John Jeavons's workshops I was working as a freshly graduated mechanical engineer designing small tools for a factory floor, gardening in my rented yard, and volunteering in community gardens on weekends. My background was suburban — and though I had certainly visited rural areas and even the occasional farm while growing up, I don't think I realized how urban my perspective was. When I left engineering to pursue farming I learned not only production techniques from the farms I worked for, but also a little about rural living — lessons I intended to bring back to an urban setting someday.

ABOVE: *Typical September share, Slow Hand Farm CSA*

Ecology Action

Ecology Action had its roots in Palo Alto, California, where in 1972 the group began to work a small piece of undeveloped land. They studied the ideas of British master gardener Alan Chadwick, who was over the mountain in Santa Cruz at the time. A few years into the project, the group lost the land to development and moved north to a larger piece of ground in Willits, California, a rural area with no threat of development. They left behind a small garden store in Palo Alto. When I moved to Palo Alto in 1996, it was still there, a little gem for local gardeners seeking quality tools, seed, amendments, and information for growing food in their yards. (See Ecology Action and its founder, John Jeavons.)

THE BASICS

My idea for Slow Hand Farm was a small, hand-scale production garden selling produce to the local community. I knew this would translate well as a model for urban agriculture. I intended to focus on special varieties — varieties you'd happily eat out of your own garden that were particularly tasty and productive but weren't what you'd find in the grocery store.

My other goal was to work on the farm only part-time. This fit well with the "compact model," as it reduced the amount of space I needed in order to make enough money to cover expenses and to pay myself for my labor.

In the first year, the space was modest. Everything was seeded directly into the ground. I stored almost everything, especially tools, at my home and brought them on workdays, and initially I packed the vegetables for market in the shade of a few apple trees.

By its fourth year, Slow Hand Farm was a well-developed model, still with plenty of improvements to be made, but showing the potential to make a modest living on an extremely small piece of ground. At this point, the farm occupied this much real estate:

- a 56-by-120-foot rectangle of ground
- an 8-by-4-foot reach-in heated greenhouse in the corner of a larger, unheated high tunnel
- three more 8-by-4-foot tables in the high tunnel
- two corners of barns on the property for tool and equipment storage and for washing and packing vegetables twice a week, totaling approximately 300 square feet of covered space

CUSTOMERS AND MARKETS

With limited space and labor, I wanted to focus on growing specialty vegetables that were very productive for their space requirements. I didn't want crops that needed a lot of space or required a lot of babying since I'd only be on the farm two days a week.

I like interacting with customers, so direct marketing seemed like a good fit, especially as it allowed me to charge full retail value for all of my produce. Charging

full retail allowed me to make relatively more income per space cultivated than if I were selling it wholesale or to a store that needed room to mark up the price.

I considered three direct-market channels: farmers' markets, direct sales to restaurants, and CSA (community-supported agriculture). I ruled out farmers' markets when I ran the numbers and realized that I would have to spend one of my two farm workdays each week at the market (traveling to the market, staying to sell, and then cleaning up). That would leave me only one day a week to do all of the other farm work. I couldn't figure out how to grow enough food that I would be able to sell enough in one day at the market to make it worth the time.

I originally thought I'd sell direct to restaurants, as I knew the scene in Portland pretty well and figured I could grow some small specialty items that would get me a good price, especially if bigger growers weren't bothering with them. The restaurant sales plan lasted only until a friend encouraged me to start a CSA. I was hesitant; even though I had more than a decade of production experience on CSA farms elsewhere, I had no experience on the new land. I didn't want to not be able to deliver, and I was more comfortable taking on all of the risk myself, but after the conversation with my friend I started thinking about the benefits of a CSA.

One of these is very clear: cash flow. My seed and irrigation supply expenses would be covered by money coming in for CSA shares before crops were even planted. The other benefit was a consistent and predictable weekly workload, since orders wouldn't be coming in week by week from fickle chefs with their own ups and downs and their varying needs. Instead, customers were committing to a full season of harvests and paying in advance for me to deliver a nice mix of fresh vegetables, picked just for them and with a backstory connecting them to the farm.

Community-Supported Agriculture

First developed in the United States in the mid-1980s, community-supported agriculture (abbreviated CSA) was built on earlier ideas from biodynamic farms in Europe and mirrored farming models developed in Japan and Chile.

Trauger Groh started one of the first two CSA farms in the United States in 1996, with the idea that a stronger connection between the farm and the community that farm was feeding would be mutually beneficial. The concept included community ownership of the land, cooperation between the growers and the community, and

paying attention to the needs of the land and of the people involved rather than just profit. Since then the number of CSA farms in the United States has exploded; thousands of farms around the country now offer shares.

In most cases, CSA means the consumer makes a cash payment to the farm at the beginning of the growing season. This buys a mix of vegetables selected by the farmer and provided weekly to the consumer during the harvest season.

Consumers benefit by having a regular supply of seasonal, farm-fresh produce from a single farm. They are connected to that farm and its practices, supporting it consistently through the year, and the farmer is working directly for the consumer. This explicit mutual commitment is what sets CSA apart from other direct marketing approaches.

Farmers benefit from a larger up-front payment to help with cash flow; in some cases, CSAs reduce the amount of marketing work they must do. The details of each farm's CSA model vary quite a bit and there is much internal debate in the CSA world about what defines a "real" CSA farm.

Journalist Steven McFadden has written several books and many excellent articles on the CSA movement over the past three decades. Elizabeth Henderson, a CSA grower in New York, wrote a good book, *Sharing the Harvest: A Citizen's Guide to Community Supported Agriculture,* coauthored by Robyn Van En, cofounder of the other pioneer CSA farm in the United States, which got its start at about the same time as Groh's.

FINDING A NICHE: CSA-LITE

To make things work with my small scale of production, I decided to offer a different kind of CSA share than I had seen at any other farm. I designed plantings for a very, very small CSA share, a sampler based around seasonal salad ingredients with a few other items in there, too. It was CSA-lite, a starter or gateway CSA share inviting in new customers.

The idea was to give individuals, not just families and couples, the ability to sign up for a CSA share without being overwhelmed each week or having to find a friend to split the share with. I figured folks who wanted more food could order a second and

even third share, or maybe go to the farmers' market, too. From experience I knew some folks would want to get some vegetables from other sources anyway, and with a small share they wouldn't feel guilty that they weren't using everything in their share because they just couldn't eat it all.

Over the next few years, I simplified the process of signing up for a share by shortening the member's commitment to a single three-month season and offering four consecutive seasons each year: winter, spring, summer, and fall. This let folks pick and choose, and it evened out the cash flow for all of us. Some people still signed up for all four seasons and paid up front; most signed up a season at a time; some who had gardens dropped out for the summer, returning in the winter; those who only really wanted tomatoes and lettuce dropped out during the winter.

ABOVE: *Cleaning beets for the CSA shares*

LABOR

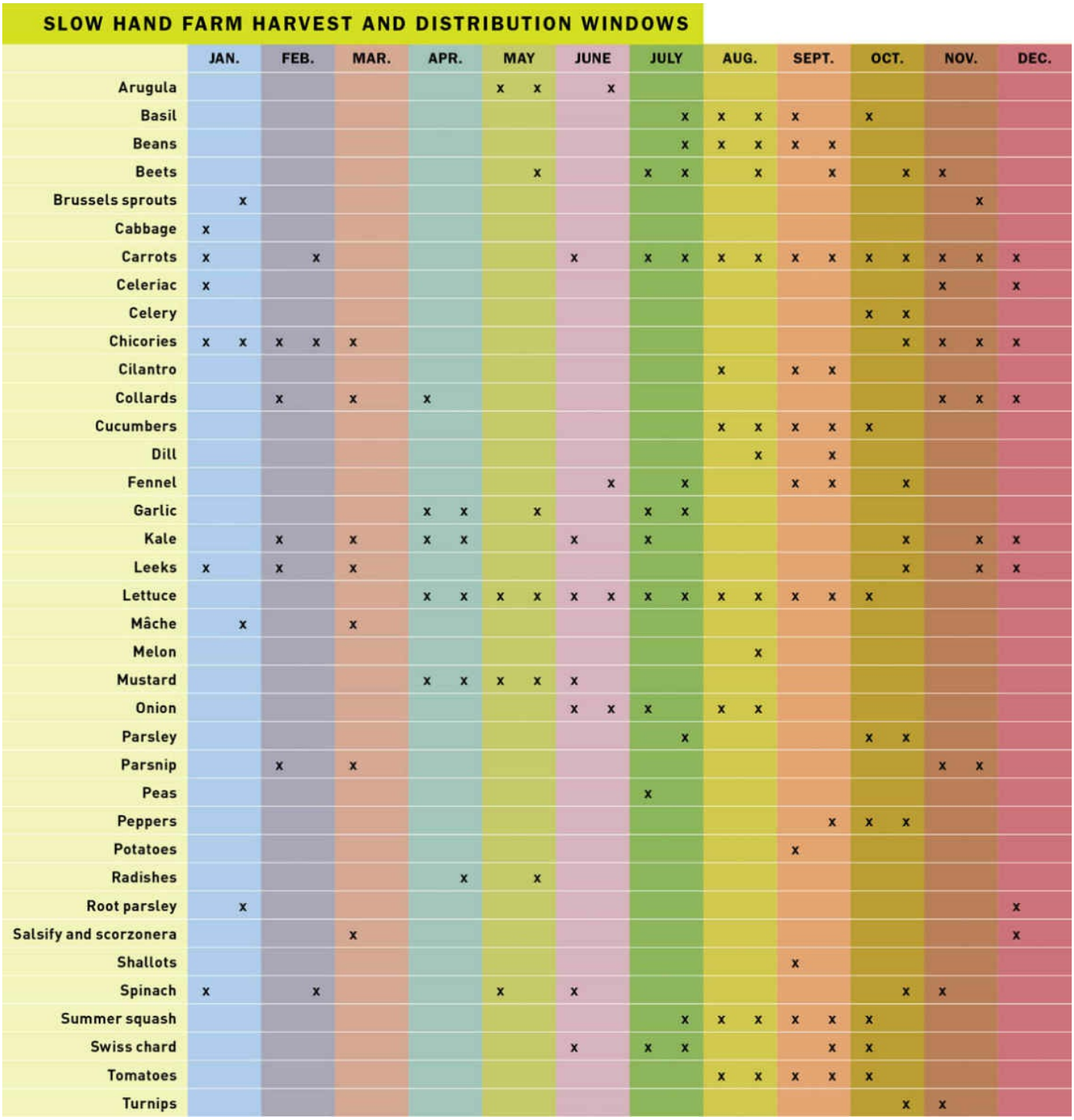
Before starting Slow Hand Farm, I worked for almost a decade as a full-time farm worker and manager. In the peak seasons I put in long hours; in the slower seasons I worked shorter days and took longer vacations — typical farming schedule. During that period, I stumbled into an opportunity to develop a farm with only part-time workers, all working together just two or three days a week. That model showed a clear benefit: a lack of burnout during the peak season in late summer. The part-time crew came in with energy and stories from their other pursuits, just as excited to work with the plants as they had been earlier in the summer, and I had that same feeling.

By the time I started Slow Hand Farm in 2009, I knew that part-time farming could work for me. I decided on a two-day-a-week project, setting aside just two days each week to commute out to the farm, plant, cultivate, and harvest. I wanted to be involved in all aspects of the farm, not as just the manager but performing all of the fieldwork as well.

PART-TIME AND PARTNERING SOLUTIONS

Farming with a partner kept the farm resilient labor-wise. For the first year of Slow Hand Farm, Danny Percich and I operated similar side-by-side businesses on the same land, but when one of us was away the other covered whatever work couldn't be put off, including harvests and deliveries, keeping a record of our hours. At the end of the season, we tallied our expenses and total hours; if there was a balance of hours, we paid the other a proportional amount of our profits, which, as sole proprietors, was our income for the year.

After the first year, Danny moved on to start a larger farm (see Full Plate Farm). I connected with another former coworker, Kji McIntyre, whose business Edible Horizons had a slightly different mix of crops and a different marketing model, but the same-sized fields and work schedule. This arrangement worked well for the next three years.



SLOW HAND FARM HARVEST AND DISTRIBUTION WINDOWS	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
Arugula					x x	x						
Basil							x	x x	x	x		
Beans							x	x x	x x			
Beets					x		x x	x	x	x	x	
Brussels sprouts	x										x	
Cabbage	x											
Carrots	x	x				x	x x	x x	x x	x x	x x	x
Celeriac	x										x	x
Celery										x x		
Chicories	x x	x x	x							x	x x	x
Cilantro								x	x x			
Collards		x	x	x							x x	x
Cucumbers								x x	x x	x		
Dill								x	x			
Fennel						x	x		x x	x		
Garlic				x x	x		x x					
Kale		x	x	x x		x	x			x	x	x
Leeks	x	x	x							x	x	x
Lettuce				x x	x x	x x	x x	x x	x x	x		
Mâche	x		x									
Melon								x				
Mustard				x x	x x	x						
Onion						x x	x	x x				
Parsley							x			x x		
Parsnip		x	x								x x	
Peas							x					
Peppers									x	x x		
Potatoes									x			
Radishes				x	x							
Root parsley	x											x
Salsify and scorzonera			x									x
Shallots									x			
Spinach	x	x			x	x				x	x	
Summer squash							x	x x	x x	x		
Swiss chard						x	x x		x	x		
Tomatoes								x x	x x	x		
Turnips										x	x	

ABOVE: *Double-tap the image to open to fill the screen. Use the two-finger pinch-out method to zoom in. (These features are available on most e-readers.)*

WATER

We were lucky to have good access to water. Land without water is far less productive, and in our region we generally don't get rain from July into September. May, June, and September can also be quite dry in the Northwest. We do get significant rainfall in the

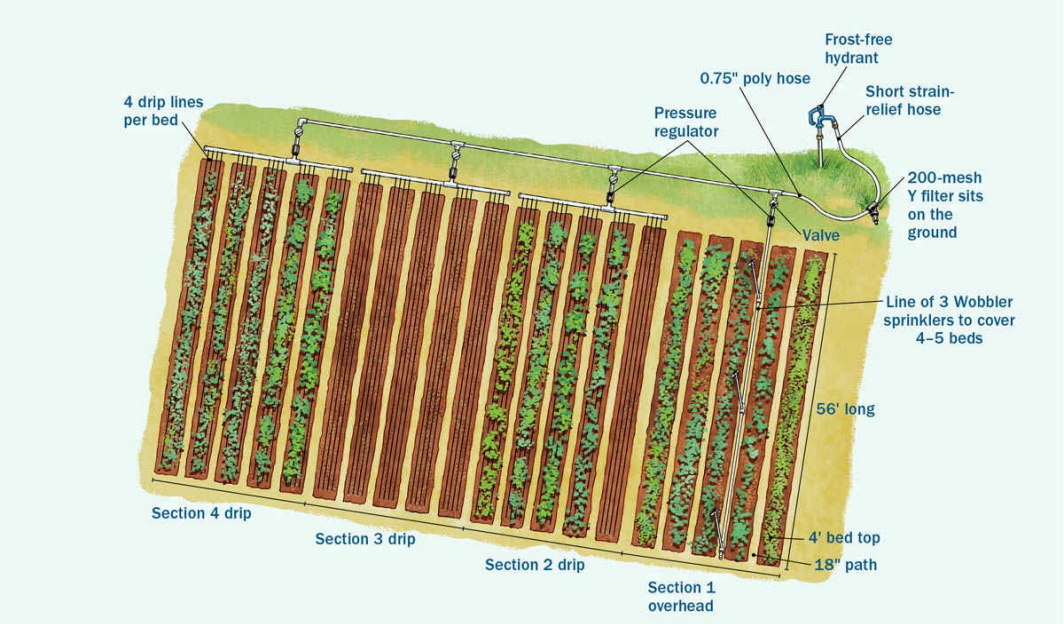
winter months, but at that time crops are growing slowly, if at all, and the rain is so frequent that it becomes difficult for fields to dry out for planting in the early spring.

I started out only irrigating with drip lines. It had worked well in my backyard garden in Portland, but it was not ideal for some of the crops in the sandier soil of Sauvie Island. The second year I added overhead sprinklers. Initially I used Ein Dor sprinklers from DripWorks in California, but as I expanded the space I wanted to irrigate with overhead water so I started using Wobblers, also from DripWorks.

After dragging hoses back and forth between the irrigation zones for a couple of years, I finally settled on a setup I liked, so I plumbed each zone with its own hoses and valves. That meant I only had to switch valves on and off when I wanted to irrigate. The only trick was mowing around the hoses: fortunately, they were easy to pick up for mowing under, and at the end of the irrigation season I could easily move them to the barn, out of harm's way.

Water

Slow Hand Farm had 20 4' × 56' beds, broken into four sections for irrigation



Water at Slow Hand Farm came from a well, delivered to 0.75-inch frost-free hose bibs in the field. The flow rate was about 8 gallons per minute, and at that rate, it took most of the two days of the week we were on the farm to irrigate the Slow Hand Farm fields and the sister fields of Edible Horizons.

I used Wobbler sprinklers from DripWorks for overhead irrigation and strung them together with 0.75-inch distribution tubing and sprinkler sled bases, also from DripWorks.

For the drip tape, I used 8-inch high-flow T-Tape and ran four lines on every 4-foot bed top. The 20 beds on the farm split nicely into four irrigation zones and I could run one zone at a time, putting down enough water for half the week in one hour per zone. A single Y filter kept the drip lines from clogging. Pressure regulators at the head of each irrigation zone ensured consistent application rates with no fiddling around.

FERTILITY

Slow Hand Farm started with land that had been unmowed, ungrazed pasture for many years, presenting us with thick sod to transform. To prepare beds, we stripped the sod off the soil and stacked it, upside down, on a future bed to rot.

I sent soil samples off to A&L Western Labs to determine the macro- and micronutrient levels. The results showed that most nutrient levels were actually quite good, with the exception of a few micronutrients and nitrogen, which is usually low in unfertilized soil. We continued to test the soil most years to track progress, using the same lab and the same time of year for consistency.

Our fertilizer mix consisted of blood meal or feather meal (whichever was cheaper) at a rate of 400 pounds per acre in order to add nitrogen (both are 12 to 13 percent nitrogen) and kelp meal for micronutrients at 400 pounds per acre. We bought the material in 50-pound bags, mixed enough into a bucket for whatever space we were fertilizing each week, and spread it by using “calibrated” quart-size yogurt containers. We sprinkled it as evenly as possible on the soil surface as the next-to-last step before planting, gently raking it into the surface and then marking the planting lines with a hoe.

During the first year, we also added any weeds or finished crops and grass clippings to the same piles of sod that we took from the beds. After these piles sat for a year, we roughly sifted them and spread the slow-composted material back on the beds, usually as a side-dressing for plants, but sometimes at the same time as the fertilizer mix before planting. Any material not fully broken down we added to new piles to rot for another year. We definitely spread some weed seeds and roots this way, but weeds aren’t

difficult to deal with when they are young and the addition of composted organic materials far outweighed any downside to the low-labor, slow-composting method we used.

ABOVE: *Kji preparing a bed for planting in the hoop house with a DeWit seed bed rake*

TOOLS AND INFRASTRUCTURE

BED PREPARATION

My standard bed-preparation tools are an old Clarington garden fork with a 42-inch D handle (properly sized for my height) and a DeWit seed bed rake. The fork loosens the soil deeply and the rake breaks up clods on the surface, leaving a smooth finish.

I bring out other tools occasionally. If I need to strip sod, I usually use a Japanese farmer's hoe, imported by Hida Tool, or sometimes a sharpened Clarington garden spade. That spade also edges beds and applies compost. If beds are particularly rocky, or if I'm in a hurry, I might use the tine end of my Magna Grecia hoe instead of the garden fork to loosen the soil.

TOOL TIP

For starting seeds, 1020 trays are an industry standard. They are approximately 10 inches by 20 inches and typically made from very thin black plastic. They come in many different cell configurations.

GREENHOUSES AND PROPAGATION

My greenhouse setup was small and mostly automated, since I was at the farm only two days a week. I purchased organic potting mix in 2.5-cubic-foot bags and seeded into 32-, 128-, and 200-cell 1020 trays. I built a 4-foot-by-8-foot table with a little insulated shelf under the top made from old corrugated tin roofing. I placed Hydrofarm four-tray electric heat mats with a thermostat and a soil probe on the lower shelf to germinate seedlings; after germination, they moved up to the tabletop.

A little wood-frame greenhouse covered the tabletop. The greenhouse top opened with an automatic vent opener via a wax cylinder that expanded when it heated up. Roll-up sides allowed for moving flats in and out and for additional venting when the weather was warmer. Hanging Ein Dor sprinklers, operated by a simple DIG battery timer, allowed up to four watering cycles a day. After plants got a good start in the reach-in greenhouse, we moved them to unheated tables, also equipped with Ein Dor sprinklers and a similar timer, unless the plants needed to stay in the warmer space.

ABOVE: *The hoop house at Slow Hand Farm in late winter with beds planted, tables full of seedlings, and the reach-in heated greenhouse in the back right corner*

ABOVE: *Two views of a prototype hand cart, designed by the author, being used to haul plant debris to the compost pile; plans for building the cart are at farmhandcarts.com*

SPREADING AMENDMENTS

We used no special tools for spreading amendments other than quart-size yogurt containers, marked to show how much material to spread on a bed, and 5-gallon plastic buckets for mixing and carrying the materials.

For moving and working with compost, I typically worked with a wheelbarrow or a specially designed two-wheel cart that fit over my beds. I used a T-handled compost fork from Clarington for building compost piles and sifting the finished compost into the cart or wheelbarrow. A garden spade spread compost onto the bed tops.

SEEDING AND PLANTING

I started out only direct-seeding, doing most of it with a Johnny's six-row high-density seeder I already had around, and seeding some of the bigger seeds by hand. I soon learned that the six-row seeder, while great at times, was super-finicky in many ways and didn't do a good job with larger beet seeds. I missed the simplicity and functionality (for the price) of the Earthway, so I got one and ended up seeding beets with that, and occasionally other things too.

In the second year, I also switched over to transplanting most crops, a good move given the soil we had. For transplanting, I would mark straight planting lines on the beds with the corner of a rake or a hoe. I used a 6-inch ground staple to anchor the end of a 100-foot reel tape measure and then pulled the tape the full length down the center of the bed. I dropped plants on the planting lines at the proper spacing according to the tape measure and planted them with a transplanting trowel.

ABOVE: *Lettuce planted on the shoulders of a tomato bed. The lettuce is harvested by the time the tomatoes get tall. This saves a bit of space, provides a little shade for the lettuce as the summer warms up, and gives the tomatoes more airflow later in the season.*

CROP CARE

Some of the spring greens, carrots, and a few other crops needed protection from insects, so we covered them at planting time with Agribon AG-19 row cover. We held the row cover in place with 6-inch ground staples and old barn boards, and we used hoops bent from 0.5-inch EMT conduit to hold the fabric up off the crops. This was particularly useful in late fall when I used the row cover for frost protection, as crops are more likely to be damaged if the cover actually touches the leaves.

For trellising, I used 6- and 8-foot bamboo poles, pushing them into soft, wet beds immediately after an irrigation to set them in place. For tomatoes, I used one stake per plant, tying the plants to the stake with a Tapener tape gun, which is available from

nursery suppliers; it uses vinyl tape and small staples. Pruning the plants to a single leader kept the stakes from falling over from the weight of the plants. For cucumbers, I tried similar approaches with less success.

Early and frequent hoeing took care of most weeds. I used different tools, depending on crop spacing and soil conditions. For wet conditions, I found that an SHW four-tine cultivator (imported by Earth Tools) worked well, with minimal clogging or scraping. I also have a Heron hoe from Holdredge Enterprises with a stainless steel blade that soil doesn't stick to as much as it does to other types of blades.

For drier conditions, I prefer a lightweight narrow collinear hoe or the slightly heavier DeWit 6-inch swan neck hoe, depending on crop spacing. For pathways and larger spaces with big weeds, I used the Japanese "farmer hoe" from Hida Tool. When weeds got away from me, I used a big lettuce harvest knife (see Harvesting, below) or Japanese scraper to slice away weeds that were close to the crop plants.

HARVESTING

For a long time my favorite harvest knife was a big lettuce field knife with a high-carbon blade, not the newer stainless steel versions. The high-carbon blade sharpens very easily but it holds a very fine edge for vegetables. It was my preference even though it rusts easily if you're not careful. For smaller crops, I used an Opinel No. 8, which also has a high-carbon blade and folds neatly into my pocket.

Now I'm using a Morakniv knife with a thick, flexible stainless steel blade and a fantastic hard plastic sheath that clips to anything. This has become my all-around knife because the sheath makes it so easy to access.

I harvested into Ropak nest-and-stack hard plastic harvest totes and old hard plastic bulb crates, both used from other farms. My farm was so small that 10 of each type was plenty. For larger loads I used my two-wheel cart, but most of the time I just carried small loads; the barn was close to the field and a walk back and forth between harvesting bins provided a good break for my back.

POST-HARVEST

WASHING AND PACKING

For washing harvested crops, I built a simple washing table and a stand for a utility sink and stored them in the corner. On washing days, we pulled them out into the big doorway of the barn. The wash table was 2 feet deep and 4 feet wide with a backsplash and slatted top that let through water and mud. We washed with a garden hose and pistol grip sprayer and filled the utility sink with the same hose.

For packing the shares, I used organic cotton tote bags, washed the night before and left damp. The moisture helped keep the produce hydrated and cool. To pack the bags, I hung them on 2×2s supported by sawhorses. To transport the bags into town and leave them at pickup sites, I used plywood boxes from Ikea. (Those are no longer available, but I make my own now and have a design and instructions available at joshvolk.com.)

DELIVERY AND SALES

I dropped off CSA boxes in places where I was already going, to make pickup by my CSA members more convenient for both of us. Initially, my Honda Civic hatchback worked well for all of the deliveries. Eventually, I made a deal with a local cargo bike shop to lease a Bullitt cargo bike equipped with a BionX electric assist. Delivering by bike added a little time to my day, but I love riding bikes and it was so much better than sitting in the car, not to mention much easier to park in town.

ABOVE: *Kji washes carrots on the shady side of the barn using the spray-down table, with the dunk sink in the foreground.*

ABOVE: *Kji packs his shares. Slow Hand Farm tried not to use plastic bags, but sometimes they were unavoidable. The shares were packed into the hanging cloth*

bags, from totes of cleaned vegetables above.

ABOVE: *Eventually I put almost 15,000 miles on the Bullitt cargo bike delivering vegetables.*

OFFICE, COMMUNICATION, AND RECORD KEEPING

I make extensive use of spreadsheets for crop planning, and while I was at Slow Hand Farm I worked with Apple's Numbers to make them (I've since reverted to Microsoft Office Excel, but both have advantages). Initially, I tracked all of my sales and expense activity in Numbers as well, but eventually I decided to pay for QuickBooks. After a steep learning curve, I found it easier to keep track of invoices and payments, and it made life much easier for my accountant during tax season. (I highly recommend finding and using a good accountant to help prepare your taxes.)

Having a website where people could look up information about the farm and share it with friends was invaluable; that was how I attracted most of my CSA members. I didn't have a way for folks to sign up online, but I e-mailed customers and they mailed their checks. I added a few informational pages to the website using Blogger and I maintained a weekly blog with information on the farm and the CSA shares. With an iPhone, I could upload notes and photos directly to the blog from the farm fields.

FOUR SEASON FARM

THE BACKSTORY

Although the farm started in the fall of 1968, the present name was coined in 1991 when Eliot and Barbara began commercial investigation of four-season farming.

ELIOT COLEMAN AND BARBARA DAMROSCH

Space in Production: 2 acres in crops, 8 acres in pasture

Location: Rural — Harborside, Maine

Crops: Mixed vegetables, culinary herbs, eggs and broiler chickens, cut flowers

Markets: Farmers' market, wholesale to stores, and restaurant

Year Started: 1968

Four Season Farm sits on a 40-acre piece of land close to the water on the midcoast of Maine. The land was part of the original homestead that Scott and Helen Nearing, who wrote the seminal homesteading book *Living the Good Life*, moved to in 1952. In 1968 they sold the wooded acres to Eliot Coleman, and over the past four decades he has cleared 14 of the 40 acres to use for building a market garden, orchards, livestock pasture, farm infrastructure, and housing. The main production of the farm is concentrated on just a couple of acres of the best ground, with surrounding cleared fields used for some livestock pasture and grass that adds to the fertility of the intensively cropped areas.

Eliot is well known for work he has been doing since the late 1960s, initially experimenting with and refining techniques from market growers he visited in France and other parts of Europe. His first book, *The New Organic Grower*, detailed the systems he developed and has been an essential reference for small growers since it was first published in 1989. In the years since, he has continued to refine his systems and to develop tools, always tinkering and focusing on work efficiency, season extension, and year-round growing in cold climates. His 2009 book, *The Winter Harvest Handbook,* builds on his earlier work and focuses on winter production techniques.

FOUR SEASON FARM

MAP

ABOVE: *Double-tap the image to open to fill the screen. Use the two-finger pinch-out method to zoom in. (These features are available on most e-readers.)*

KEY

1. Main greenhouse (heated)
2. Seed-starting greenhouse
3. Unheated greenhouses
4. Low tunnels
5. Woodworking shop/office
6. Equipment shed

7. Farmstand
8. Orchard

THE BASICS

At times, including the present, the farm has cut back on selling during the conventional growing season to focus on out-of-season production ("the other eight months," as Eliot calls them). They have reduced the number of markets they sell in, but they are still tinkering with and refining systems on the farm.

The core of the farm is still intensive, year-round vegetable production. Poultry and sod have become a larger part of the rotations in their production system. Eggs were added in 2009, and, in some years, pigs. The animals allow the farm to produce more fertility in place. Eliot can also take more time to work on tool development as production pressures have shifted.

CUSTOMERS AND MARKETS

Four Season Farm has always been a market farm. Until just a few years ago, the farm was traveling to as many as three summer markets, all within an hour's drive, running a farmstand on-site, selling to restaurants and stores in the area, and continuing through the winter with one farmers' market. Recently they've scaled back, eliminating both the farmstand (for the most part) and summer markets to concentrate on the winter markets from October to May. They continue to sell to stores and restaurants year-round. Barbara operates a small flower business on the farm, selling mixed bouquets wholesale to several stores in the spring, summer, and fall.

ABOVE: *Eliot explaining his mobile chicken house to a visitor. Initially set up on November 1 where Eliot is standing, the house already made five moves by early December, depositing chicken manure in its wake and giving the chickens access to fresh pasture each time. Chains on the corners with come-alongs are attached to anchors in the fields to keep the mobile house from blowing away.*

LABOR

Training young farmers has always been one of Eliot's interests. Depending on the season and the goals for the farm in that year, he typically has one or two employees who start working in February or March. Another one or two new hires come on in April, and sometimes more start in May or June. As the work slows down in September, some of the employees finish their seasons but most of the crew works through Thanksgiving, with two staying on through the winter. Eliot oversees the vegetables and livestock, keeping records such as planting and harvest dates. Barbara works with the cut flowers and runs the back end of the business, hiring workers and keeping the books and financial records.

The farm's worker training doesn't follow a formalized structure. Workers are employees first and therefore learn primarily through work, but Eliot and Barbara are always there to answer questions, and when employees show interest in particular areas they receive extra resources and information and room to experiment.

The farm has small apartments in some of the farm buildings for the crew to live in while they are working on the farm. They share a kitchen and shower in another building

on-site, and the farm is building a house for a permanent farm manager.

WATER

Water on the farm comes from two drilled wells on the property. Some of the tomatoes get drip irrigation, but most crops are irrigated with overhead sprinklers. Garden hoses feed the sprinkler system. Wobblers on stands, either rebar stakes or tripods, are the sprinkler of choice in the outdoor fields, and three or four can be strung together to water the full bed lengths. Quick disconnects between hoses make the systems easier to take apart and faster to move.

In the tunnels Netafim hanging sprinklers are used, hung from the frame of the tunnels, which keeps them out of the way and off the ground. The well water is also used for washing and cooling produce.

ABOVE: *Wobbler sprinklers set up on tripods to irrigate precision-seeded carrots*

FERTILITY

Compost is a cornerstone of the fertility program at Four Season Farm. The farm makes its own compost using mowed forage crops from neighbors, vegetable waste, clay soil, and seaweed gathered from the coast. Sometimes Four Season buys in composted manure from other farms, but they are moving more and more toward on-site fertility sources.

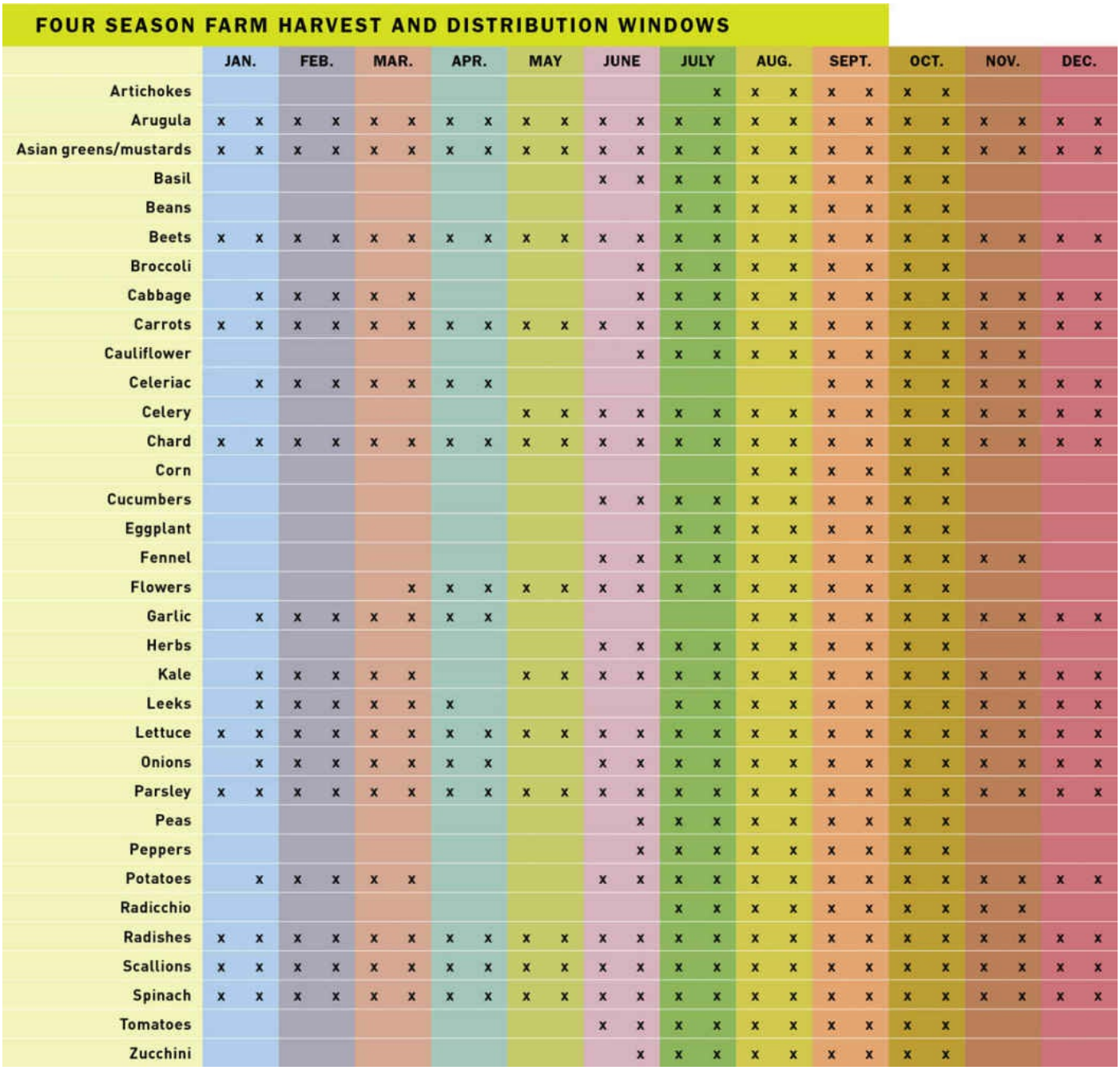
Compost is applied with every planting at a rate of about 15 tons per acre, but with multiple plantings every year in many beds, the actual rate of application per year is higher than that.

Based on soil tests and careful observation over the years, a number of other amendments are also added to the soil when preparing beds. Crab meal is a favorite. Pelleted Gran-U-Bor is used in small, very carefully measured amounts for a few of the

crops that benefit from the application of additional boron. Alfalfa meal is used for additional nitrogen. Amendments such as lime, rock phosphate, green sand, rock dusts, boron, and seaweeds are also used where needed.

When the farm was in year-round production for market, the use of cover crops was limited. There was almost always a cash crop in every bed, and crops were planted intensively, covering every square inch of the beds. This intensive planting does require careful amending, but it also contributes significant crop residue itself through unharvested plant parts that are composted and roots that are turned in when the beds are ready to be replanted.

Recently the farm has started incorporating a year of pasture grasses and legumes, grazed by chickens, into a two-year rotation. In the winter, the chickens live in a 20-by-50-foot mobile greenhouse. This allows them access to fresh greens all winter, deposits manure, and prepares the ground for the crops that follow.



FOUR SEASON FARM HARVEST AND DISTRIBUTION WINDOWS

	JAN.		FEB.		MAR.		APR.		MAY		JUNE		JULY		AUG.		SEPT.		OCT.		NOV.		DEC.	
Artichokes														x	x	x	x	x	x					
Arugula	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Asian greens/mustards	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Basil											x	x	x	x	x	x	x	x	x	x				
Beans													x	x	x	x	x	x	x	x				
Beets	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Broccoli												x	x	x	x	x	x	x	x	x				
Cabbage		x	x	x	x	x						x	x	x	x	x	x	x	x	x	x	x	x	x
Carrots	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Cauliflower												x	x	x	x	x	x	x	x	x	x	x		
Celeriac		x	x	x	x	x	x	x								x	x	x	x	x	x	x	x	x
Celery									x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Chard	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Corn															x	x	x	x	x	x				
Cucumbers											x	x	x	x	x	x	x	x	x	x				
Eggplant													x	x	x	x	x	x	x	x				
Fennel											x	x	x	x	x	x	x	x	x	x	x	x		
Flowers						x	x	x	x	x	x	x	x	x	x	x	x	x	x	x				
Garlic		x	x	x	x	x	x	x							x	x	x	x	x	x	x	x	x	x
Herbs											x	x	x	x	x	x	x	x	x	x				
Kale		x	x	x	x	x			x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Leeks		x	x	x	x	x	x						x	x	x	x	x	x	x	x	x	x	x	x
Lettuce	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Onions		x	x	x	x	x	x	x			x	x	x	x	x	x	x	x	x	x	x	x	x	x
Parsley	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Peas												x	x	x	x	x	x	x	x	x				
Peppers												x	x	x	x	x	x	x	x	x				
Potatoes		x	x	x	x	x					x	x	x	x	x	x	x	x	x	x	x	x	x	x
Radicchio													x	x	x	x	x	x	x	x	x	x		
Radishes	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Scallions	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Spinach	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Tomatoes											x	x	x	x	x	x	x	x	x	x				
Zucchini												x	x	x	x	x	x	x	x	x				

ABOVE: *Double-tap the image to open to fill the screen. Use the two-finger pinch-out method to zoom in. (These features are available on most e-readers.)*

POULTRY ON THE FARM

The farm runs 200 laying hens, and sometimes a few broilers, through the pastures in the summer. The laying hens are replaced yearly to keep egg production high. Pastures are mowed before chickens move onto a section. The hens are moved in 100-by-100-foot sections fenced with poultry netting. The hens (and the netting) are moved once a week. Broilers get smaller paddocks and move less frequently, as they don't range quite as far.

For the young chicks and broilers, Eliot has developed what he calls “chickshas,” hand carts with little hoop structures on them for night shelter. For the mature layers, the farm uses the “biddy wagon,” a larger cart, about 10 feet square, with roosting bars and laying boxes on the sides.

In the winter, the layers move into a 20-by-50-foot greenhouse on wheels with roosting bars, below which most of the manure will drop. The greenhouse gets pulled down a long field of grass/legume mix, moving 10 feet each week and leaving the manure behind. When there is snow on the ground it is plowed ahead of the greenhouse. T-posts for anchoring the house as it moves are driven into the ground before the ground freezes, and as the house is moved it is chained to the closest T-posts to keep it from blowing away.

TOOLS AND INFRASTRUCTURE

BED PREPARATION

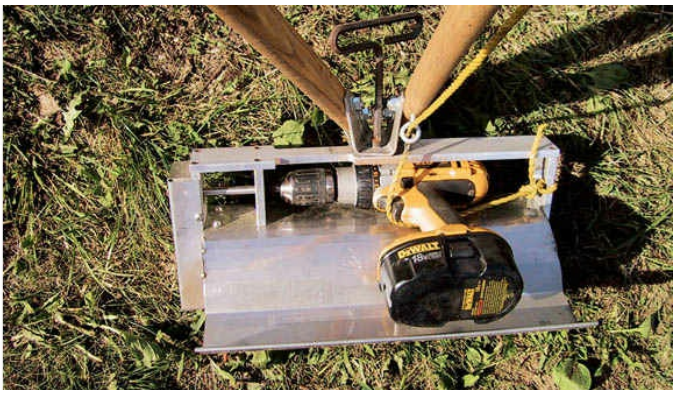
Beds are initially stripped of aboveground plant material, which is raked up and composted if the bed is to be replanted immediately; if not, the beds are tilled under.

In the greenhouses a broadfork is used to loosen the soil deeply, and then compost and amendments are spread by hand and worked into the soil shallowly with a Tilther.

When heavier tillage is needed the farm uses a BCS two-wheeled tractor with a rototiller or a larger tractor-mounted rototiller. The farm uses movable tunnels on its beds, so the workers can usually prepare and plant the beds before the tunnels are moved into place over the maturing crops. (The main greenhouse, which has a concrete floor for washing and packing at one end, does not move.) Every time the beds are prepared, the workers define them by scraping a small amount of the soil out of the pathways and moving it back onto the bed tops.

To prepare the beds for transplanting, the workers finish and mark them with a rake. The bed-finishing rake can be fitted with special marking extensions to pull or push planting lines into a bed to make a grid for spacing transplants. For seeding, they use a cage roller to firm the surface and get it ready for the high-density seeder. Reel-type tape measures, string lines, and stakes are frequently used to make sure beds are properly aligned and straight. Straight beds not only look good but also help with cultivating and harvesting.

ABOVE: *In the winter the chickens are slowly moved through the grass and legume planting using a mobile greenhouse. By the end of the winter the chickens have prepared and fertilized the ground for the crops that follow.*




ABOVE: *The Tilther is a tool Eliot designed for shallow incorporation of amendments and to create a fine tilth on the surface of beds to be planted or seeded. The Tilther works only the top 2 inches of the soil so that it is not bringing weed seeds buried deeper to the surface, where they can germinate. The tool is powered by a cordless drill, making it lightweight and fume-free. The man using the Tilther is Michael Plane, an Australian farmer/friend, during a visit to the farm.*

GREENHOUSES AND PROPAGATION

Four Season Farm uses Fort Vee potting mix from Vermont Compost to make soil blocks for growing starts for transplanting. The extra soil volume in the soil blocks, relative to plug trays, produces healthier, unstressed seedlings with no eventual transplant shock. It also means the seedlings can wait longer, if necessary, before being transplanted. With Four Season's short outdoor season and variable weather, this gives the farm more flexibility with transplanting dates, but they still prefer to put the seedlings in while they're young.

For starting seeds that need bottom heat, the farm uses a mini soil blocker, germinating the mini-blocks on electric heat mats. The mini-blocks save space and potting medium. Larger-seeded crops, such as melons and cucumbers, that need more heat are also put on heat mats but are seeded into larger blocks to start.

There are two heat mats, one set to 70ºF and one set to 85ºF for more heat-loving crops. Crops that don't need the extra warmth to germinate are seeded directly into larger blocks. The farm uses the 1.5-inch, 2-inch, and 3-inch blocks. For tomatoes, peppers, and eggplant, the farm pots up seedlings into 6-inch pots once they are 3 weeks old. As the plants grow, the pots are progressively moved apart to give them plenty of light and air.

The propagation house is a 20-by-50-foot hoop structure, heated with propane using a forced air heater that keeps the house between 60 and 65°F. Horizontal airflow (HAF) fans are used to keep air circulating, which evens out temperature and humidity in the house. The propagation house has automatic ridge vents for summer cooling. For crop watering by hand, a hose and a Wonder Waterer wand are used. Modular 10-by-12-foot and 14-by-16-foot hoop structures are used for overflow during the peak of seedling production. The greenhouses are outfitted with benches that easily set up and break down, made of recycled plastic with holes for drainage.

ABOVE: *Peppers trellised with horizontal Hortonova polypropylene mesh*

SPREADING AMENDMENTS

Fertilizers are spread with a 4-foot Gandy drop spreader. The farm uses a manure spreader to spread compost on the outdoor fields, and buckets do the job in the greenhouse.

SEEDING AND PLANTING

For direct seeding, the farm uses high-density precision seeders that Eliot helped develop, sold through Johnny's Selected Seeds, a company he works closely with as a tool designer. There are single-row, four-row, and six-row models. All can seed small seeds; the multirow versions sow rows 2.25 inches apart (or wider row spacing if you don't fill all of the hoppers) and are adjustable, giving accurate spacing between the seeds within the row. The four-row model is much smaller and fits into tighter spaces but requires an extra step of rolling before and after seeding. The six-row version is heavier and a bit larger, but it incorporates pre- and post-rollers, as well as a bit more control over in-row spacing.

Spinach is seeded with the single-line seeder and five rows go onto a 30-inch bed. Carrots, salad greens, and radishes are all seeded with the multirow seeders at 12 rows per bed. Turnips are also seeded with the multirow seeders, but only using every other hopper, for a total of six rows per bed.

ABOVE: **Top to bottom:** *onions; precision seeding; beds marked for transplanting*

TRANSPLANTING

The farmers transplant the soil blocks by hand. They pre-mark the beds with light aluminum bed-shaping rakes fitted with short pieces of hard plastic tubing to pull planting lines along the soil.

CROP CARE

Eliot Coleman is well known for developing movable tunnel systems for extending the growing season. These mobile tunnels can be moved over late-season crops after they are already planted but before fall temperatures become too cold for them, and onto summer crops after harvesting early spring crops from the tunnels. This allows the soil covered by the tunnels to receive the cleansing effect of natural rainfall, freezing, and

thawing and results in lower investment in tunnel structures to cover more area in a season.

In addition to the mobile tunnels, Four Season uses Quickhoops and row covers to protect spring and fall crops from low temperatures and to increase the viability of crops inside the tunnels in the coldest months. Eliot has detailed his methods for season extension using these tools in his excellent book *The Winter Harvest Handbook*.

For plants that are trellised outdoor crops, a variety of systems are used, including plastic pea trellis on metal frames and a mix of wood stakes and T-posts with a stake-and-weave style. Inside the tunnels, a Dutch system, using twine on reels and plastic clips, can provide different setups for different species:

- Tomatoes are pruned to a single leader, and as they grow taller the twine that supports them is slowly let down, laying the plants over and making harvest easier.
- Cucumbers use a similar system; the twine is hung from a 1-inch top bar that sits on the trusses or attaches with brace bands to the hoops. The cucumbers run all the way up to the top bar with a single leader and then get two leaders when they go over and start back down. The bars are set about 7 feet off the ground.
- Peppers get staked with wood stakes and a weave, requiring only two lines of twine.

The Four Season crew occasionally uses row cover to prevent damage from flea beetle and Colorado potato beetle.

Weeds are controlled with a collection of hoes, harvest knives, and flame weeding. Eliot is well known for developing the collinear and wire weeder hoes, and also for promoting the use of Glaser stirrup hoes and wheel hoes. All have uses on Four Season Farm. Flame weeding is used for preemergent weeding of slow-germinating crops like carrots, and also for stale seedbeds.

Solarization is another technique employed on the farm. Workers tightly cover ground in temporarily unused summer greenhouses with clear plastic for a few weeks, heating the soil enough to kill weed seeds in the top 2 inches of the soil and so providing weed-free soil in which to plant for the winter season.

Field borders and the areas around hoophouses are mowed using a push mower. The short grass exposes voles to predators, helping reduce the damage done by these pests year-round both in the fields and in the greenhouses. It also makes the farm look tidy, keeps weeds from going to seed, increases airflow, and makes it easier to move around.

ABOVE: *Beds in a mobile tunnel ready for seeding. Hanging Netafim sprinklers are used for irrigation in the tunnels.*

ABOVE: *Flame weeding*

HARVESTING

Small, sharp Victorinox knives are used to harvest most crops; clippers are used for some large beefsteak tomatoes. A digging fork is used to loosen carrots and leeks before pulling them.

Most of the crops are harvested into bulb crates and the farm uses two sizes — a short and medium height. Five-gallon buckets are used for harvesting some greens and cucumbers. For melons, which are very heavy, the tractor bucket hauls the crop out of the field. Artichokes are harvested into a special basket that is strapped to the back.

Flowers are harvested with needle-nosed clippers into shallow plastic Tubtrugs that have a flared shape that protects blossoms. A variety of garden carts, flat nursery carts, and wheelbarrows haul the crates and buckets out of the field and into the packing area.

POST-HARVEST

WASHING, PACKING, AND STORAGE

The farm has two stainless steel sinks, a single basin and a double, on a concrete pad in the washing and packing area. Roots are thoroughly hosed off in the bulb crates before getting two final rinses in the sinks. Bagging and weighing take place on stainless steel counters.

To pack produce for delivery, the farm uses collapsible plastic crates, similar to the bulb crates. Leafy greens go into poly bags before being packed in the crates.

The farm uses an 8-by-8-foot walk-in cooler for most crops year-round. In the winter, two root cellars store beets, potatoes, kohlrabi, carrots, and celeriac; the root cellars require no electricity for cooling and keep produce from freezing in the winter. During the summer tomatoes are stored outside, not cooled. Garlic, storage alliums, and winter squash are all cured after harvest in the greenhouse on tables before being stored in a dry storage room. That room can be heated minimally as needed to prevent the produce freezing.

ABOVE: *Above, the market stand on a trailer, folded up for the season; below, the washing and packing setup*

DELIVERY AND SALES

The farm's delivery vehicle is a Dodge minivan. Eliot built a fold-out market stand on a 5-by-8-foot trailer base, allowing him to drive a bigger load to farmers' markets and then quickly flip out the sides and ends for pre-made displays. Now that they attend only an indoor winter farmers' market, they no longer use that trailer. The winter market takes place entirely in a large heated glasshouse at a local nursery, which is nice for both the farmers and the customers. The space is a bright, warm meeting place for the community during the cold months.

OFFICE, COMMUNICATION, AND RECORD KEEPING

Four Season Farm relies on e-mails and phone calls for communications with chefs and stores. For convenience, the phone numbers for the customers are posted in the office in the field (a corner of the woodworking shop) as well as in the office in the house. Walkie-talkies are used in the field — when they work.

COOK'S GARDEN

THE BACKSTORY

Cook's Garden was the obvious name for Stephen Cook's farm. It was originally Cook's Organic Garden until they dropped their organic certification.

STEPHEN COOK

Space in Production: 0.75 acre

Location: Peri-urban — New Lebanon, Ohio

Crops: Plant starts, strawberries, mixed vegetables, cut flowers, honey

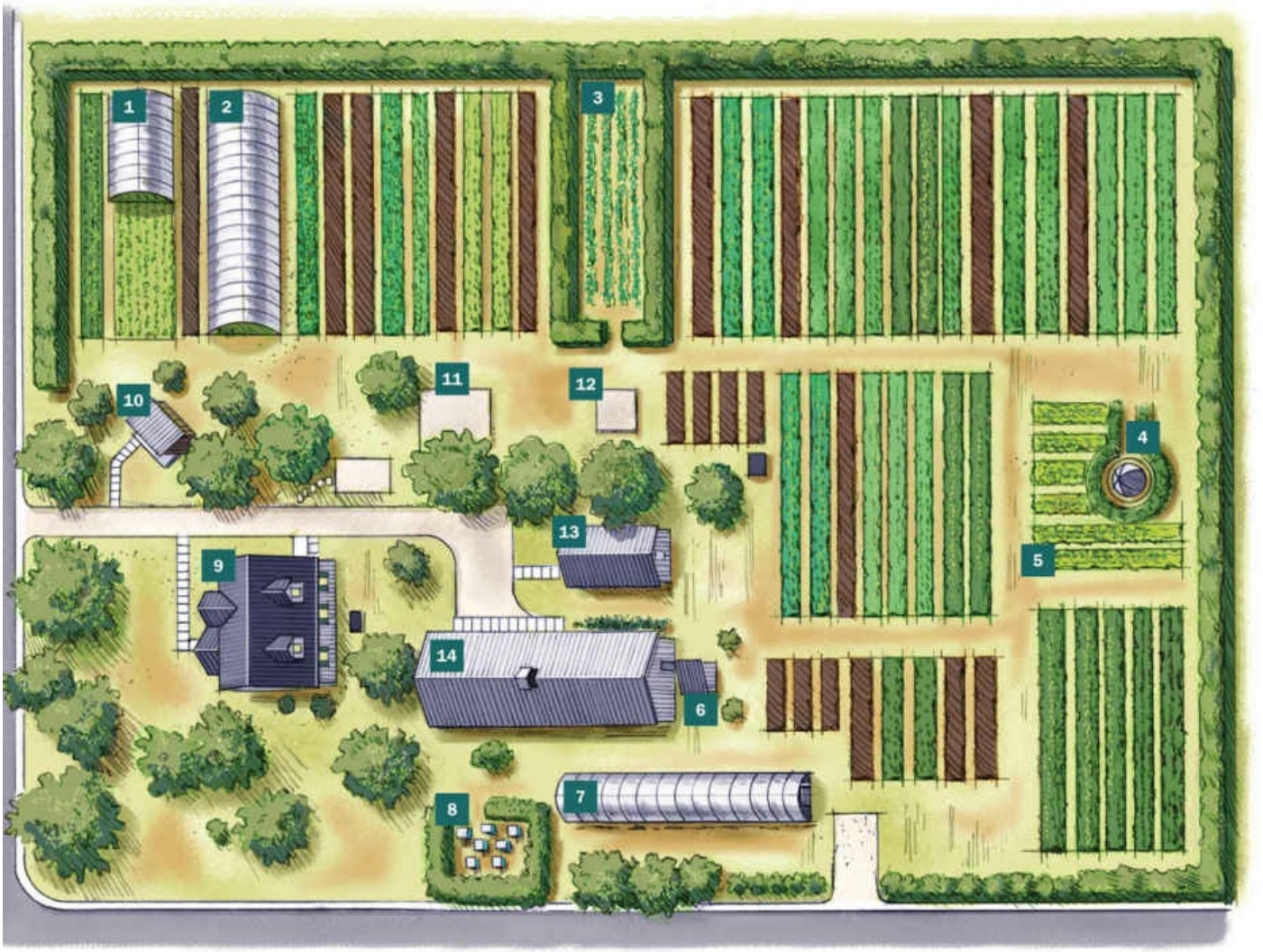
Markets: Farmstand and farmers' market

Year Started: 1985

Stephen Cook grew up on a market garden in England, and after he and his wife, Zella, met in West Africa, where she was working in the Peace Corps, they moved to the United States. He was inspired to start his own garden and to try the French Intensive techniques that John Jeavons promoted. Cook started the garden in 1982; in 1985, he expanded and began selling his produce as an actual business.

COOK'S GARDEN

MAP



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KEY

1. Movable tomato house
2. Permanent hoophouse
3. Secret garden
4. Ornamental fish pond
5. Perennial flower beds
6. Chicken house
7. Movable greenhouse
8. Beeyard

9. House
10. Farmstand
11. Permanent solar greenhouse
12. Swingset area
13. Cottage
14. Barn

THE BASICS

The property is a flat 2 acres and includes a house the Cooks live in, plus a cottage for an intern or for rental income. The gardens take up three-quarters of an acre, laid out primarily in 70-by-5.5-foot beds with 2.5-foot pathways between them. Additional space goes to a perennial garden with a fish pond and a beeyard. Stephen recently built a chicken coop and enclosed run to house a small flock of layers for use by the family and to add an attraction for children who visit the farm.

Stephen works hard to keep his market garden efficient and productive enough to make a reasonable living selling his products at the modest prices his community and farmers' market will bear. The farm has provided a place for him and his wife to raise a family over the years and now they enjoy their grandchildren's visits to the farm.

CUSTOMERS AND MARKETS

The farm has two outlets for its produce: sales directly off the farm and at a nearby Saturday farmers' market in northwest Dayton, Ohio. Because the farm is so small, the farmstand doesn't need separate staffing but simply has a list of the vegetables available and a dinner bell. Customers who drop by during farmstand hours, Tuesday through Friday, ring the bell and Stephen rides his bike from the field to the stand to take their order. He can then hop on the bike and ride back to the field to custom-harvest the order. On Fridays, much of the produce is pre-harvested for the Saturday farmers' market, so on those days it's just a matter of packing up the order.

The sales season for the farm begins in May with plant starts. Stephen sells the plant starts through late May and then discounts the leftovers to clear them out before u-pick season begins. He also concentrates on having vegetables as early as possible to attract more market customers and get sales off to a flying start. U-pick strawberries are available in June, and the farmers' market runs from early May through mid-October. The Shiloh Farmers' Market in Dayton, where he sells, has a diverse range of shoppers from a wide range of income levels, tending toward working class.

HONEY BEES

Stephen keeps honey bees on the farm and has a small, dedicated beeyard fenced off with tin roofing and surrounded by hedges. This keeps the bees flying high as they leave the beeyard and out of traffic that passes the farm. He has capacity for eight colonies on the farm and the honey they produce brings in extra income in the fall as vegetable sales start to decline.

The beekeeping schedule conflicts with the vegetable growing, as the heaviest work times for both activities coincide, but he loves working with the bees and their symbiotic relationship with the gardens. For honey production, Stephen uses shallow supers and has a Kelley hand-crank honey extractor that can spin four frames at once. He extracts the honey in his small solar greenhouse, which is bee-proof and very warm in the summer, perfect for keeping the honey flowing.

ABOVE: *A frame of brood comb*

ABOVE: *Stephen's beeyard*

LABOR

Stephen hires one intern, or a committed couple, per year to help with the garden. The intern is there for labor and to learn market gardening. Interns are paid and live in the cottage on the property.

WATER

Stephen uses both drip and overhead irrigation for watering crops during the growing season. A 5-gallon-per-minute irrigation well on the property is enough to properly irrigate; he also uses the domestic well for some drip and hand watering and to serve the two houses on-site.

The drip is heavy T-Tape, and he reuses it each season; some of the tape and distribution lines have been in service for 20 years. The system includes a filter. For overhead water, a basic oscillating fan-type sprinkler covers small patches. For watering larger sections, typically six beds at a time, Stephen uses a Wade Rain impact sprinkler on a tripod that disperses 5 gallons per minute.

This year, Stephen installed 0.75-inch PVC lines with quick-disconnect hydrants in buried irrigation valve boxes throughout the field. This means less time spent dragging hoses and fewer hoses placed in the way of other operations.

ABOVE: *Buried irrigation valve boxes, giving easy access to water in the fields*

Tiling

Fields that have drainage problems and tend to hold water can have drain tile installed. In the old days this was done with buried clay pipe, and thus the term "tiled." Today, tiling is done by burying perforated plastic drainpipe, usually about 3 feet deep and gently sloping toward a drainage point on the edge of the field.

FERTILITY

Most of the fertility for the farm comes in the form of horse manure. Stephen has a longtime relationship with a miniature horse farm 10 miles down the road. Each fall, he loads up his trailer with horse manure, spreads it in the beds, and lightly tills it into the soil. In the spring, he supplies the owner of the horse farm with plants for his garden.

For the first 15 years, Stephen did not test his soil. When he started annual testing on the advice of an agronomist, he found that his soil was slightly alkaline from the addition of so much manure. To bring down the pH, he now adds about 1 pound of sulfur per bed each year. According to the soil tests, the rest of the necessary nutrients on the farm are in abundant supply.

The farm uses no winter cover crops, avoiding the annual struggle with plant residue in the spring. In August, Stephen sows empty spaces with buckwheat, which suppresses weeds and provides forage for his bees. He has the best success seeding buckwheat with his Earthway seeder.

COOK'S GARDEN HARVEST AND DISTRIBUTION WINDOWS

	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
Arugula					X X	X X						
Asparagus				X X	X X							
Basil						X X	X X	X X	X X			
Beans						X X	X X	X X	X X			
Bedding plants					X X							
Beets					X X	X X	X X	X X	X X			
Blackberries							X X	X X				
Cabbage							X X	X X				
Carrots						X X	X X	X X	X X	X X		
Cauliflower							X X	X X				
Chard					X X	X X	X X	X X	X X	X X		
Cucumbers						X X	X X	X X	X X			
Cut flowers					X X	X X	X X	X X	X X	X X		
Dill and cilantro					X X	X X	X X	X X	X X			
Fennel							X X	X X				
Garlic							X X	X X	X X	X X		
Honey									X X	X X		
Kale					X X	X X	X X	X X	X X	X X		
Leeks									X X	X X		
Lettuce					X X	X X	X X	X X	X X	X X		
Onions					X X	X X	X X	X X	X X	X X		
Parsley					X X	X X	X X	X X	X X	X X		
Peppers							X X	X X	X X	X X		
Radishes					X X	X X						
Raspberries								X X	X X	X X		
Rhubarb					X X	X X						
Shallots					X X	X X	X X	X X	X X	X X		
Strawberries						X X						
Summer squash						X X	X X	X X	X X			
Tomatoes						X X	X X	X X	X X	X X		

ABOVE: *Double-tap the image to open to fill the screen. Use the two-finger pinch-out method to zoom in. (These features are available on most e-readers.)*

TOOLS AND INFRASTRUCTURE

BED PREPARATION

In the spring the soil is bare after having received an addition of manure lightly tilled in the previous fall. The entire farm is tiled to improve drainage, which makes it easier to work the soil early in the season and sooner after rainstorms.

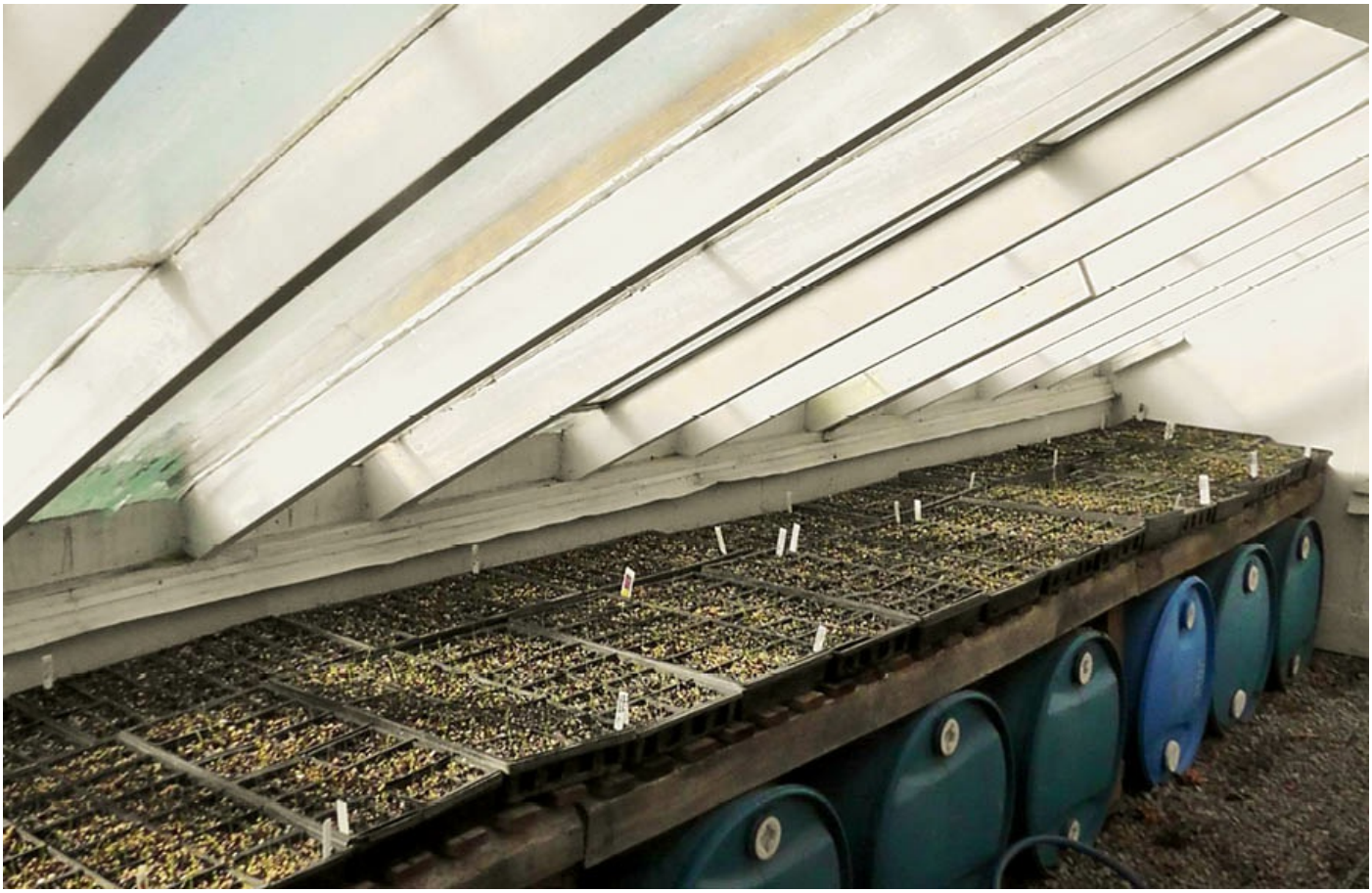
To prepare beds, Stephen uses one of two old Troy-Bilt rototillers, typically making two passes, 6 to 8 inches deep. If there are significant weeds or previous crop residue,

Stephen mows with a mulching push mower before tilling to keep the tiller from clogging. Each bed has a piece of 1.25-inch metal pipe, cut with a shear, pounded about 1 foot into the ground on two adjacent corners. Stephen pulls a string between the pipes to keep the beds straight when preparing and planting. The bed numbers are painted on the pipes to make record keeping and mapping easier.

Stephen has three older Troy-Bilt rototillers: a 1979 four-speed that he converted to diesel and named "Luigi" to honor the new motor's Italian origin; a 1972 Horse with an 8-horsepower gas motor that he named "Luisa"; and a smaller, 5-horsepower version primarily used for cultivation of pathways and grass edges. (Stephen has posted a video on YouTube showing how he converted to diesel, for folks who are interested.) The 5-horsepower tiller has the same tines as the two larger machines but they are configured differently so that soil isn't thrown to the side, which makes it better for cultivating between planted rows or along bed edges. Luisa is easier to deal with than Luigi, so she tends to be the tiller of choice for the interns while Stephen uses Luigi.

In 2015, after going to one of Jean-Martin Fortier's workshops (see the profile of Les Jardins de la Grelinette), Stephen experimented with tarping beds before planting in order to germinate and kill weeds. He used landscape fabric and old greenhouse plastic to cover his beds instead of silage tarps because that's what he had on hand. Unfortunately, the fabric and plastic collected earthworms that drowned in the puddles and created an unpleasant stench, so his new plans are to try the technique again with just the landscape fabric. I love that even after 30 years Stephen is still experimenting with new methods, and even watching what younger growers are devising.

ABOVE: *"Luigi" preparing beds in the spring*



ABOVE: *Seedlings in the solar greenhouse with drums of water below*

GREENHOUSES AND PROPAGATION

The farm started making its own potting soil some years ago when commercial potting soil began to cost more than Stephen wanted to spend. In the spring and summer he mixes the soil in the big greenhouse, which is a warmer, brighter space than the barn. The soil is a mix of perlite, peat, and compost he buys in bulk with a neighbor. He adds kelp meal and Osmocote Bloom for fertility. The Osmocote Bloom is the only non-organically allowed material the farm uses, but Stephen isn't certified and he feels that the slow-release formula produces better plant starts than the organic alternatives he's tried.

Seeds get their start during the cold months in an east-facing window in Stephen's house. He uses 9-inch-square aluminum pans with plastic lids, "like the ones you'd get cookies in at the grocery store," he says. He punches drain holes in the bottoms and the lids keep the humidity high. To keep the trays warm, he sets them on PVC pipe that circulates warm water from a bucket with an aquarium heater in it.

The farm has two greenhouse spaces, a small 10-by-20-foot solar greenhouse and a 20-by-70-foot hoophouse. The smaller, insulated greenhouse gets started in early to mid-February; it has a propane gas heater for heat and an auto-thermostat fan and shutter for cooling. The small greenhouse also uses a box fan to circulate air.

Both houses use old plastic 55-gallon drums filled with water to prop up wooden slatted tabletops that hold the seedlings. These drums of water provide thermal mass, and since he started using them, Stephen says he has noticed a big difference in the heating requirements: the drums typically hold nighttime temperatures 15 degrees above the temperature outdoors. In the smaller greenhouse, the drums provide insurance in case the heater fails, and they extend the frost-free period in the greenhouse. He keeps his tropical ornamentals in the small greenhouse in the winter.

The larger greenhouse serves as a potting shed as well as space for seedlings. All of the seedlings from the aluminum trays are potted up into containers ranging in size from six-packs to 6-inch pots, depending on the plant and the intended destination. The farm sells garden vegetables, flowers, and bedding plants in the spring. The Cooks also grow seedlings for their own use.

Hand watering of seedlings is done with a hose and water breaker on a wand. The big greenhouse is ventilated by opening the ends, which are just big split curtains. River rocks hold down the curtains when closed, and ropes tensioned across the end bows,

halfway up the curtains on the inside and outside, keep them from blowing back and forth in the wind. Stephen uses dog-leash clips to make it easy to drop the ropes when he wants to get into the greenhouse.

ABOVE: **Top**, *potting up tomatoes;* **bottom**, *watering seedlings with a water breaker on a wand*

SPREADING AMENDMENTS

At Cook's Garden the workers spread manure using a wheelbarrow and a fork and then lightly till it into the soil. Manure is spread and incorporated in the fall and left to sit for the winter.

ABOVE: **Top**, *a beautiful display of bedding plants and seedlings in the 20-by-70-foot hoophouse;* **bottom,** *moving tomato seedlings that have germinated from the aluminum pan into six-packs*

SEEDING AND PLANTING

Stephen built a low cart for transplanting. Basically a wooden platform with four fat tires at the corners, the cart is wide enough to straddle the full bed width and lets him plant while kneeling directly over the bed, without compacting the soil. He uses his hands in the soft soil and a marking stick to evenly space the transplants. The marking stick has all the different spacings for different plants on it: 9, 12, 15, 18, 24, and 36 inches. The cart allows him to plant one to three lines of plants, depending on the spacing, before he has to push the cart farther down the bed for the next set of plants. Plants are spaced according to a square grid on the beds. A string line along one edge of the bed runs between permanent metal stakes to keep the bed and planting lines straight.

For direct seeding, Stephen uses an Earthway seeder.

ABOVE: *The transplanting cart Stephen built to help straddle the wide bed, and a planting stick to measure spacing for the transplants. He places his hands on the soil and his feet against the back bar and pushes backwards.*

CROP CARE

WEED CONTROL

Cook's Garden employs a combination of hoes and mulch for weed control. The farm has a number of different hoes collected from garage sales and received as gifts over the years. The favorite hoe on the farm is a Planet Jr. knock-off that Stephen bought 25 years ago from Dalton Cooper & Gates. He replaced the parts that weren't right and made mounts for a 6-inch and a 9-inch tractor sweep, which are his favorites out of a wide variety of blades that he has for the hoe.

Typically, Stephen hoes beds once or twice with the wheel hoe in both directions, down and across, before applying straw mulch. Timely wheel hoeing is so key in his eyes that he's considering hiring someone to be on call for situations when he and his intern don't have time to do it. The plants also get hand-weeded when needed.

Stephen has successfully employed flame weeding in the sections of the beds devoted to carrots, using a small handheld propane torch. His method used very little propane and was effective in controlling the in-line weeds.

Flame Weeding

Flame weeding is typically done either just before seeding or just before germination. It is most effective on very small weeds with growing tips that are aboveground (grasses and other monocots have growing tips belowground and are not killed by flame weeding). A very hot torch passing over very small weed seedlings will singe the leaves and growing tips, causing the plants to wilt and die over the next few hours. It does not affect the crop seeds if they are buried and have not yet poked through the soil surface.

SEASON EXTENSION

To get crops earlier, Stephen uses low tunnels and row covers. These provide frost protection, control tomato diseases, and speed growth. Because his beds are so wide, the usual 9-gauge wire hoops don't work for him, so he uses ⅜-inch rod bent into hoops to support the row cover and clear plastic. Twine is fed through loops bent into the

bottoms of each hoop to pull over the row cover and hold it down; the row cover can be slid up on the hoop, still under the twine, to access the crop.

Cook uses three movable tunnels that span two beds at a time and are large enough to walk through — 13.5 feet by 70 feet. If temperatures are very cold at night, he uses Kero-Sun wick-type heaters to add supplemental heat and keep the frost off the plants in these tunnel. Ground anchors and rope hold down the plastic on the tunnels. The plastic sidewalls slide up under the rope to vent the sides; later in the season, some of the tunnels will have their plastic removed entirely, when it's no longer needed for protection.

Stephen also uses quite a bit of floating row cover. In the spring, it speeds things up and aids early germination when the soil is still cold. Later in the season, he uses it to control insects on young cucumbers and squash. Upside-down round planter pots stationed between plants hold the cover up off young transplants, and bricks along the edges hold it down. This prevents damage to the young plants from wind flapping until they are big enough to start supporting the row cover themselves.

Used row cover gets stuffed into soil bags for storage and labeled with the size and condition of the fabric.

ABOVE: *Tomatoes tied up with sisal twine*

PEST AND DISEASE CONTROL

In addition to row cover, Stephen uses PyGanic, an organically approved pesticide, in some situations. On young cucumbers and squash he sprays before covering them with row cover to ensure any cucumber beetles underneath are killed before they can do damage. He also uses PyGanic to control flea beetles on young eggplant. DiPel (B.t.) is sprayed to control caterpillars on cabbage and cauliflower.

He keeps spraying to a minimum; it is both expensive and also no fun. As his soil has improved over the years, Stephen has noticed his green bean crop has significantly less insect damage. The farm is free of larger animal pests, probably thanks to the dogs on the property.

TRELLISING AND PRUNING

Tomatoes are trellised with double-leader pruning and strands of sisal twine. At the end of the season, Stephen burns the vines and the twine to prevent spreading diseases. The sisal twine hangs from triple strands of baling twine strung between the hoops of the mobile tunnels.

Recently he started experimenting with tying up peppers and eggplant in a similar way. Typically he cages peppers. He is also experimenting with trellising cucumbers on wire-roll fencing, with a 4-inch mesh supported by T-posts.

HARVESTING

Stephen made an oversized Radio Flyer–style wagon out of two riding lawn mower front ends to haul produce boxes out of the field. He built his own wooden lug boxes, which stack nicely and make a good display at market. His first round of boxes lasted 15 years and he's made improvements since then. They now feature drainage holes in the bottom corners so produce can be spray-rinsed right in them.

Many harvested crops go into 2-gallon buckets, which are easy to carry, and are transferred into the wooden lugs. Dirty crops such as roots get harvested into a wheelbarrow, as does lettuce. The farm has four wheelbarrows of various types.

Cut flowers are harvested into buckets as well. Flower harvest is Thursdays, with storage in the cooler for the Saturday market. Stephen makes all of the bouquets at market, typically making 60 bunches in five hours while his wife or an intern handles the vegetable sales.

ABOVE: *Tomatoes ripening in the hoophouse*

ABOVE: *U-pick strawberries*

POST-HARVEST

WASHING AND PACKING

Washing and packing happen in the shade of a tree next to the farmstand. Dirty crops such as roots are sloshed in a water-filled wheelbarrow and transferred to wooden lugs for a final rinse. The farm also has a stainless steel trough from a restaurant salad-and-sandwich-prep station for soaking lettuce.

Produce is harvested the day before market and held in a small 6-by-6.5-foot walk-in cooler built into the corner of the produce stand at the farm. If items need storage longer than overnight, Stephen covers the lug boxes with plywood lids to keep the humidity higher inside and to preserve the quality of the produce.

ABOVE: *A spring display at market*

DELIVERY AND SALES

Cook's Garden sells produce and plant starts directly from its farmstand. In the late spring the farm opens a u-pick strawberry patch. The June-bearing strawberries have a short picking season.

The farm also sells at a weekend market that Stephen's wife, Zella, manages. A Dodge Caravan minivan with a 3-cubic-yard trailer transports produce to market. The wooden lug boxes were designed to fit into the trailer with no wasted space.

ABOVE: *Stephen's wagon, made from lawn mower front ends, hauling a big load of tomatoes from the field in the boxes that he built*

ABOVE: *Trailer loaded for market*

ABOVE: *Stephen on the bicycle he uses for quick trips to the field from the farmstand for custom-harvesting orders*

OFFICE, COMMUNICATION, AND RECORD KEEPING

Stephen keeps records in three different bound books: one for receipts and financial records, one for farmers' market records, and one for the garden records. The farmers' market book records what goes to market, what the weather was like, how much was sold, and what the prices were for every week.

The garden book keeps track of the seed order and all of the sowings in the garden. He uses a composition book for this, writing the sowing date and crop in the margins of the pages where they are easier to see and other notes on the rest of the page.

These books make it easy for him to look back at previous years and compare information. He keeps maps of the garden for each year to help with rotation planning.

Stephen does his strategic planning just after the holidays and then orders seeds, usually by January 10 each year. This isn't early enough for his earliest tomato seedings, so he uses seeds held over from the previous year's order for those tomatoes. When he finishes his planning and seed order, he does the farm taxes.

HARVEST MOON FLOWER FARM

THE BACKSTORY

Before Linda started the farm she hosted a large party each year on the harvest moon. The farm name followed, and she believes it gives the farm a romantic quality, a fitting attribute considering all of the weddings they do.

LINDA CHAPMAN

Space in Production: 2.5 acres

Location: Rural — Spencer, Indiana

Crops: Cut flowers, vegetables, bedding plants

Markets: Farmers' markets, chefs, business subscriptions, weddings

Year Started: 1988

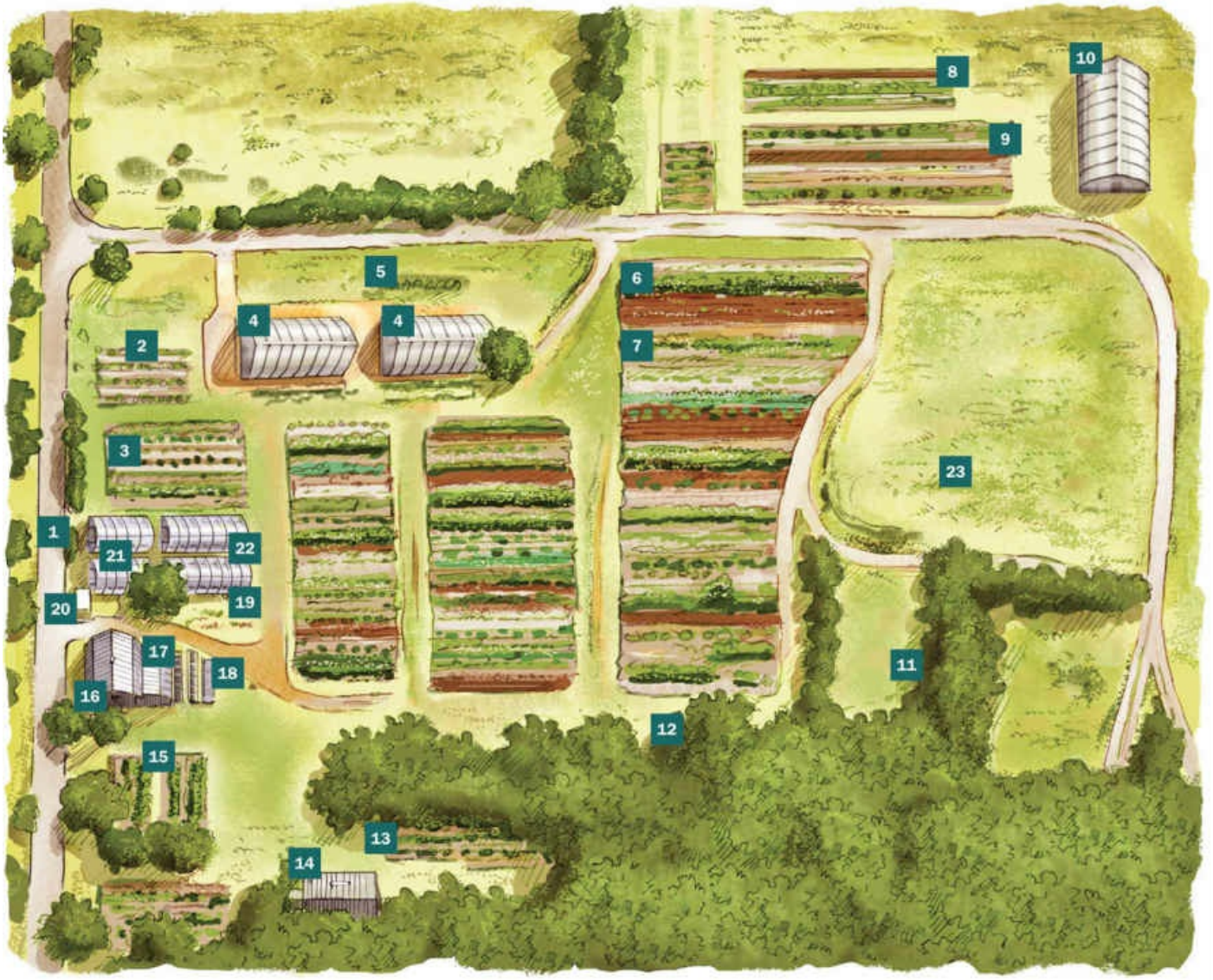
Linda Chapman started her specialty cut-flower farm in 1988 as a way to stay home and home-school her two children and make money on the side. Previously she had worked for a season on a friend's farm helping harvest flowers for market one day a week. She had had big vegetable and flower gardens but had never sold her produce.

Aside from the land, which she already owned, her startup costs for the first year of farming totaled $400. In her bare-bones setup, she modified her porch with clear plastic to function as a greenhouse for starts, and she used an old Gravely garden tractor for tillage.

Initially she sold at one farmers' market a week when the kids were younger and she was learning the trade. After 10 years, she took a big leap forward and invested in a membership in the Association of Specialty Cut Flower Growers and attended the annual conference. The conference, quite expensive for her at the time, generated numerous ideas for production techniques, harvest, handling, and marketing — tools she needed to step up to the next level. After nearly three decades in business, she's still learning; she says that she feels she'll never know more than a fraction of all there is to know about the flower business.

HARVEST MOON FLOWER FARM

MAP



ABOVE: *Double-tap the image to open to fill the screen. Use the two-finger pinch-out method to zoom in. (These features are available on most e-readers.)*

KEY

1. Pussy willows/forsythia
2. Blueberries
3. Buddleia
4. Unheated hoophouses (24' × 55')
5. Woodies
6. Zinnias
7. Coxcomb

8. Biochar plot (three-year study with Purdue University)
9. Sunflower field
10. New Nifty Hoops hoophouse (30' × 72')
11. Woodies: buddleia, viburnum, spirea
12. Compost area
13. Shade gardens
14. House
15. Holly and winterberries
16. Barn
17. Solar greenhouse
18. Cold frames in front
19. Potted plant area
20. 8' × 10' cooler
21. Heated hoophouses
22. Unheated hoophouses
23. Mixed field, flowers, herbs, and produce

THE BASICS

The farm is located in southern Indiana, 20 minutes northwest of Bloomington and one hour south of Indianapolis. It produces year-round, ramping up flower production in the warm season and concentrating more on vegetables in the cold months. The weather can be quite cold in the winter, with snow and temperatures below 10°F.

The farm sits on a slightly sloping site, bordered by various features on the sides, both natural and built. Linda sees the farm as a massive number of little microclimates and this allows her to tailor what she plants to each of those spots.

Growing flowers allows Linda to work surrounded by beauty, and this is a big motivator for her. The farm is quite diverse, growing more than 100 species of flowers with many succession plantings (crops planted multiple times in the same season to extend their harvest). In addition, many of the beds on the farm are replanted multiple times each season, a typical approach on compact farms, usually referred to as "double cropping" or even "triple cropping." The farm isn't certified organic, but Linda considers it sustainable and her practices focus on improving the soil and creating a healthy ecosystem.

Linda is not mechanically inclined so there is minimal mechanization. This saves her from having tools that break and can't be easily fixed, and it allows her to provide more work for people around the farm. Over the years, she has favored investing in her employees instead of expensive equipment to do the work.

CUSTOMERS AND MARKETS

The farm sells through four main channels: farmers' markets, direct to chefs, subscription flowers for businesses, and weddings. Weddings have the biggest profit margin and the farm has supplied flowers for more than 80 weddings in a year. The farm works with a handful of chefs, supplying both vegetables and cut flowers for their restaurants. Harvest Moon also works with more than a dozen businesses that have flower subscriptions, delivering customized fresh-cut flower displays weekly. During the warm season, Linda goes to three farmers' markets a week; in the winter she drops down to two a week. The farm used to sell a lot of flowers to wholesale florists, but expanding direct markets now allow more direct sales.

Harvest Moon's primary crop is cut flowers, sold as bouquets and other arrangements. The farm also produces vegetables, culinary herbs, and microgreens for chefs and the farmers' markets and in the spring sells bedding plants at the markets.

Season extension is important on the farm. In the fall, the farm extends the flower season with dried flowers and wreaths, candle centerpieces, and Christmas wreaths. The selling season stretches into the winter with winter vegetable production of carrots, kale, chard, salad spinach, and microgreens. In the late winter and early spring, tunnels help them get an early start with flowers and vegetables again.

ABOVE: *An early morning view of the barn*

LABOR

Although Linda runs the farm full-time, she has incredible help from experienced, longtime employees. Her neighbor, Gay, has worked on the farm part-time for 24 years. Both Linda and Gay have daughters who grew up working on the farm and now are there full-time. As Linda gets closer to retirement age, she is starting to work on the process of transitioning the farm to the next generation, and she has purchased an adjacent property as her "retirement farm." There are many details to work through in handing over control, and financial and legal obligations, so it is a process that likely will take many years of planning, thoughtfulness, and discussions.

In addition to the two longtime families, the farm also hires one or two part-time workers each summer to help in the field and at markets. Occasionally, high school

students hire on for short-term labor projects such as mulching the fields early in the season.

WATER

A municipal water connection supplies the farm with water for irrigation, washing, and packing. Indiana enjoys regular rainfall in summers, but there have been dry years that required irrigation. Linda makes the call each year on whether to install a drip system or gamble on a potential scramble later. Drip irrigation is labor intensive for the farm to set up and then work around. For several dry years, Linda used drip tape to irrigate the entire farm. The 2015 crop year was a wet one, so Harvest Moon removed all of the drip irrigation equipment. When drip irrigation isn't available, an oscillating fan-type lawn sprinkler covers critical areas. The sprinkler requires frequent moves, but it's a simple and easy process.

The hoophouses utilize drip tape for irrigation.

FERTILITY

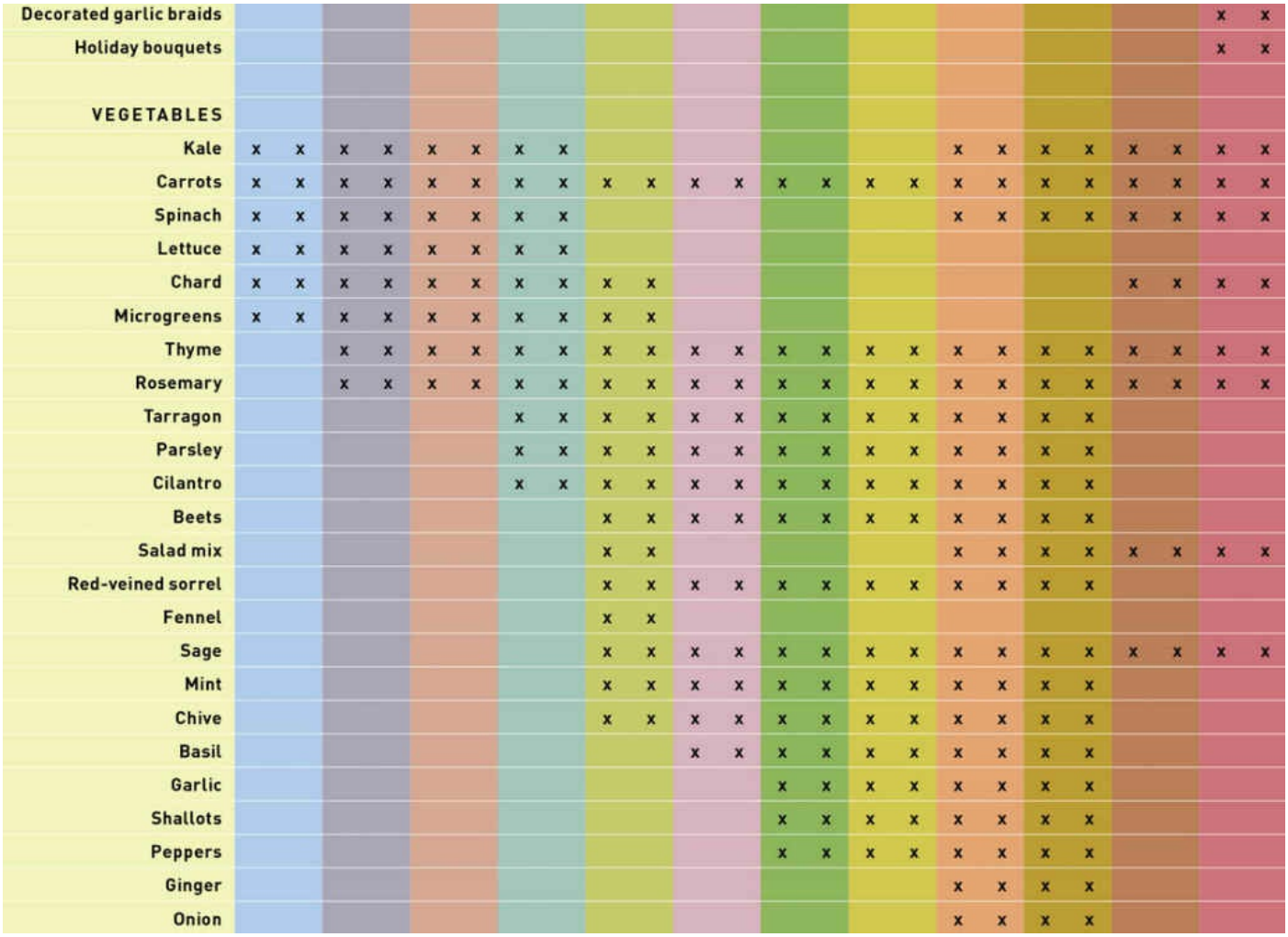
To monitor fertility requirements, Harvest Moon tests its soil every spring and fall; the results influence decisions for the plants. Any ground without a crop on it gets a cover crop. In the summer, buckwheat or cowpeas help build soil between seasonal plantings. The straw mulch used over the years has provided significant organic material to the soil.

The farm makes some compost to supplement that purchased by the truckload to spread on beds in the spring. Chicken manure pellets are an additional amendment. The farm applied sulfur in one of the hoophouses to bring the pH down after incorporating a load of bad compost. In general, the soil on the farm is well balanced and naturally fertile, needing few amendments.

HARVEST MOON FLOWER FARM HARVEST AND DISTRIBUTION WINDOWS

FLOWERS	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
Lilies	x x	x x	x x	x x	x x	x x	x x	x x	x x	x x	x x	x x
Stock	x x	x x	x x	x x							x x	x x
Boxwood	x x	x x	x x	x x								
Anemones		x x	x x	x x								
Pussy willow		x x	x x	x x								
Tulips			x x	x x								
Hyacinth			x x	x x								
Ranunculus			x x	x x								
Freesia			x x	x x								
Bleeding hearts				x x	x x							
Snapdragons				x x	x x	x x					x x	
False indigo					x x							
Dianthus					x x	x x	x x	x x	x x	x x		
Campanula					x x	x x						
Peonies					x x							
Centaurea macrophylla					x x							
Bachelor's button					x x	x x						
Matricaria					x x	x x	x x	x x	x x	x x		
Bupleurum					x x							
Bells of Ireland					x x	x x						
Lamb's ears					x x							
Physocarpus					x x							
Snowball viburnum					x x							
Yarrow						x x						
Daisy						x x						
Hydrangea						x x	x x	x x	x x	x x		
Godetia						x x						
Gooseneck loosestrife						x x						
Lupines						x x						
Zinnias							x x	x x	x x	x x		
Dahlias							x x	x x	x x	x x		
Basils							x x	x x	x x	x x		
Frosted explosion							x x	x x	x x	x x		
Marigolds							x x	x x	x x	x x		
Butterfly bush							x x	x x	x x	x x		
Asclepias							x x	x x	x x	x x		
Coxcomb							x x	x x	x x	x x		
Sweetpea							x x	x x	x x	x x		
Caryopteris							x x	x x	x x	x x		

	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
Celosia							x x	x x	x x	x x		
Hairy balls							x x	x x	x x	x x		
Scented geraniums							x x	x x	x x	x x		
Cerinthe							x x	x x	x x	x x		
Strawflowers							x x	x x	x x	x x		
Decorative peppers							x x	x x	x x	x x		
Mexican sage									x x	x x		
Winterberries									x x	x x	x x	x x
Mums									x x	x x	x x	
Wreaths												x x
Candle arrangements												x x
Potted paperwhites												x x



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TOOLS AND INFRASTRUCTURE

BED PREPARATION

Bed preparation is very simple at Harvest Moon Flower Farm. Most crops are transplanted and mulched, so they don't require a fine seedbed; turnaround is quick. In the field, the primary tool is a 48-inch rototiller on the back of a Kubota utility tractor. Following tender crops, the rototiller works the crop directly into the ground and incorporates compost and other amendments.

When conditions are good, direct replanting can occur following a single pass with the tiller. If the bed is particularly rough and there is time, the bed sits for a week before a second tilling and then planting. In beds with tougher plants to incorporate — such as sunflowers — Linda uses her zero-turn mower to cut down the crop before tilling.

There is very little measuring on the farm; Linda does most things by estimation and feel. Bed tops are roughly 48 inches wide, the width of the tiller, and pathways range from 18 to 24 inches wide. In the past, the farm applied straw mulch to bed tops after planting. A trial of plastic mulch didn't work well, so for the past few years it has been paper mulch on the bed tops and straw in the pathways. Some beds, particularly the perennials and zinnias, get heavy-duty woven weed cloth.

Linda uses a small electric Mantis tiller in the hoophouses. The tiller has a power cord, but two of the six houses have electricity and the others are close to electrical outlets. The electric tiller is quiet and doesn't generate fumes, which is especially important in the cold winter months when the houses are closed to maintain heat.

GREENHOUSES AND PROPAGATION

Almost all of the plants on the farm are transplanted into the fields. This gives them a jump on the weeds and results in even stands in the field, with no gaps. Seeds start in a 16-by-30-foot solar greenhouse built into the side of the barn; the temperature stays above 48°F all winter with no supplemental heat, due to good insulation and plenty of thermal mass. From there, seedlings move out to one of the farm's 14-by-40-foot hoophouses, where a propane Hot Dawg forced-air heater provides supplemental heat. Set at 38°F, it is just enough to keep the hoophouse from freezing. In the summer, the seedlings move outside to harden off before being planted in the fields.

Seeds develop in 72- and 120-cell 1020 trays filled with purchased potting mix, usually supplemented with chicken manure or compost. Seedlings get sprayed weekly with fish emulsion from a Solo backpack sprayer. Linda likes to use a Vibro hand seeder for seeding in the greenhouse.

Trays that need extra warmth for germinating sit on electric bottom-heat mats that rest on a sheet of rigid foam insulation and are protected by a plastic sheet. A thermostat controls the mat temperature via a temperature probe stuck into the potting soil in one of the trays. The solar greenhouse has enough bottom-heat space for about 54 trays, which is about 75 percent of its space capacity.

Hand watering in the solar greenhouse utilizes a head on the hose that provides a fine mist. Once the seedlings move out, they're watered with a Dramm wand with a heavier spray pattern.

The hoophouses are set up with both roll-up sides and automatic louvers on a thermostat for ventilation. There is a hanging shelf over the center bed of the hoophouse to allow plants in the ground at the same time that seedlings are on the shelf. In the

summer, two box fans hang at the ends of the shelf on bungee cords. Hung this way, they naturally slowly rotate back and forth, creating good airflow in the house. The hardware-cloth shelf doesn't shade the beds when seedlings aren't there, and it's high enough that the shade is minimal when seedlings are there.

ABOVE: *Inside the hoophouse, where it stays above freezing all winter*

Gimme Shelter

The terms "greenhouse" and "hoophouse" are sometimes used interchangeably. I use the term "greenhouse" to refer to any structure that is used specifically for

propagation of seedlings. Usually this means the structure has some supplemental heat, as well as furniture to hold seedling trays up off the ground. Frequently it also means there is some sort of automatic ventilation, and maybe automatic watering systems.

"Hoophouse" typically means a structure that is made from metal pipe, bent into bows and covered with plastic film to create a protected space. I usually use the term to refer to structures where plants are planted in the ground for production of crops. Hoophouses usually don't have any supplemental heat or permanent furniture for holding up seedlings.

On many compact farms (and even some larger ones), some or all of the hoophouse space will be used for seedlings at one point in the season and for in-ground production at another. Sometimes this is the case for greenhouses as well, but not as often. Many of the greenhouses on farms in this book are not hoophouses, in the sense that they are not built from metal hoops but are instead framed from lumber, but there are exceptions.

There's a wide range of structures out there, and they are used in widely varying and frequently creative manners. (For more on this topic, see here.)

SPREADING AMENDMENTS

The farm spreads all amendments and compost with 5-gallon buckets or conveniently sized coffee cans. Farm workers dump buckets of compost at regular intervals along the beds and then rake them out evenly. Amendments are evenly applied by hand, using the buckets as carriers.

SEEDING AND PLANTING

Three crops on the farm are direct-seeded: salad mix, carrots, and sometimes beets. The farm crew makes a furrow with a hoe and then drops in the seeds by hand.

All other crops on the farm are transplanted, usually into paper mulch or landscape fabric. Linda determines spacing by experience and feel. The spacing is based on the eventual target size of the plant and its growth characteristics. She sets out example

plants to start off the planting and then the crew follows her lead. Rows are not always straight, but when the plants fill in no one can tell.

Transplanting trowels punch through the paper mulch to set the plants. Weed cloth - features pre-burned holes and set spacing.

ABOVE: *Tulip bulbs laid out for planting in the fall and blooming in the spring*

ABOVE: *The barn, with its built-in solar greenhouse on the side, two hoophouses to the right, and flowers blooming everywhere*

CROP CARE

Mulching is the primary form of weed control on the farm. In the past, the farm used rotten straw exclusively, but that is now reserved for pathways since paper mulch and weed cloth are faster to put down before planting. To ensure there are no weed seeds in the straw mulch, the farm buys straw the year before mulching and lets it sit outside so any seeds will germinate and the straw will start to compress as it breaks down in wet weather. The following spring, the crew uses the flakes from the bales to mulch the pathways, covering every square inch of pathway with a deep layer to prevent weeds from emerging.

The only hoe used at Harvest Moon is a short-handled Japanese scraper. A gas-powered Mantis tiller often works in the pathways and on bed tops. The farm purchased it for a potato trial that could not receive mulch, and it's still used for hilling potatoes. Remaining weed control is by hand.

The farm operation uses quite a bit of floating row cover to protect fall-planted, overwintering flowers and provide extra protection to winter crops in the hoophouses. For plants in the field, windy conditions in the area necessitate row cover with no hoops, held down with 6-inch staples. In the hoophouses, where wind isn't an issue, 9-gauge wire hoops keep the fabric off the crop.

Hoophouses are used to grow both flowers and vegetables. There are six on the farm: four measure 14 by 40 feet, and two measure 24 by 55 feet. The site slopes for two of the 14-by-40 houses, so they needed to build a retaining wall and to fill in to provide a flat pad. All of the hoophouses have roll-up sides for ventilation in the summer, and the two closest to the barn have electricity and propane heat to keep them from freezing in the winter. The heated houses provide harvests for the coldest months, while the unheated houses are used for production in the late winter and early spring.

No vegetables grown at Harvest Moon require trellising, but many of the flowers do require support. Hortonova polypropylene mesh provides this support. For flowers that require only a little extra support, rebar stakes are pounded in along the bed sides and the Hortonova is strung horizontally across the bed for the plants to grow up through. Dahlias get this same treatment, but because the plants are much bigger, T-posts replace

the rebar for holding up the Hortonova. Sweetpeas grow up, climbing Hortonova hung vertically on T-posts.

A favorite tool on the farm is the electric golf cart. This is really a utility cart with a bed on the back instead of mounts for golf bags. The cart runs quietly and is light on the ground. There's no warmup in the morning and it requires almost no maintenance. The farm utilizes the cart for hauling everything around the farm: amendments, compost, supplies, and harvests. It's also handy for quickly getting around the fields to check on crops.

HARVESTING

The electric cart is only one of the farm's simple harvest tools. For harvesting flowers, the crew uses basic utility knives instead of clippers to cut the stems.

Flowers are harvested and transported in black nursery pots without drainage holes. HydroFlor added to the harvest water helps extend vase life.

Broader, shallower versions of the drain-free nursery pots suffice for vegetables. For harvesting salad mix and microgreens, the crew uses scissors.

POST-HARVEST

WASHING AND PACKING

The packing area is a simple space with tables for making bouquets and a fiberglass double-basin utility sink for washing vegetables. A high-powered sprayer washes roots and dirty vegetables. Salad mix doesn't get washed unless it has soil splashed on it from rain; Linda finds that not washing the greens extends their shelf life. When needed, salad mix washing includes a dunk in the sink and a spin dry with a 5-gallon hand-crank spinner. Customers know that salad mix is typically not washed and it will need a final wash before being served.

Flower bouquets don't receive sleeves, but Floralife is used in the bucket water to increase vase life. When bouquets are sold at market, the Harvest Moon staff wraps the base of the bunch in a wet paper towel and puts a plastic bag and band over it for transport home if the customer doesn't have a vase.

The farm has one cooler. It was originally a 7-by-9-foot insulated box on the back of a truck, but it now sits on a concrete pad and has a commercial cooling unit on it. Wire racks line the cooler to make better use of the space for floral buckets and delicate salad greens. Cedar lattice affixed to the cooler's exterior is covered in honeysuckle and clematis vines in the summertime.

At the end of each day, the Harvest Moon crew always makes sure the barn and other spaces are left clean so that everything is ready in the morning. Typically, the farm also hosts a wedding on-site each summer, an added incentive to keep the farm neat and clean during the season.

ABOVE: *Salad sprayer*

ABOVE: *The electric "golf cart," hauling blooms*

DELIVERY AND SALES

Sales to chefs are done by calling with an availability list and taking orders over the phone. All orders for chefs are kept in a spiral notebook. Orders for weddings and market sales also have their own spiral notebooks. For deliveries the farm has two Dodge Grand Caravans.


IT'S THE BEST

ABOVE: *Stunning displays awaiting delivery*

OFFICE, COMMUNICATION, AND RECORD KEEPING

The farm's record keeping is thorough, recorded in spiral-bound notebooks. Linda does most of the planning in her head, ingrained from years of experience, but as she starts to transition the farm to the next generation she's working on writing more down.

Marketing for the farm relies on word of mouth. Businesses with subscriptions usually allow Harvest Moon to put out cards with the weekly floral displays to let folks know who supplies the flowers.

PEREGRINE FARM

THE BACKSTORY

The peregrine falcon is a symbol of ecological resurrection, having come back from near extinction due to overuse of DDT in agriculture. The Latin root for the word “peregrine” is also sometimes translated as “through the field or land.”

ALEX AND BETSY HITT

Space in Production: 4 acres

Location: Rural — Graham, North Carolina

Crops: Mixed vegetables, cut flowers, blueberries

Markets: Farmers' markets, direct to restaurants, direct to groceries

Year Started: 1982

Alex and Betsy Hitt moved to North Carolina after graduating from Utah State University with degrees in soils and forestry. Inspired by the ideas of Booker T. Whatley (1915–2005), professor of agriculture at Tuskegee Institute, they wanted to manage land in an environmentally responsible way and created a business plan for a 10-acre farm based on pick-your-own berries. The Raleigh-Durham area had the best combination of affordable land, favorable growing climate, and a potential customer population with income levels to create a good market.

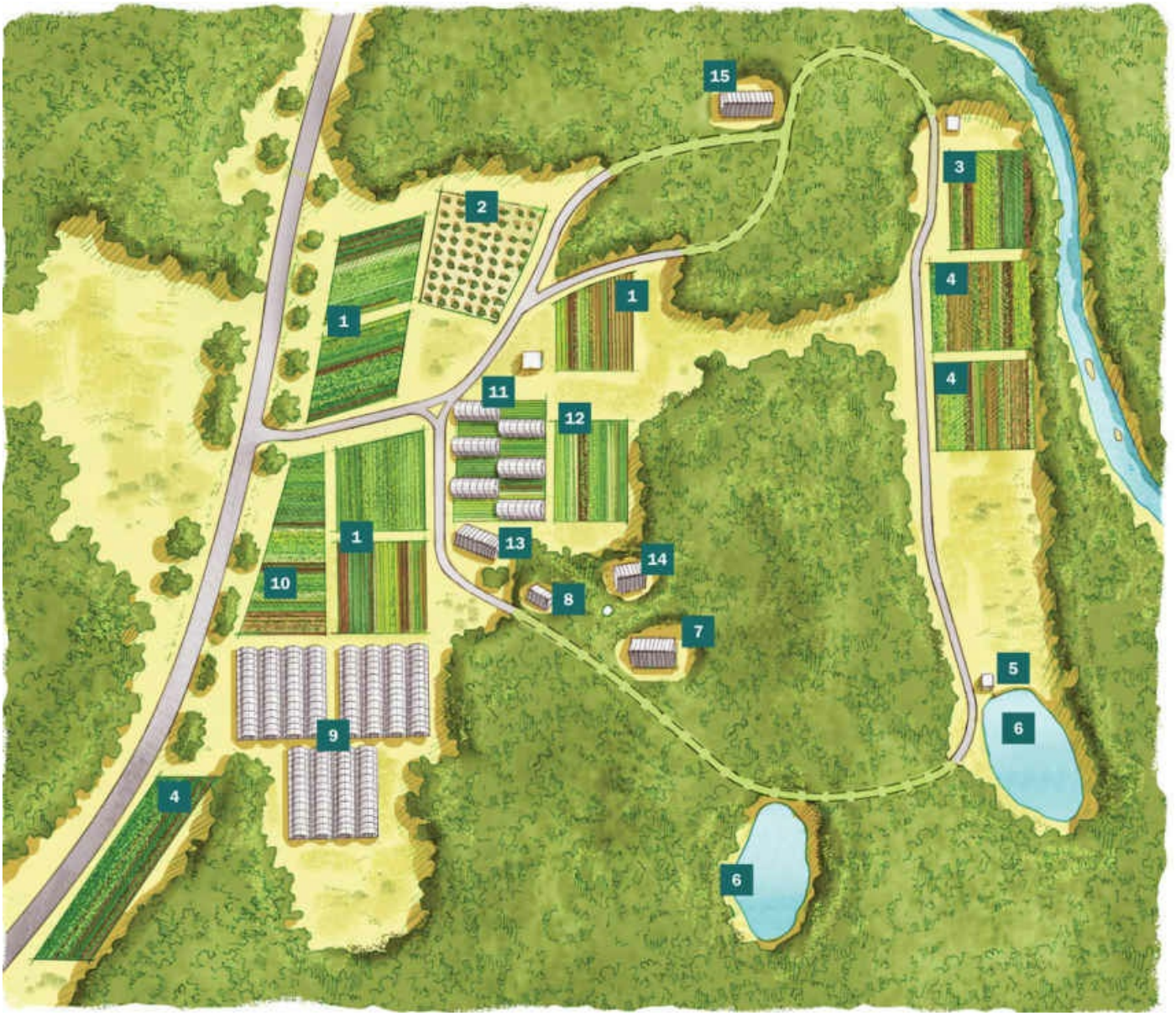
Fresh out of school and without family resources, the Hitts had no money at the start, but with the help of a lawyer and their business plan they created a corporation, persuading 18 friends and acquaintances to buy shares and ultimately invest $80,000 to

help start the farm. The 26 acres of land they purchased was partly cleared and partly in forest, with no infrastructure at all. At first the farm consistently lost money. After about eight years, however, it started to turn a real profit, once most of the infrastructure was in place and they had moved away from a u-pick operation into vegetables and cut flowers. Eventually, Alex and Betsy bought out all of the shareholders and they now own the farm. By continuing to live as if they aren't making money, they have also been able to save some for eventual retirement.

After 35 years farming the same piece of land, the Hitts are working on slowing down a little and eventually passing on the farm to the next generation. One of their longtime employees, Jennie, has added winter vegetable production to help finance her year-round, full-time salary. Alex and Betsy are working with a lawyer and accountant to figure out the best way to transition ownership of the business to Jennie over time, while still remaining on the farm and involved in the day-to-day activities.

PEREGRINE FARM

MAP



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KEY

1. Main annual crop rotation
2. Blueberries
3. Perennial cut flowers
4. Other annual crop production
5. Irrigation pump
6. Ponds

7. Packing shed
8. Equipment shed
9. Haygrove high tunnels
10. Pollinator and perennial cut flowers
11. 16' × 48' sliding tunnels
12. Woody cut flowers
13. Solar greenhouse
14. Workshop
15. House

THE BASICS

Peregrine Farm sits in the middle of North Carolina on slightly rolling ground that consists of 6 to 8 inches of sandy loam on top of well-drained red clay. There are about 4 acres of soil in production (down from a peak of 5 acres at one point), some double-cropped.

The climate in the Southeast is one of extremes, so there are very hot temperatures, especially in midsummer, and very cold spells in winter, broken by warm weeks. With 40 inches of annual rainfall, the region receives very hard rain at times, as well as extended dry periods. The farm operation has moved to year-round production and marketing in recent years in order to support three full-time salaries.

The farmers pay close attention to labor costs and gross income, the two biggest factors in their ongoing success. Alex and Betsy measure success broadly, as quality of life, and they make decisions around that fundamental goal, considering stress level, time off, and keeping people happy, along with the bottom line. Labor costs for the farm, including salaries for Betsy and Alex, run about 39 percent of the gross, and the amount of labor a crop requires plays a big part in their decisions about crop mixes. Their second largest expense behind labor is insurance, a relatively fixed cost.

All of the beds on the farm are 100 feet long. This makes rotation planning easier and standardizes such supplies as drip tape, row cover, and trellising so they can be

used anywhere on the property. The farm configuration is in quarter-acre blocks with sod drive-throughs between to make it easier to truck materials to and from the fields.

CUSTOMERS AND MARKETS

Peregrine Farm sells its products at the Carrboro Farmers' Market (a very successful, nationally recognized market established in 1978), at both the main-season market on Wednesdays and the year-round market on Saturdays. The farm also supplies about a dozen restaurants in the area.

The farm grew up with the local market and restaurant scene, so the Hitts were in early with all of their market channels and developed their niches when there wasn't as much competition as there is now. They formerly sold to more grocery stores but have scaled that effort back over time; they now sell to just two of the local co-ops.

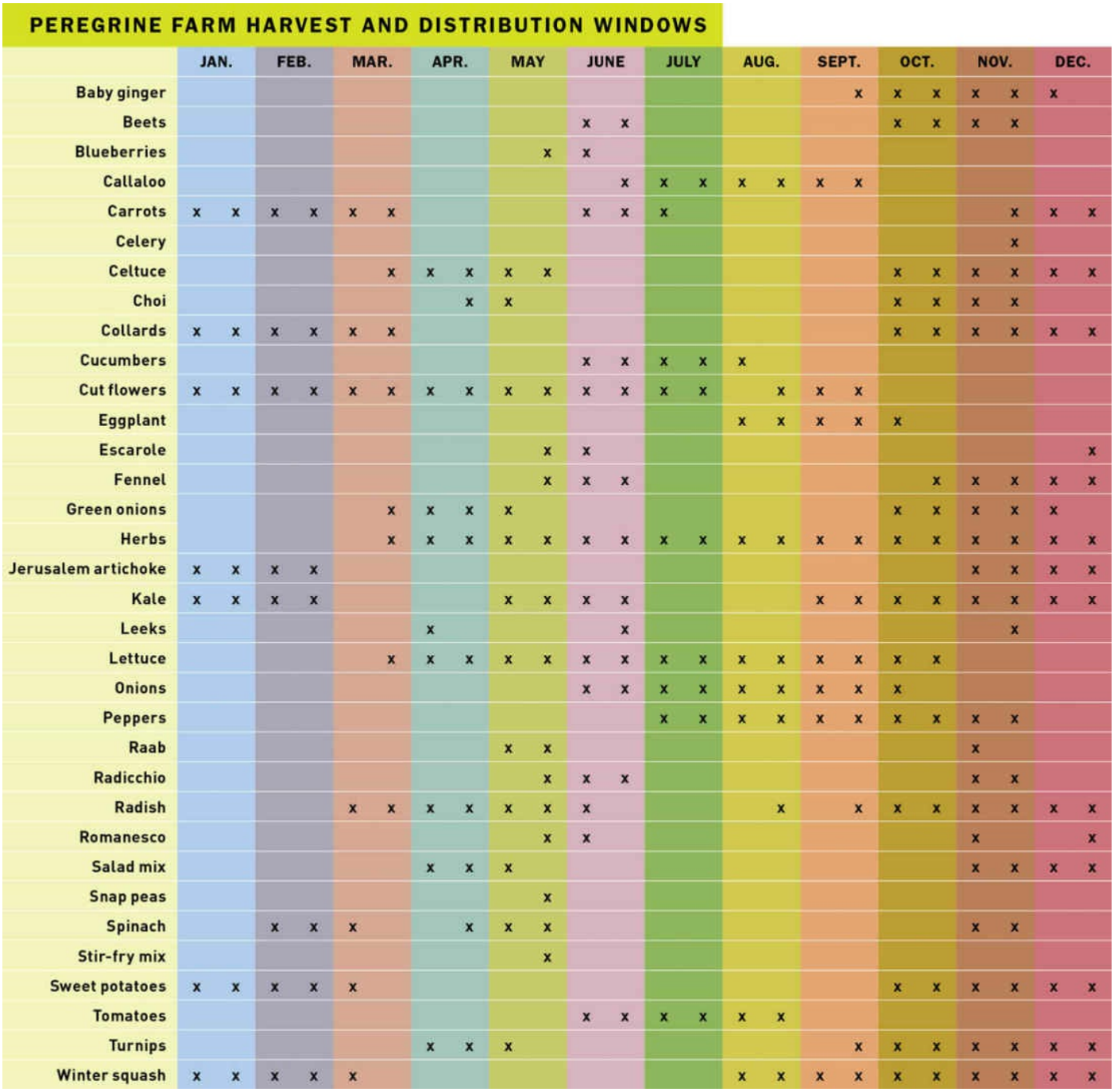
The mix of market channels gives the farm flexibility in how to sell produce and flowers on any given week. The larger grocery channel can sometimes absorb gluts, and specialty items that aren't available in large quantities can go to the smaller channels, often for a higher price.

LABOR

For a long time, Alex and Betsy ran the farm as its sole full-time, year-round salaried employees. They usually hired two seasonal workers to help during the main growing season, April through October. Now that Jennie works at Peregrine Farm full-time, year-round, and the farm sells through the winter, the Hitts hire just one part-time seasonal worker for the main season.

Betsy manages the cut-flower part of the operation and does all of the harvest and packing for those markets. Alex manages the vegetables and Jennie has taken over some of those duties, adding the winter vegetable production.

The Hitts consider the farm's labor expenses (wages only), typically 39 to 40 percent of gross sales, to be at a good level to keep the farm profitable.



PEREGRINE FARM HARVEST AND DISTRIBUTION WINDOWS

	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
Baby ginger									x	x x	x x	x
Beets						x x				x x	x x	
Blueberries					x	x						
Callaloo						x	x x	x x	x x			
Carrots	x x	x x	x x			x x	x				x	x x
Celery											x	
Celtuce			x	x x	x x					x x	x x	x x
Choi				x	x					x x	x x	
Collards	x x	x x	x x							x x	x x	x x
Cucumbers						x x	x x	x				
Cut flowers	x x	x x	x x	x x	x x	x x	x x	x	x x			
Eggplant								x x	x x	x		
Escarole					x	x						x
Fennel					x	x x				x	x x	x x
Green onions			x	x x	x					x x	x x	x
Herbs			x	x x	x x	x x	x x	x x	x x	x x	x x	x x
Jerusalem artichoke	x x	x x									x x	x x
Kale	x x	x x			x x	x x			x x	x x	x x	x x
Leeks				x		x					x	
Lettuce			x	x x	x x	x x	x x	x x	x x	x x		
Onions						x x	x x	x x	x x	x		
Peppers							x x	x x	x x	x x	x x	
Raab					x x						x	
Radicchio					x	x x					x x	
Radish			x x	x x	x x	x		x	x	x x	x x	x x
Romanesco					x	x					x	x
Salad mix				x x	x						x x	x x
Snap peas					x							
Spinach		x x	x	x	x x						x x	
Stir-fry mix					x							
Sweet potatoes	x x	x x	x							x x	x x	x x
Tomatoes						x x	x x	x x				
Turnips				x x	x				x	x x	x x	x x
Winter squash	x x	x x	x					x x	x x	x x	x x	x x

ABOVE: *Double-tap the image to open to fill the screen. Use the two-finger pinch-out method to zoom in. (These features are available on most e-readers.)*

WATER

Peregrine Farm has spent more on irrigation systems than on any other system, but the investment has saved them many times over. The farm irrigates out of two ponds and a creek using a permanently mounted 2.5-horsepower electric pump that will deliver 35 gallons per minute. The water travels through double 24-inch sand filters and then into

the fields in buried 2-inch PVC pipe, with valves at every field block corner to keep it accessible.

Water is the most limiting resource for the farm, especially as the climate changes. Almost all of the crops are irrigated with drip tape. Alex and Betsy use a few Netafim microsprinklers for greens in the spring and fall, when they are planting more lines on a bed and the crops benefit from some cooling.

The farm has two wells on the property. One supplies the house and the other the packing shed, greenhouse, and hose bibs in the field. The field hose bibs provide water for washing hands, drinking, and field-cleaning produce.

FERTILITY

North Carolina is one of the few states that still offers free soil testing to farmers through its department of agriculture. Alex has a degree in soils, so he takes advantage of the service and tests each rotational block every year in September, which works out to about 10 to 12 tests a year.

This timing coincides nicely with his preference for working the soil more heavily in the fall, when it starts to cool off and the biological activity slows down. It also coincides with the driest months on the farm and a time when most beds are coming out of production and transitioning into winter cover crops.

Alex and Betsy add dolomitic lime, potassium sulfate, and rock phosphate, all based on soil test results, and then work up beds for winter cover crops of oats and crimson clover, or rye and hairy vetch, depending on the crop that will follow in the spring. Sudax and cowpeas or millet and soy serve as summer cover crops when there are free beds, depending on the following crop. Feather meal applied before planting adds nitrogen to beds that need it.

The only compost used on the farm is high-quality worm castings from hog manure added to the potting mix. The farm used to run 100 turkeys through the quarter-acre rotational blocks, which added good biological activity directly into the fields, but when the local processing plant shut down they discontinued that practice. When the turkeys were on the farm, they remained in a block until they had deposited 500 pounds of manure, figured on the amount of feed they had consumed.

Alex is considering purchasing compost to bring in more biological activity in the areas where there aren’t as many cover crops planted in a particular year, but for now

he is satisfied with the good vigor the fields have maintained through cover crops and mineral additions.

ABOVE: *A field of Haygrove tunnels. The Haygroves are three-season tunnels so the plastic comes off in the winter.*

TOOLS AND INFRASTRUCTURE

BED PREPARATION

A Kubota L3901 four-wheel drive tractor with 37 horsepower and a front-end loader powers the field preparation. Most bed preparations begin in the fall. If there is significant plant material in the fields at that point, the first step is to flail-mow. Then they spread spread minerals and work the fields with a heavy 6-foot three-point disk or a five-shank spring-tooth field cultivator, working the ground 10 to 12 inches deep. Hilling disks off the back of a tool bar on the tractor then list up the soil into beds spaced 48 inches on center; the beds have 32-inch tops and the paths are 12 to 16 inches

wide. A cone-type spin spreader on the back of the tractor is used to seed grains (rye or oats). A bag-type walking spin spreader seeds the legumes (clover or vetch).

In spring, a tiller is used to knock down the cover crop and incorporate it into the beds four weeks before planting a cash crop. If there's a lot of cover crop, they use the flail mower to chop it up first, which prevents clogging the tiller and helps break down the plant matter faster. On the week of planting, a final pass with the rototiller creates the seedbed.

The tractor can't access the beds in the sliding high tunnels, so there they use an 8-horsepower BCS walk-behind tractor with a sickle bar mower and a tiller.

The Hitts prepare no-till beds for sweet peppers starting in the usual way, but without raising them up. They seed a cover crop of rye and vetch. When these flower in the late spring, they first roll them down with the roller on the back of the flail mower, without running the mower itself. They crimp the stalks by rolling the tractor rototiller over the top of the bed without the power takeoff (PTO) running. To make planting into the beds easier, they cut slits in the rolled and crimped cover crop and the soil with Yetter wavy coulters mounted on the tractor tool bar.

One more trick in the Peregrine bed preparation tool kit is solarizing beds. This is done to control fusarium, a soil-borne fungal disease that can be a problem for hoophouse tomatoes. The farmers solarize by working the field flat with the rototiller while there is good moisture and then tightly covering the field with greenhouse plastic, buried on the edges. This is left in place for at least a month of hot, sunny weather, to bake the soil and kill both the pathogen and weed seeds. It also kills good biology, but the beds have had high levels of residual biology, so it hasn't been a problem yet.

GREENHOUSES AND PROPAGATION

Betsy manages the greenhouse on the farm and grows all of the seedlings. The farm has a 10-by-50-foot passive solar greenhouse that puts out about 250,000 plants a year. She buys Fafard's Growing Mix #2 and mixes in 10 percent worm castings to add fertility and biology. The farm is no longer certified organic and the growing mix is not organic, due to a wetting agent, but that's one of the few changes the farm has made in past years, and it's largely one of convenience.

The Hitts use Winstrip trays, hard plastic plug trays that are made in North Carolina, last forever, and are difficult to find these days. They use 50-, 128-, and 168-cell sizes. Seeds in the trays germinate in a simple germination chamber, an insulated box with

electric heat mats at the bottom and three shelves that will hold 30 to 40 trays at a time. Watering and ventilation in the greenhouse are manual tasks.

ABOVE: *Mobile hoophouses are covered year-round and are moved down the field to rotate crops into new locations from year to year.*

SPREADING AMENDMENTS

The farmers spread minerals with a cone-type spin spreader off the back of the tractor. They spread feather meal bed by bed with a Scotts lawn drop spreader. Alex and Betsy modified the holes on the underside by cutting out some of the separators to make the holes bigger to allow more material to flow.

SEEDING AND PLANTING

The Hitts have several seeders and love/hate relationships with all of them. For a long time, Alex and Betsy used Earthway seeders, but they have now switched primarily to a Jang Clean Seeder for direct seeding of small seeds such as carrots, radishes, and beets.

For peas and other large seeds, they use a European push seeder that Johnny's used to sell. For winter squash, they have switched in recent years from a jab-type seeder to transplanting. To keep an even spacing between rows, they use the row markers off the Earthway seeders, modified to work on the other models.

They transplant by bare hand. Alex built three versions of a bed dibbler with nine dibbles each for marking plant spacing. They plant most flowers in rows 10 inches apart and with 8 inches between plants in the line. Lettuces are planted in rows 12 inches apart with either 10 or 6 inches between plants, so the dibblers are designed for these spacings. The dibblers stamp out holes in the tilled soil that fit the transplant plugs. The farmers just drop the transplant plugs into the holes and they move a little soil to cover the top of the plugs.

CROP CARE

Hoes and hands are the main weed control tools. The farmers do use a Williams tool, from Market Farm Implement in Pennsylvania, off the back of the tractor on winter squash and some flowers. A Glaser wheel hoe with metal handles, a rubber tire, and different widths of stirrup hoes is Alex's favorite weed control tool. The farm also has a variety of other blades for the wheel hoe and a collection of long-handled stirrup hoes of various widths for cultivating.

Planting densely to shade out weeds is another part of Peregrine Farm's weed control strategy. For weed control on the tomatoes and some of the peppers the farmers use landscape fabric, an approach that works well in crops that are in the ground longer.

To make stale seed beds for crops like carrots and beets, they employ a backpack flame weeder. The same flame weeder knocks back early weeds after seeding but before the crop germinates. Solarizing beds is also effective for killing weed seeds and reducing the number of weeds that germinate in a bed.

For season extension, the farm sets aside one-half acre for Haygrove tunnels, using these three-season tunnels mainly to keep rain off tomatoes and flowers. The legs are set in multiple rotation blocks, which allows them to rotate the position of the tunnels in the fields by just moving the hoops and plastic from year to year. The tunnels are on a three-year rotation.

Alex and Betsy also employ six sliding 16-by-48-foot tunnels that can move back and forth into one of two positions in the field. These are up year-round. Floating row

cover — held up with PVC hoops and anchored with cinder blocks — protects some of the hardier crops in the field.

A number of crops on the farm need extra support. T-posts are used for all of the trellising on the farm, simplifying their systems and requiring only one set of tools for setting and pulling posts. Tomatoes are trellised on 4-foot-high hog wire fencing hung on 6-foot T-posts that are driven a foot into the ground so the top of the fence ends up about 5 feet off the ground. A Tapener ties errant vines to the fencing. Peppers get support from 5-foot T-posts with crosspieces made from 2×4s and 2×2s. The method is basically a weave, but they can set out many fewer T-posts by using them with the crosspieces.

Hortonova netting, hung vertically on 6-foot T-posts, supports peas and cucumbers. Many of the flowers require extra support, with netting hung horizontally over the beds on T-posts.

Peregrine Farm deals with pest and disease issues primarily by rotation and diversity. Having a mix of cut flowers helps provide beneficial habitat, and typically flowers mix in with vegetable rotations. In the past, flowers made up about 50 percent of the production, but the addition of winter vegetables has decreased that to 30 percent.

A Solo backpack sprayer is used for some insect and disease control. Bt is sprayed once or twice on tomatoes to control fruit worms, and it's also applied for cabbage worms in some conditions. Spinosad is sprayed to control flea beetles on small brassicas, usually just an application or two in the spring; sometimes row cover is used instead. Copper is sprayed to control bacterial leaf spot.

Electric fencing keeps deer out of the fields. Where the electric fencing isn't adequate for the job, the farmers supplement it with 7-foot-high netting.

HARVESTING

Harvesting is all done by hand using lettuce field knives and hooked grape knives for crops that need to be cut, and a spading fork for deeply rooted crops that need to be dug. Harvest goes straight into market containers wherever possible. Occasionally, the farmers use bulb crates or 5-gallon buckets for harvest.

About a decade ago, Peregrine bought a pallet load (150 count) of hard plastic stack-and-nest bins, with lids, from Rehrig Pacific. The crew packs most crops in these and transports them to restaurants and stores. For tomatoes, they still use cardboard flats, and all flowers go into clean, white 5-gallon buckets.

The farm has two pickup trucks, both with caps that provide shade for transporting crops from the field to the packing shed.

ABOVE: *Anemones; lilies in bulb crates*

Skills

Betsy and Alex have found the following skills to be useful in building and maintaining the farm: carpentry and masonry, basic electrical and plumbing, chain saw use, basic mechanics and equipment repair, and computer proficiency. Alex also recommends welding and refrigeration repair as important farming skills to consider.

POST-HARVEST

WASHING AND PACKING

Peregrine Farm has a 30-by-30-foot packing shed; one-third of that space is outside but under cover, and the rest is enclosed. The building is in a shady location, which keeps it cooler. Inside the shed are two walk-in coolers, one 10 by 10 feet and the other 10 by 6 feet, both with commercial cooling units.

The farm does as little packing in the shed as possible, preferring to field-pack and save time when possible. For crops that need some additional cleaning, the farmers use a high-pressure hose, a mesh table for spraying roots, and a bathtub they can fill for dunking crops such as spinach. A collection of stainless steel tables and plastic greenhouse bench tops set between the tables allow boxes to drain. For flowers, a bunch cutter is mounted on a sheet of plywood that can be set atop one of the tables when needed. Trash cans collect trimmings and everything except the bathtub is on wheels so the space can be easily configured to any crop.

DELIVERY AND SALES

The same trucks that fetch produce from the fields make deliveries and go to market. One is a smaller Toyota Tundra with a shell, and the other is a 1995 half-ton Chevy 1500 with a custom shell that has shelves for hauling flower buckets and produce. The trucks are cleaned out between harvests and deliveries to keep the washed produce

clean. At peak harvest season both trucks are completely filled. Restaurants can also pick up their produce at the markets.

OFFICE, COMMUNICATION, AND RECORD KEEPING

The farm keeps and uses records for planning; the farmers have weekly meetings to go through the numbers and make sure they're on track. All of the production planning is on spreadsheets and the farm has developed systems for making sure that records are kept during the season to feed information into that plan.

Handwritten production records go on various forms. There are sheets for keeping track of what was planted when and where, as well as handwritten maps of the fields. Daily work records of weeding and picking activities are kept in a calendar format. Market sales recorded on paper forms are transferred into QuickBooks weekly. The farm uses QuickBooks to keep track of sales by variety, as well as all other expenses. Categories and classes make it easier to create reports in QuickBooks that help with planning and analyzing the business. Those detailed records also provide all of the information the farm's accountant needs at the end of the year to file taxes.

LIBERTY GARDENS

THE BACKSTORY

Liberty Gardens sits on Liberty Road, along which soldiers transported the Liberty Bell to protect it from the British during the American Revolution. “Gardens” is

used to suggest their small scale and attention to detail.

JEFF FRANK AND KRISTIN ILLICK

Space in Production: 1.5 acres

Location: Rural — Coopersburg, Pennsylvania

Crops: Specialty greens, mixed vegetables

Markets: Direct to restaurants

Year Started: 2000

Jeff Frank and Kristin Illick started Liberty Gardens in 2000. Kristin's great-grandfather bought the farm in the late 1800s and her family still owns 31 acres of the original property. They live in Bethlehem, Pennsylvania, and commute to the farm, growing on a piece of the family land rent-free; her uncle lives on a different part of the property.

The property was farmed, growing processing tomatoes for the Campbell Soup Company, until the 1960s, when it was fallowed. Forest started to reclaim the fields during the fallow decades; in 2000, Jeff and Kristin started re-clearing the fields. At their peak, Jeff and Kristin were farming about 4.5 acres but they've scaled back to 1.5,

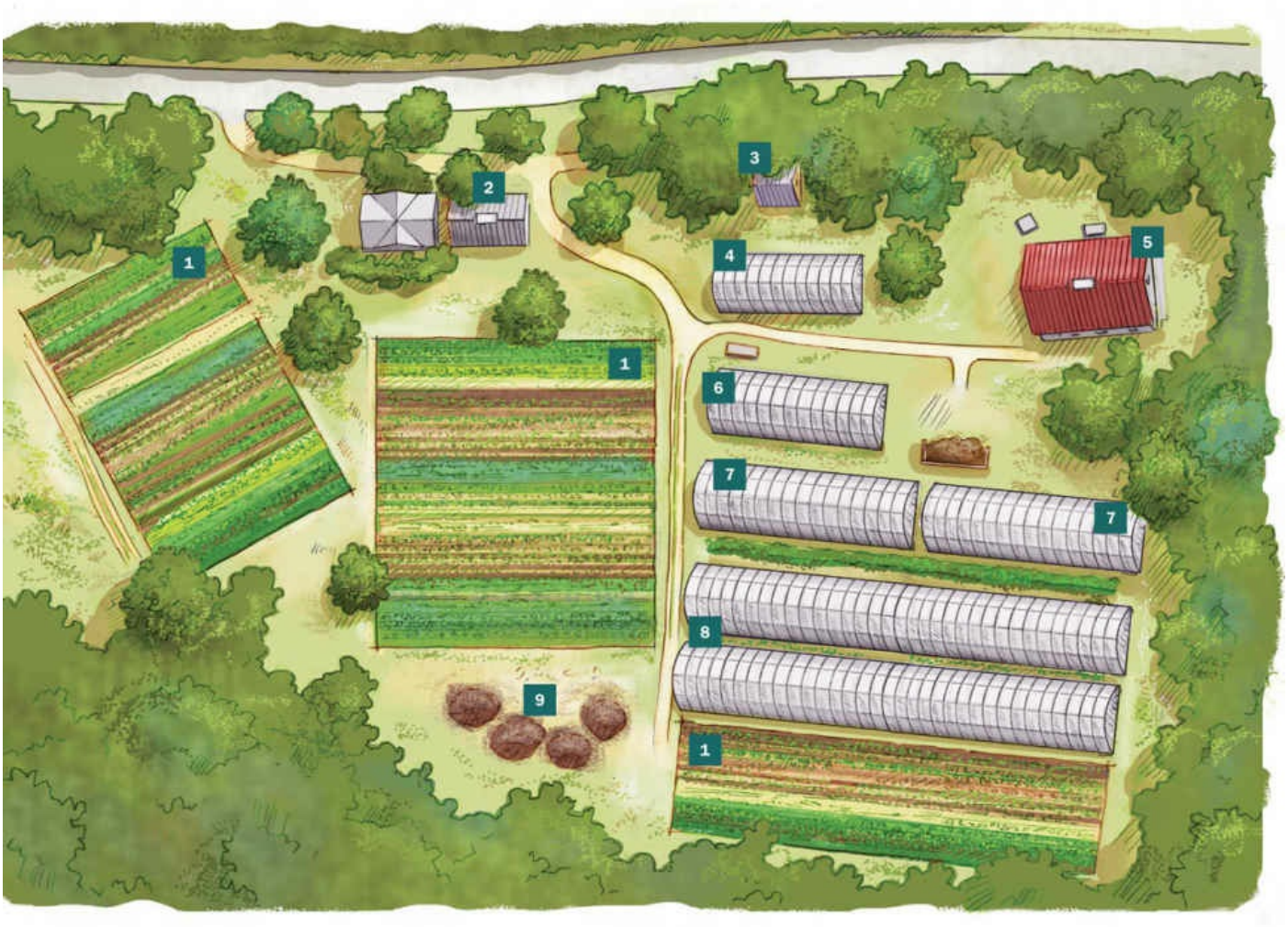
preferring to concentrate their efforts on a small piece of ground rather than spread their attention over too many fields.

Scaling back has allowed the couple to focus more on hand labor and less on working with tractors, which fits their preferences for quieter surroundings and hands-on work with the plants. Liberty Gardens started out as a certified organic farm, then switched to “naturally grown” certification; the farm now maintains the same practices but has not been certified for years.

When they first started the farm, Jeff and Kristin modeled it closely on what they had learned working for other farmers before starting their own operation. As time has gone on, they’ve continuously improved their soil, their production techniques, and their marketing, even in the years they shrank the acreage. They are continuously experimenting with new crops and techniques, evaluating their markets, and considering the future.

LIBERTY GARDENS

MAP



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KEY

1. Fields
2. Packing shed: walk-in coolers, sinks, etc.
3. Tool shed
4. Greenhouse with radiant-heat tables
5. Barn
6. Greenhouse with tables and forced-air heat
7. Two 100' hoophouses
8. Two 200' hoophouses, tractor-accessible

THE BASICS

Liberty Gardens specializes in baby salad greens, selling them both as mixes and single components. Jeff and Kristin also grow and sell a variety of other specialty produce based on a mix of demand and the crops they enjoy. Production is year-round, with nearly half of the production space covered in tunnels; two tunnels have supplemental heat (although they use the heat less and less each year). The farm has a strong focus on quality and good customer service.

CUSTOMERS AND MARKETS

The farm sells exclusively to restaurants. The majority of customers are in New York City; Liberty Gardens ships produce there via UPS. The farm also sells to restaurants in the Lehigh Valley, where Liberty Gardens is located. Jeff and Kristin would like to sell their products more locally, but for now they have strong accounts in New York willing to pay the shipping for their high-quality, high-value produce.

In the past, Kristin and Jeff also marketed to buying groups and farmers' markets. As the farm scaled back on acreage, they simplified their marketing channel to restaurants only, which allowed them to work fewer hours.

LABOR

Jeff and Kristin started out hiring people part-time to help with heavy harvest days; over the years, they have switched to hiring full-time, year-round help. Hours are shorter in the winter and longer in summer, and they pay hourly wages. They currently run the farm with three or four full-time employees who have been with them three to four years. Jeff and Kristin are very active in the day-to-day management and hands-on fieldwork.

WATER

A domestic well on the property has a capacity of about 23 gallons per minute. The plumbing is limited, though, running through the house before heading to the fields. The farm is able to irrigate entirely off that well, although they would like to upgrade the plumbing.

Sprinklers are used for germination, and once seeds have germinated, drip tape waters everything.

FERTILITY

Jeff and Kristin started off testing soil regularly, but after the first years of data collection they now test only every few years. Based on their soil needs, they amend with rock phosphate, green sand, gypsum and dolomite, Fertrell Blue N, and blood meal. In the past, they experimented with different seed meals and other amendments before settling on the mix they use now. Amendments are spread by hand with coffee cans and

buckets. Not everything gets amended; plantings are amended based on the farmers' experience.

Amendments are used as a supplement, but cover crops form the basis of the long-term fertility on the farm. Jeff and Kristin try to put in a cover crop once per year for every section, but in reality some sections don't get one every year. Rye, oats, peas, and vetch are used as winter cover crops and buckwheat is seeded as a summer cover crop.

The farm makes some compost on-site with a tractor bucket loader. The farmers use leaf waste as the carbon source, and crop residue provides the nitrogen. Compost is spread with the tractor bucket or by hand.

LIBERTY GARDENS HARVEST AND DISTRIBUTION WINDOWS

	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
Basil						x x	x x	x x	x x			
Beans							x x	x x	x x			
Beets						x x	x x		x x	x x		
Cabbage									x x	x x	x x	
Carrots										x x	x x	
Celery								x x	x x	x x		
Celery root									x x	x x	x x	
Chard						x x	x x	x x	x x	x x		
Chives				x x	x x	x x			x x	x x	x x	
Cucumbers							x x	x x				
Eggplant							x x	x x	x x			
Fennel					x x	x x						
Fingerling potatoes							x x	x x	x x	x x		
Garlic							x x	x x	x x	x x		
Garlic scapes						x x						
Green garlic					x x	x x						
Head lettuce			x	x x	x x	x x			x x	x x	x x	x x
Kale				x x	x x	x x			x x	x x	x x	x x
Kohlrabi										x x	x x	x x
Lovage					x x	x x						
Micro and baby greens, and salad mixes		x x	x x	x x	x x	x x	x x	x x	x x	x x	x x	x x
Parsley				x x	x x	x x			x x	x x	x x	x x
Peppers							x x	x x	x x	x x		
Radish				x x	x x					x x	x x	x
Rhubarb					x x	x x						
Sage							x x	x x	x x	x x	x x	
Sorrel				x x	x x	x x			x x	x x	x x	
Spinach		x x	x x	x x						x x	x x	x x
Spring onions			x x	x x	x x	x x						
Squash blossoms						x x	x x	x x	x			
Summer squash/zucchini						x x	x x	x x	x			
Sunchokes									x x	x x	x x	
Tarragon					x x	x x			x x			
Thyme						x x	x x	x x	x x	x x		
Tomatoes							x x	x x	x x			
Turnips		x x	x x	x x						x x	x x	x x

ABOVE: *Double-tap the image to open to fill the screen. Use the two-finger pinch-out method to zoom in. (These features are available on most e-readers.)*

TOOLS AND INFRASTRUCTURE

BED PREPARATION

To prepare beds for planting, the farmers typically strip all of the plant material off the bed, cutting with hoes and raking off the plant material or simply pulling it into bins by hand. They spread amendments evenly on the bed tops using a coffee can and buckets; experience dictates the specific mix and quantities. After spreading amendments, they go over the bed with their 5-foot Perfecta II cultivator on the back of a 32-horsepower Ford tractor.

The farm also owns a two-bottom plow and a disk for working new ground or ground that's been in cover crops. In the one hoophouse that the tractor can't access, they prepare beds by hoeing and raking. If the hoeing and raking are insufficient, they'll prepare beds with a walk-behind rototiller. The bed tops are 4 feet wide with 1-foot paths between them. The farm also has a plastic mulch layer that can be pulled behind the tractor when preparing beds for some of the crops.

The farmers mark planting lines with a three-gang Earthway seeder, sometimes using string or a tape measure to make the lines as straight as possible. For direct seedings, they rake the bed and then roll it flat with a seedbed roller from Johnny's before seeding.

ABOVE: *Seeding greens on the tables; pressing seed into soil to improve germination; cutting baby greens from the tables*

GREENHOUSES AND PROPAGATION

The farm grows all of its own seedlings. They fill 1020 plug trays with a soil mix of their own recipe, mixed in an old bathtub. For seeding large quantities of lettuce they use a plate-type vacuum seeder. They use raw seed and sow two or three seeds in each cell because they are planting for baby heads or cut leaves. They top all trays with vermiculite; they have experimented with other methods, but the vermiculite has given the best results with germination and healthy plant growth.

The farm built a bottom-heat system for germination using PEX tubing and an on-demand water heater, which is much more efficient than their old method of using forced air. They grow on tables in the greenhouses and have a bit of space outside the greenhouse for hardening off and summer propagation.

The greenhouses have HAF (horizontal air-flow) fans to circulate air and thermostatically controlled automatic louvers with a ventilation fan. All of the greenhouses have roll-up sides for extra ventilation in the summer. Previously, they sealed the houses with insect screen over the doors, roll-up sides, and vents, but now they simply use roll fencing to keep animals out as they've seen problems with insect pests subside over the years.

ABOVE: *Radiant heat tables with PEX tubing; hand-seeding onions in winter; pinpoint seeder, roller, and green harvester*

SEEDING AND PLANTING

Most direct seeding is done with a Johnny's Four-Row Pinpoint Seeder in concert with a seedbed roller. For larger-seeded crops, the farm uses a Cole Planet Jr. seeder. Transplanting is done by hand or with trowels. The sandy loam soil is very soft and forgiving.

ABOVE: *Tied-up tomatoes with double-leader pruning*

ABOVE: *Growing seedlings and baby greens on tables in one of the farm's hoophouses*

CROP CARE

The farm has more than one-half acre of high tunnels that are 30 feet wide. With each new tunnel they build, the endwalls get better. Currently they have roll-up endwalls, which allow good tractor access. In the winter when the walls are down, they install vertical pipe bracing in the center of the door to help support the wide span in the wind. Two of those tunnels are used as heated greenhouses, one with the PEX bottom heat for propagation and microgreens, and the other with a rarely used forced-air heater that has tables for growing baby greens.

Most of the cultivation on the farm is done with Dutch and collinear hoes, including slicing out crop residue when crops are finished. Plastic mulch helps control weeds on a number of crops: potatoes, celery root, all solanums, cucumbers, and some squash. Some tomatoes are grown under red plastic instead of black plastic. They increasingly use white plastic, rather than black, for soil cooling. The farm has a Farmall Cub cultivating tractor with a Budhing basket weeder, but as the acreage has shrunk and

plants have gone to higher-density spacing, the tractor has become less and less useful, to the point where it is no longer used.

Jeff and Kristin use a stake-and-basket-weave system for tomatoes, but they are experimenting with double-leader pruning. Peppers are also trellised with the basket-weave method but require only low stakes and just two lines to hold them up. For cucumbers the farm uses vertical Hortonova mesh.

The biggest pest on the farm is deer. Deer pressure is increasing and the farm is moving from three-line electric fencing to a permanent fence of plastic deer netting on 7.5-foot posts. They tried stringing multiple rows of high-test fishing line as an interim solution with only temporary success. Bird netting over some crops keeps deer from nibbling.

For insects, Jeff and Kristin spray Bt on fall brassicas to control cabbage looper, their one major insect pest. No row cover is used for insect control, but they do use row cover for frost protection.

HARVESTING

The standard harvest tool on the farm for greens is a retractable box cutter. These are used full length and are replaced when dull. When conditions are just right in the salad

greens, the crew uses a Johnny's Quick Cut Greens Harvester. For herbs, harvest is done with garden snips, and for larger vegetables they use bigger knives of all sorts. All crops are harvested into Rubbermaid totes.

POST-HARVEST

WASHING AND PACKING

The Liberty Gardens wash and pack area includes a walk-in cooler, a three-basin stainless steel sink, and a salad spinner. Bread trays laid over the sinks help with root washing. A big flat packing table in the center of the area holds smaller scales for packing boxes, and a large benchtop scale propped up on a pair of milk crates next to the cooler weighs heavier items.

DELIVERY AND SALES

The farm sells almost entirely to restaurants, with about 30 on the ordering list. Most are in New York City; some are local. Jeff and Kristin deliver for local sales; orders bound for New York are shipped via UPS with delivery by the next day, and the restaurants pay for the shipping.

Success as Liberty Gardens Sees It

I first visited Liberty Gardens in 2010. It was December and quite cold outside, but they had beautiful greens on tables and in the ground in the tunnels. I got a real sense of the farm being well thought out, with simple systems that allowed Kristin and Jeff to farm in a way that supported them and the surrounding land.

I asked Kristin and Jeff to share some of their thoughts on what "success" meant to them, both personally and in the context of their operation. They thoughtfully sat and separately made notes for me, literally on the back of envelopes, and included a number of factors they consider important in cultivating the successes they've had on their farm. Their responses were very similar, probably a good sign for a couple who farms together.

KEYS TO THE FARM'S SUCCESS

- Being professional
- Developing good relationships with customers and good customer service — consistency in product, ordering, billing, paying suppliers
- Maintaining good relationships with employees — paying a high wage, selecting carefully for folks truly wishing to farm, providing incentives for employees to return
- High emphasis on quality and quality control
- Focusing their markets over time and concentrating on the ones that are profitable
- Not limiting themselves to marketing in their immediate area and taking advantage of more distant markets with high demand
- Focusing on high-value products
- Focusing on soil
- Growing multiple crops per bed in a year
- Trying to have sustainable methods that focus on soil replenishment and don't cause burn-out for themselves and the crew
- Taking one full day off per week
- Having family land — reduces costs and reduces stress
- Saving money before starting the farm as a good cushion
- Setting benchmarks and making a five-year plan when starting the farm
- Seeking out mentor farmers
- Continuously conducting research
- Controlling expenses and capital investments
- Using time and space efficiently

WHAT THEY CONSIDER TO BE MEASURES OF SUCCESS

- Satisfaction with work
- Happiness, health, home
- Time for family and nonfarm pursuits
- Earning enough to live on

- Good relationships with other farmers
- Producing quality products
- Happy customers and employees
- Improving their land over time
- Beauty everywhere

KEALAOLA FARM

THE BACKSTORY

The Hawaiian word *keala* means “the path,” and *ola* means “life” — “the path of life.”

BARRY LEVINE

Space in Production: 3.8 acres

Location: Peri-urban — Kealakekua, Hawaii

Crops: Lettuce, other greens, beans, coffee

Markets: Wholesale, direct to restaurants, direct to retail

Year Started: 1990

Before Barry Levine became a farmer, he led bike tours, frequently rolling past miles of small farms and thinking that's where he should be. In the mid-1990s he left bike touring to start a small CSA on the edge of Portland, Oregon, with a friend. While visiting family in Hawaii, he looked at a small lettuce farm for sale near Kona. At 1,200 feet on a slope looking out over the ocean, it was a beautiful spot — the perfect setting in some ways — but the place was too expensive and Barry had to pass. He carried a photo of the farm with him for years afterward. While on another visit to Hawaii, he heard of an older couple looking for a manager for their lettuce farm. It turned out to be the same spot, and in 2004 he took the job, leaving the Oregon CSA to his farming partner at the time.

Barry worked as the manager of the lettuce farm for a few years and then bought out the owners with the help of a new farming partner and took over in full. Having run a sizable CSA in Portland and sold to restaurant, grocery, and wholesale accounts, he liked the simplicity of focusing on one main crop. Simplifying continues to be a major goal for the farm. Available space dictates the size more so than do the markets or Barry's desire to stay small. He makes a living and has time to enjoy island life with his wife and two children. At the beginning of 2015, he bought the farm outright from his farming partner and is now the full owner.

KEALAOLA FARM

MAP

ABOVE: *Double-tap the image to open to fill the screen. Use the two-finger pinch-out method to zoom in. (These features are available on most e-readers.)*

KEY

1. Rental property
2. Baby lettuce terraces
3. Germination tent
4. Barn and processing
5. Tool storage
6. Barry's house

7. Seedling tables
8. Banana orchard
9. Guest yurt
10. Lower coffee
11. Lettuce terraces
12. WWOOFer tents
13. Upper coffee

THE BASICS

Kealaola Farm sits on the Kona side of the Big Island of Hawaii, a small, 5-acre holding on a little road just off the main loop road. Annual rainfall is low and temperatures are consistently warm, but there is seasonal variation, with a cooler, dryer season in the winter and a warmer, wetter season in the summer. The elevation is 1,200 feet, which helps moderate temperatures. The property sits on a significant slope and is terraced to keep the fields flat. The ocean view is beautiful, and hundreds of acres of ranchland lie just to the north.

The farm is certified organic. Lettuce is the main crop; it occupies the majority of the land and provides nearly all of the income. The farm produces at least six crops of lettuce on any given piece of ground over the course of a year, and up to 18 crops of baby lettuce. The farm also grows a few other greens and green beans, but these crops make up a small fraction of the harvest and income. Historically, the area grew coffee, and the farm still has significant plantings that are harvested and sold in the raw cherry stage. Plans for farm expansion involve coffee bean processing, taking the beans to the parchment stage where they can be stored longer and sold at a higher price, but currently coffee is not a significant part of the farm's revenue.

ABOVE: *Looking over a lettuce field toward the packing shed*

What's WWOOF?

World Wide Opportunities on Organic Farms is an international network that connects farm volunteers with organic farms. The organization began in 1971 in the United Kingdom to provide a way for urban residents with no access to land to participate directly in the organic farming movement and to help organic farmers. Over the past four decades, the organization has grown and evolved, retaining the WWOOF acronym but changing the words a number of times.

There are now WWOOF organizations in many countries around the world. Typically, they pair people who want to learn more about organic farming through hands-on work with farmers who are willing to teach them and provide room and board in exchange for their help. The amount of work is about 4 to 6 hours a day; some farms allow short visits but others ask for longer stays of a few weeks to a few months. Learn more at wwoof.net.

CUSTOMERS AND MARKETS

The cousin who encouraged Barry to move to the island is a wholesale distributor on the island; 30 to 45 percent of the crops sell through him. The farm also sells direct to grocery stores and restaurants in the area, but none of the customers are more than 10 miles away.

LABOR

Barry keeps things simple and runs the farm with a rotating crew of six or seven WWOOFers (see above). Most folks stick around for four to five months, working mornings and learning about the farm's production methods, camping on the farm, and sharing meals made from farm produce and fruit. Afternoons are free for relaxing and exploring the island. Some workers stay for several years.

WATER

Kealaola Farm water comes from the county water department and from natural rainfall. Drip tape irrigates the annual crops; everything else relies on rain. The soil is very porous, so during dry times irrigation is a nightly task. An Irritrol controller manages the drip irrigation, cycling through 10 separate zones on the farm to ensure that all of the irrigated sections have enough water pressure.

FERTILITY

For a number of years, the farm made its own compost with local chicken manure, macadamia nut hulls, and other local resources. Many of those feedstocks are no longer available, so now the farm relies solely on a feather meal–based fertilizer, applied by hand at every planting. Ongoing soil tests show that the organic matter and fertility are maintaining good levels despite the farm discontinuing use of compost, perhaps due in

part to the large quantities of potting mix and root material that are incorporated into the beds with so many plantings every year.

KEALAOLA FARM HARVEST AND DISTRIBUTION WINDOWS

	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
Arugula	x	x	x	x	x	x	x	x	x	x	x	x
Basil	x	x	x	x	x	x	x	x	x	x	x	x
Bok choi	x	x	x	x	x	x	x	x	x	x	x	x
Coffee							x	x	x			
Green beans	x	x	x	x	x	x	x	x	x	x	x	x
Kale	x	x	x	x	x	x	x	x	x	x	x	x
Lettuce	x	x	x	x	x	x	x	x	x	x	x	x

ABOVE: *Double-tap the image to open to fill the screen. Use the two-finger pinch-out method to zoom in. (These features are available on most e-readers.)*

ABOVE: *Coffee cherries ripening*

TOOLS AND INFRASTRUCTURE

BED PREPARATION

To prepare beds, all plant materials are first cleared from the beds. Usually this is already done, as the beds are planted after harvesting, but sometimes there's some hand weeding of grasses that still needs to be done. Broadcasting fertilizer follows, and then an old BCS tiller is used to work the beds. The farm has a collection of old BCS tillers ranging from 9 to 13 horsepower. To limit the risk of spreading disease, different tillers are used in different fields on the farm.

Most of the beds are on flat terraces but a few are on slightly sloped ground. To reduce any tendency for the soil to migrate downslope with tilling, soil is pulled up the sloped beds with a rake.

ABOVE: *All of the farm's crops are grown using drip irrigation, and all of the lettuce is transplanted.*

ABOVE: *Seedlings are grown outside, with lightweight PVC frames stretched with bird netting to keep birds off.*

GREENHOUSES AND PROPAGATION

The farm has a good collection of Plastomer hard plastic plug trays for starting seedlings. These are no longer available, but Kealaola's supply is in good shape after more than a decade of heavy use. To fill the trays, the workers lay them out on tables,

dump the soil on top, and use a push broom to move soil over all of the trays, filling the cells. They brush excess soil off the top into a big shop dustpan.

Barry uses Black Gold organic potting mix, amended with some lime and a mix of blood, bone, and kelp meals, a recipe he found in author Steve Solomon's gardening books years ago. When ingredients are unavailable, he has to improvise, one of the downsides of living on a remote island.

Workers seed most of the trays by hand, but the farm has a Plexiglas plate seeder that can speed things up a bit. Barry uses pelleted seed and leaves the seed on the surface of the soil. All of the trays germinate in a tarped area that keeps out most light. After a few days, the trays move out to tables on a big gravel pad. Barry places net cages over the trays to keep birds out, and these are low enough that they don't interfere with watering. No greenhouse or shade house is necessary with their climate.

SEEDING AND PLANTING

All but two of the crops on the farm are transplanted. Arugula is broadcast by hand on the surface of the bed. Beans are hand-seeded into a furrow pulled with a hoe.

To transplant crops, the workers plant the plugs with bare hands, using the drip lines pulled straight to mark the lines.

ABOVE: *A collection of old BCS tillers*

ABOVE: *Packing lettuce*

ABOVE: *A WWOOFer trimming lettuce in the packing shed*

CROP CARE

During the wet season, the lettuce is susceptible to fungal problems, so the farm sprays sulfur using a Stihl backpack fogger, which does a better job of getting full coverage on the undersides of leaves than a regular backpack sprayer. Ironically, a bean borer has become a problem in the coffee and the control is a fungus, so the farm also uses the fogger to spray that fungus through the coffee plantings.

Weekly hoeing controls weeds. Hand weeding is only necessary after harvest, before bed preparation.

HARVESTING

Workers harvest lettuce into laundry baskets using little Japanese hand sickles with serrated blades. Most other crops are hand-picked. The farm uses a motorcycle-type four-wheeler with a trailer to move product from the field. As soon as a load is ready, it's moved immediately into the shade of the washing area.

ABOVE: *The bananas are for the crew; the lettuce is for the customers.*

POST-HARVEST

WASHING AND PACKING

The farm has a barn with one big open side where workers wash and pack the lettuce. Stainless steel sinks and plastic livestock water tanks are available to dunk heads and loose leaves before packing. Until recently, a washing machine with mesh bags spun the loose leaves dry before packing, but when it broke they switched to an Electrolux Greens Machine salad spinner.

Interestingly, there don't seem to be wax boxes available on the island, so all produce is packed in plain cardboard boxes, some with newspaper liners for loose packs and some with pre-bagged lettuce. All lettuce in Hawaii sells by the pound in bags, even regular head lettuce. The farmers also pack loose leaves as a salad mix and mini heads; they deliver bulk mix to some accounts in Rubbermaid totes.

All of the trimmings from the packing shed get loaded back onto the trailer behind the four-wheeler and moved into the coffee to be used as mulch around trunks.

ABOVE: *Loading the trailer with lettuce trimmings to be used for mulch in the coffee plantings*

DELIVERY AND SALES

A minivan transports deliveries, which are all within 10 miles, and sales take place over the phone. Harvest and delivery occur on the same two days each week, so there's no need for refrigeration on the farm.

OFFICE, COMMUNICATION, AND RECORD KEEPING

Kealaola Farm uses QuickBooks for invoicing and bookkeeping.

ABOVE: *Packing the delivery van with cases of lettuce*

LES JARDINS DE LA GRELINETTE

ABOVE: *Loosening a bed with a broadfork, the farm's namesake*

THE BACKSTORY

The broadfork is an essential and appropriate tool for the market garden, allowing deep tillage while preserving the topsoil structure. The tool traces its origins back to the *grelinette* invented in France in the 1960s and is emblematic of the farm's philosophy of manual, efficient, and environmentally sound organic gardening.

JEAN-MARTIN FORTIER AND MAUDE-HÉLÈNE DESROCHES

Space in Production: 1.5 acres

Location: Rural — Saint-Armand, Quebec, Canada

Crops: Mixed vegetables, vegetable plant starts

Markets: CSA, farmers' markets, direct to restaurants

Year Started: 2003

In 2003, after two years of working on farms in the United States and Mexico, Jean-Martin Fortier and Maude-Hélène Desroches returned to Canada to start their own small farm. Initially, they leased a very small piece of ground with a beautiful view, camped out in a tepee, and started growing on just 0.2 acre. Those important first experiences led them to look for their own land, and in 2005 they bought a 10-acre piece with a 40-by-100-foot rabbit house they converted into a family home and storehouse. Out of the mostly wooded 10 acres, they designed and developed 1.5 acres of permanent raised beds, which they thought would be sufficient for making a living from growing vegetables.

The farm they have developed draws on the methods they learned working on or visiting other farms, collaborations with a cohort of local young farmers, and the work of Eliot Coleman. Over the years Jean-Martin and Maude-Hélène have created their own systems, adapting them to their location and personalities and sharing those techniques with other young growers. In 2012, Jean-Martin published *Le jardinier-maraîcher*, a book detailing their techniques and offering advice for other aspiring market gardeners. In 2014, he published an English translation and update, *The Market Gardener*, and spent the winter touring the United States and Canada giving workshops on the techniques in the book. What follows here is a cursory summary of those techniques, but the book contains much, much more detail and I keep finding new gems in it all the time.

LES JARDINS DE LA GRELINETTE

MAP

ABOVE: *Double-tap the image to open to fill the screen. Use the two-finger pinch-out method to zoom in. (These features are available on most e-readers.)*

KEY

1. Gardens
2. Chicken coop
3. Orchard
4. Raspberries
5. Beeyard
6. Hoophouses
7. Greenhouse
8. House
9. Warehouse (washing, processing, storage)
10. Compost piles

THE BASICS

Les Jardins de la Grelinette is a compact farm focused on producing vegetables efficiently, selling them at a profit to the local community, providing a good life for those who work on the farm, and helping to train more farmers to do the same. Jean-Martin and Maude-Hélène intentionally designed the farm to work without four-wheel tractors, keeping their capital expenses lower and maintaining more of a connection with the ground. The farm works toward lower tillage in a permanent bed system in order to build soil structure and fertility as much as possible. This allows them to plant their small space more intensively and rely on hand tools for most of their work.

The farm sits near the U.S.-Canadian border, 60 miles southeast of Montreal and a similar distance north of Burlington, Vermont. The cold climate limits the growing season for the farm, and while there is some season extension, the winter months are quieter; harvests start in earnest in June and run through October.

CUSTOMERS AND MARKETS

The farm sells produce at two farmers' markets, both about an hour and a half away, one near the urban center of Montreal and the other in an area popular for summer holidays. Both locations are also used for CSA share pickups, along with a third site closer to the farm. Les Jardins de la Grelinette also sells salad mix to area restaurants and retailers.

Chard covered with insect netting and hoops next to beds of head lettuce

LABOR

The farm is run by Jean-Martin and Maude-Hélène with the help of two full-time staff members during the growing season. It also hosts interns for four-week immersions during which they live on the farm and learn about production through training and hands-on work. The interns are not paid and are not considered a part of the labor force. The program focuses on teaching the farm's methods, not on gaining extra farm labor.

WATER

Jean-Martin worked with irrigation specialists to design a system that irrigates out of a pond dug on the property. Water is pumped through a filter system and runs to all of the field sections through buried pipe, with hydrants that have cam-lock fittings for quick changes. The farm has developed a flexible system using 1-inch polyethylene hose to feed four low-pressure sprinklers on movable stakes. Two lines can water a full section. Most of the crops are watered with sprinklers, but the farmers also use drip tape on

crops planted on plastic mulch. Water for the packing and washing shed comes from a domestic well.

FERTILITY

Compost is the cornerstone of the soil-building program at Les Jardins de la Grelinette. The farm purchases quality compost and poultry manure to feed the soil and crops. Compost is applied at a rate of up to 36 tons per acre, but crops rotate through fields based on how much fertility they need; hence, some parts of the rotation get no added compost or chicken manure. Soil tests are used to help monitor fertility over time and to create targets for application rates. Lime applications help raise the pH of the slightly acidic soil.

Crop rotations and cover crops play a big part in the fertility program at the farm. The farmers have worked out a 10-year crop rotation for their fields that alternates heavy feeders with light feeders. Most ground is heavily cropped, with occasional gaps where cover crops can fit in. Cover crops are also in place in the late fall, through the winter, and in early spring when snowmelt and saturated soils could otherwise cause erosion and leaching.

LES JARDINS DE LA GRELINETTE HARVEST AND DISTRIBUTION WINDOWS

	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
Arugula						x x	x x	x x	x x	x x	x	
Basil						x	x x	x x	x x	x x		
Beans						x	x x	x x	x x	x		
Broccoli						x x	x x		x x	x x	x	
Carrots							x x	x x	x x	x x		
Cauliflower						x x	x		x	x x		
Cherry tomatoes							x x	x x	x x	x x	x	
Eggplant							x x	x x	x x	x x	x	
Garlic							x	x x	x x	x x	x	
Green onions						x	x x	x		x x	x	
Greenhouse cucumbers						x x	x x	x x	x x	x		
Greenhouse tomatoes						x	x x	x x	x x	x x		
Ground cherries							x	x x	x x	x x	x	
Kale						x	x x	x x	x x	x x		
Kohlrabi						x x	x		x	x x		
Leeks							x	x x	x x	x x		
Lettuce						x x	x x	x x	x x	x x		
Melon							x	x x	x x	x x		
Mesclun mix					x x	x x	x x	x x	x x	x x	x x	x
Onions								x x	x x	x x	x x	
Peas						x x	x x	x x	x x	x x	x	
Peppers							x	x x	x x	x		
Radishes						x x	x x	x x	x x	x x	x	
Spinach						x x	x		x	x x	x	
Summer squash						x x	x x	x x	x x	x x	x	
Swiss chard							x x	x x	x x	x x		
Turnips						x x	x x	x x	x x	x x	x	

ABOVE: *Double-tap the image to open to fill the screen. Use the two-finger pinch-out method to zoom in. (These features are available on most e-readers.)*

ABOVE: **Top:** *Jean-Martin wheel-hoeing paths in the hoophouse;* **Middle:** *Cultivating between rows using a stirrup hoe*

TOOLS AND INFRASTRUCTURE

BED PREPARATION

As mentioned, the farm is designed to operate easily without four-wheel tractors. Bed preparation relies on a BCS two-wheel tractor with three main implements: a flail mower, a rotary plow, and a power harrow. Beds have 30-inch tops and 18-inch pathways. Bed preparation includes flail-mowing any plant material on the bed top, then running the rotary plow through the pathways to throw soil on top of the bed and re-raise the beds. To minimize tillage, a silage tarp covers the beds for a couple of weeks to let the plant material break down and allow weed seeds to germinate and die. The power harrow then stirs the surface to incorporate amendments, making the bed ready for transplanting or direct seeding.

A broadfork (the *grelinette*) deeply loosens the soil when needed, going well below the surface and incorporating more pore space for air, water, and roots to penetrate. The farmers intentionally do not use a rototiller in order to maintain more soil structure and ecology.

GREENHOUSES AND PROPAGATION

Quebec has very cold winters and a relatively short growing season, so the farm relies heavily on transplants. To limit heating and labor expenses, they have several clever tricks. The very earliest seedings germinate in the house, in a little curtained-off space with south-facing windows for good light. With baseboard heaters, the space is comfortable for both the plants and the people tending them. Seeds that need extra warmth for germination are placed on electric heat mats. Misters on a timer maintain the humidity, and a small fan keeps air flowing around the plants. To supplement the short day length, the plants receive extra light from fluorescent lamps hung just inches above the leaves.

When the house starts to get too full, the farmers move the nursery out to one of the hoophouses and turn on the high-efficiency forced-air propane heater. They use the same hoophouses for in-ground production and plant propagation, so the houses are oversized for just starting seedlings. To conserve energy, the seedling space is closed off from the rest of the hoophouse with a curtain of greenhouse poly, clipped to the hoops. They can move the curtain to enlarge the heated space as they seed more flats.

Skirts hung around the seedling tables keep cold air from directly contacting the tray bottoms. Ventilation and cooling are manual, with roll-up sides on the houses.

Because the seedlings are so valuable to the farm, there are several backup systems. An alarm on the hoophouse warns if temperatures get too high or too low inside. A smaller backup heater in the hoophouse is available if the first one fails on a freezing night. On very cold nights, seedlings get a layer of floating row cover to keep them warm. Later in the spring, when all threat of frost is past and nighttime temperatures are warm enough, all of the seedlings move out of the hoophouses to make space for crops to be planted in the ground inside the tunnels.

The farm prepares its own potting mix in a wheelbarrow, using a recipe that includes peat, compost, garden soil, perlite, blood meal, and lime, sifted through 0.5-inch mesh to keep out rocks and larger debris. Seeds are started in 1020 plug trays, in the 128- and 72-cell sizes. Summer crops that need potting up go into 4-inch pots. To seed the 1020 trays, the farm built a plate-type vacuum seeder, which is used for some of the larger seedings; the rest the farmers seed by hand.

All watering is done by hand with a water breaker on a hose. Because the water coming from the well is quite cold, they hold it in a 265-gallon tank in the hoophouse, painted black and equipped with a pool pump and pressure tank. This ensures that the water given to seedlings doesn’t shock them in the winter.

ABOVE: **Top:** *Seedlings still occupying hoophouse space as the first crops are growing in the ground to the left.* **Bottom:** *Mowing with the BCS tractor and a flail mower*

SPREADING AMENDMENTS

Compost is spread by dumping wheelbarrow loads in even intervals down the bed and raking out the material evenly over the surface. Similarly, lime and other amendments are spread by hand before the farmers incorporate it all with the power harrow.

The farm also has a FertiGator to inject soluble materials into the irrigation system. This is used to add calcium to pepper plantings to prevent blossom end rot and sunburn.

SEEDING AND PLANTING

For direct seeding, the farm has a fleet of implements. For larger seeds such as beans, peas, radishes, spinach, and beets, an Earthway seeder fills the bill. For small-seeded crops (like carrots) planted with wider row spacing, a Glaser single-row seeder works well. For high-density seeding of small seeds (like salad mix), they use a six-row seeder from Johnny's in Maine.

For transplanting and wider rows of direct seeding, the farmers mark planting rows in advance using a bed-preparation rake with short plastic tubes slipped over the appropriate tines. This ensures straight, evenly spaced rows. Transplanting is done by hand and the spacing is set in the row with a ruler.

ABOVE: *Seeding with a Jang JP-1 Clean Seeder*

ABOVE: *A broadfork, the farm's namesake*

CROP CARE

Les Jardins de la Grelinette takes several approaches to weed control. The farm uses a five-burner rolling flame weeder to knock down weeds after seeding carrots, beets and parsnips, before those seeds germinate. The farm also employs Glaser stirrup hoes, 3.5- and 5-inch versions, depending on crop spacing, and Glaser collinear hoes to reach in under leaves. Wheel hoes from Glaser and Hoss with a 12-inch oscillating blade cultivate pathways and crops grown on a single row. To keep the hoes sharp and efficient, the farmers tune them up weekly using an electric grinder and then keep them sharp in the field with a Speedy Sharp carbide.

For crops that appreciate more heat and are on wide spacing, such as tomatoes, peppers, zucchini, and melons, plastic mulches are used to suppress weeds. The farm uses landscape fabric, biodegradable plastic film, and strips of silage tarps that are white on one side and black on the other. The biodegradable plastic film, made from non-GMO cornstarch, can be turned into the ground at the end of the season. The landscape fabric is reusable, as are the silage tarps. The silage tarp strips work well for greenhouse tomatoes with the white side up. This reflects more light back to the tomato plants.

The farmers actively promote biodiversity for pest and disease control with beneficial habitats planted all around the farm. They take quick daily walks to scout for problems, something that is easier with a compact farm. Seed selection and creating a good growing environment are also important control tactics.

If the farmers find plants with bacterial diseases, they carefully remove them to the trash. To suppress fungal diseases, they alternate spraying copper and sulfur using a Solo backpack sprayer.

For specific insect problems, the farm uses insect netting on many crops. Btk (*Bacillus thuringiensis* var. *kurstaki*), a bacterial control for some insects, is occasionally used, as are several organically acceptable insecticides: insecticidal soap, orthophosphate, and spinosad. A chart in *The Market Gardener* details the farm's preferred and effective methods by pest.

WINTER CARE

Jean-Martin and Maude-Hélène do take winters off, as they enjoy the break, but they still use some season-extending techniques, such as 0.55-ounce row cover in spring and 1-ounce row cover for heavier frosts in the fall. In early spring, they place the row cover directly on the ground for direct-seeded crops, and for transplanted crops they lay the row cover over hoops made with 9-gauge wire to keep the cover up off the tender

transplants. For taller crops, they use hoops made from flexible PVC; when snow is possible, they use stronger hoops made from metal conduit. Soil from the pathways and sandbags at the base of the hoops hold down the row cover. When not in use, the row cover is stored in old grain sacks labeled with the length and width and condition, which keeps it in good shape and makes it easier to find when needed.

Temporary caterpillar tunnels that span two beds provide even more warmth. The farmers make the tunnels by pounding rebar stakes into the ground and then slipping 20-foot sections of 1.5-inch PVC over the stakes. Rope serves as a purlin and is staked out at the ends of the tunnels. Old greenhouse plastic covers the tunnels, held down with a combination of rope tied to stakes and sandbags. The sides can be vented by sliding the plastic up under the ropes. These tunnels are tall enough to work inside, though a bit cramped for taller people.

There are also two permanent hoophouses with roll-up sides and big doors. These houses are 30 by 100 feet and have a different rotation of crops than the field blocks do.

ABOVE: *Simple caterpillar tunnels, which are used to provide extra heat but can easily be vented by pulling up the sides*

ABOVE: *Silage tarps, part of the bed preparation system at the farm*

ABOVE: *Insect netting covering crops*

HARVESTING

A garden cart helps facilitate harvests, outfitted with an umbrella for shade and a tool box attached to the side to carry knives and other necessities such as bands. On especially hot days, the crew covers the bins in the cart with a wet wool blanket to keep the crops cool while they are waiting to be wheeled from the field to the packing shed.

After lots of experimentation, the farmers are still looking for the perfect bin for harvesting most crops. Greenhouse tomatoes go into flats, loaded on a special dolly that rolls between the rows. For summer squash, tree-planting bags of heavy canvas are utilized, allowing workers to carry the heavy squash ergonomically as they harvest.

Salad greens are cut using a harvester, powered by a cordless drill, that was developed by Farmer's Friend LLC. For large crops such as broccoli, cauliflower, and lettuce, the harvest crew uses field knives; for cutting other crops, they like the small, comfortable, easy-to-sharpen Opinel #10 pocket knives. The Speedy Sharp carbide sharpener keeps knives sharp in the field.

POST-HARVEST

WASHING AND PACKING

Most crops aren't stored for more than a day before distribution, but cooling the harvested crops quickly and thoroughly helps improve the quality and storage life. The farm has tubs for dunking produce to cool it, and spray water for cleaning produce is used in some situations. The 8-by-16-foot walk-in cooler is set to a temperature between 36 and 39°F. Crops are harvested the day before deliveries to allow them time to cool sufficiently. Most crops are stored in bins but some go in poly bags.

To learn more about the farm's specific harvest approaches, by crop, see Jean-Martin's book, *The Market Gardener*.

DELIVERY AND SALES

Les Jardins de la Grelinette has a GMC Savana van that makes deliveries and travels to markets three times a week. The van has been converted to run on straight vegetable oil.

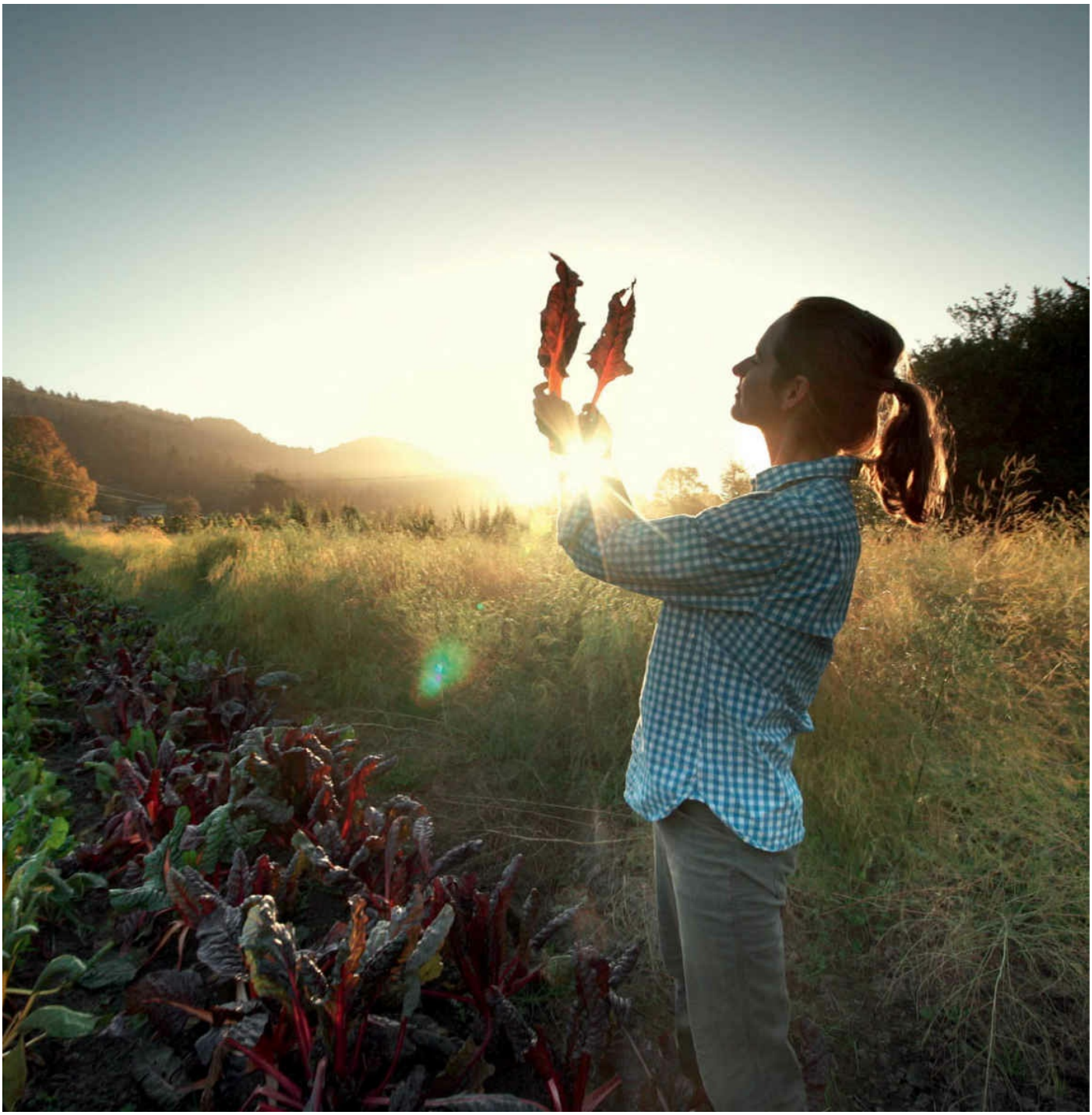
OFFICE, COMMUNICATION, AND RECORD KEEPING

Record keeping and planning are an essential part of the farm operation. Jean-Martin and Maude-Hélène have developed simple but effective low-tech approaches to keeping

track of, and using, a lot of information. They make farm plans while it's still snowing to reduce decision-making time when it's busy in the summer. They use a large At-a-Glance calendar to create a crop plan each winter with all of the details for the next season. They also make detailed field maps for planning succession cropping and rotations.

During the season, records for each crop go in a loose-leaf binder that is organized by crop. The couple also keeps information for planning the next season in the same binder, where it can be easily found and incorporated into the next season's plan.

GROUNDSWELL FARM



THE BACKSTORY

A double entendre: “ground’s well” to describe the soil from which it all springs forth; and “groundswell,” as in the gathering of force and opinion that drives social

and political movements.

ZOË BRADBURY

Space in Production: 2.5 acres vegetables, berries, and flowers; 1.5 acres orchard

Location: Rural — Langlois, Oregon

Crops: Mixed vegetables, fruit, some culinary herbs, cut flowers

Markets: CSA, farmstand and u-pick, restaurants and stores

Year Started: 2008

In the late 1990s, Zoë Bradbury and her sister, Abby, tried to start a pesto farm on land owned by their mother, Betsy, on the south coast of Oregon, where they grew up. The garlic they planted rotted, so that idea was a bust, but Abby kept at it, starting a salad greens business instead while Zoë found work on farms in other parts of the country. In 2008, Zoë finally returned to Langlois to start a small farm on Betsy's land. Zoë now farms alongside her sister's very successful (and still very small) salad greens business and her mother's complementary greenhouse vegetable production business.

Zoë returned home with visions of farming with horses, developing a CSA, and working with her sister to expand fruit production on the property. Although the three have each maintained their own businesses and production systems, they work like a producer cooperative, marketing their produce under one common name, Valley Flora. The trio handle orders, sales, and deliveries collectively and share other resources, such as the tractor, as well.

The three of them try to avoid any overlap in product. Zoë grows the widest diversity of crops and has the largest production area, concentrating on a broad variety of main-season vegetables, roots, bunching greens, u-pick berries, and cut flowers. Abby continues with salad greens in the summer. Betsy grows tomatoes, peppers, and

other high-value greenhouse crops in the summer, plus salad greens in tunnels in the winter.

GROUNDSWELL FARM

MAP

ABOVE: *Double-tap the image to open to fill the screen. Use the two-finger pinch-out method to zoom in. (These features are available on most e-readers.)*

KEY

1. Tool storage and farmstand
2. Berries
3. Annual row crops (220' beds)
4. Perennialized space
5. 85' bed

6. The Panhandle (original farm)
7. Packing shed
8. Betsy's tunnels
9. Propagation house
10. Tunnels
11. Orchard (includes grapes and kiwis)
12. The New Nine (cover crop)

THE BASICS

Groundswell Farm is a mixed-power farm, using both tractors and horse power. It's located on the south coast of Oregon, just outside the tiny town of Langlois, and sells in communities up and down the coast in an area with very few farms marketing produce directly to consumers. The farm delivers as far south as Gold Beach and into Coos Bay to the north, each about 40 miles away.

Groundswell Farm cultivates about 4 acres of Betsy's much larger property. Maude, the farm's Belgian draft horse, is pastured on an adjoining property. Zoë lives just a few miles away in the small town of Langlois with her husband and two young daughters. Betsy lives on the farm, growing her produce in hoophouses adjoining the fields she leases to Zoë and Abby.

CUSTOMERS AND MARKETS

All of Groundswell's produce is sold under the Valley Flora name, along with Abby's and Betsy's produce. Groundswell Farm produces 110 CSA shares for families. Through partnerships with other businesses, Zoë also offers add-ons to the shares — salad from her sister's operation, eggs from a neighboring farm, and frozen tamales from a local restaurant. Groundswell also sells produce to more than a dozen restaurants and stores in the same area.

During the spring harvest season, Valley Flora sets up a self-service u-pick and farmstand, and Zoë and her crew intentionally disappear from that part of the farm during the open hours so they won't be distracted by the customers. Until recently they were able to rely on good signage to provide directions to customers. Traffic at the farmstand has grown so much that they now have one person staff the stand and u-pick, starting in June and continuing through December. The farm also sells plant starts for

local vegetable gardeners, through the farmstand and the local farm supply store in Langlois.

LABOR

Zoë runs her operation with a full-time year-round foreman, Roberto, who has been with the farm for five years. In the summer, she hires two part-time people to help with harvests and deliveries.

WATER

The farm pumps irrigation water from Floras Creek, which runs just past the farm. Every few winters the creek jumps its banks, flooding the fields. An electric pump is put into place seasonally for summer irrigation with buried distribution lines through the field and valves and hydrants in underground control boxes. The buried hydrants make it easier to mow without breaking risers, while still having access to water in all parts of the field. The farm uses a combination of drip tape and aluminum hand line with sprinklers, depending on crop needs.

Water used for washing in the barn comes from a spring and a gravity-fed domestic system.

ABOVE: *Aluminum hand line with impact sprinklers. The lightweight pipes are 40-foot lengths but are easy to move around the fields.*

ABOVE: *Abby's Greens shares land and resources and also markets collaboratively with Groundswell.*

FERTILITY

The farm relies on a combination of cover crops, compost, and amendments to improve the soil and keep the fertility high. Soil tests are made annually in February and determine the application rates of a mix of bone meal, kelp, lime, and gypsum. Compost comes from a local lambing operation and is applied in the spring at a rate of about 6 to 8 tons per acre.

For winter cover crops, the farm uses a mix of oats, cereal rye, vetch, field peas, and clover, seeded in the fall. Sections to be seeded very late in the fall receive annual

ryegrass instead of the mix. The annual ryegrass has better cool-soil germination and growth in the reduced light of late fall and early winter. Where there is space to get a summer cover crop, the farm uses either buckwheat or Sudan grass. The buckwheat is very quick and is used where there is a short window; the Sudan fills longer gaps in plantings.

A pelleted blend of blood meal and feather meal is side-dressed after planting to add supplemental nitrogen.

GROUNDSWELL FARM HARVEST AND DISTRIBUTION WINDOWS

	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
Artichoke			x x	x x	x x	x x	x x	x x	x x	x x	x x	x
Asparagus				x x	x x	x						
Beets						x x	x x	x x	x x	x x	x x	x
Broccoli					x	x x	x x	x	x	x x	x	
Brussels sprouts											x x	x
Cabbage						x	x x	x x	x x	x x	x x	x
Caneberries						x x	x x	x x				
Carrots					x	x x	x x	x x	x x	x x	x x	x
Cauliflower							x x	x x		x x	x x	
Celeriac											x x	x
Celery									x x	x x	x x	
Chard		x x	x x	x x	x x	x x	x x	x x	x x	x x	x x	x
Choi						x x				x x	x	
Cut flowers						x	x x	x x	x x	x		
Eggplant								x x	x x			
Escarole/radicchio										x x	x x	x
Favas							x					
Fennel						x x	x x	x x	x x	x x	x	
Herbs		x	x x	x x	x x	x x	x x	x x	x x	x x	x x	x
Kale/collards		x x	x x	x x	x x	x x	x x	x x	x x	x x	x x	x
Kohlrabi						x x	x			x	x x	x
Leeks									x x	x x	x x	x
Lettuce					x x	x x	x x	x x	x x	x x	x x	
Onions/shallots			x x	x x		x	x x	x x	x x	x x	x x	x
Parsnips											x x	x
Potatoes			x x	x x				x x	x x	x x	x x	x
Radishes/turnips					x x	x x	x			x x	x x	
Rhubarb						x	x x	x x				
Snap peas					x	x x	x					
Strawberries						x x	x x	x x	x x	x		
Sweet corn								x x	x x	x		
Winter squash		x x	x x						x x	x x	x x	x

ABOVE: *Double-tap the image to open to fill the screen. Use the two-finger pinch-out method to zoom in. (These features are available on most e-readers.)*

TOOLS AND INFRASTRUCTURE

BED PREPARATION

The primary tool for bed preparation is a 54-inch rototiller mounted on a 32-horsepower Kubota utility tractor. If there is a lot of plant material in the field, the field is mowed with a brush mower on the tractor first, but otherwise they go into the field directly with the rototiller, using it to break up the soil and incorporate plant material.

For the very early-season crops, when the soil is cool and biology is slow to break down the incorporated materials, field preparation starts as much as 6 to 8 weeks before planting. As the soil warms up, bed preparation starts as late as 4 weeks before planting. Typically, the rototiller makes two or three passes, spread out over those weeks, and then comes through in a final pass, followed by the tractor driving over the tilled ground to mark the pathways with the wheels. The compressed tire tracks are 42 inches apart on center and about a foot wide, leaving a 30-inch bed top.

If the ground is too wet for the rototiller, which is typical in the early spring, Zoë can get into the field with Maude, her draft horse, and a disk. The disk opens up the ground, chops in some of the plant material, and helps the soil dry out for the next rototiller pass a week or two later.

GREENHOUSES AND PROPAGATION

The farm grows its own seedlings. Zoë started with a 20-by-40-foot tunnel with inflated double-layer plastic. She has since added 25 feet to the tunnel, but she left the original endwall in place and covered the extra 25 feet with single-layer plastic to make a cooler space for hardening off seedlings.

All of the greenhouse space has 4-by-8-foot tables with plastic greenhouse bench tops on wood frames. The farm has one 4-by-32-foot germination table with PVC pipe buried in a sand bed. The pipe connects to a propane water heater; a sensor monitors the temperature of the soil in the seedling trays sitting on the sand bed and circulates hot water to warm them when they are cool. There is no other supplemental heat in the greenhouse; Zoë ventilates by opening and closing the doors. In the summer when doors aren't needed, she removes the plastic covering the doors but the doors remain, covered with chicken wire to keep out animals. When she needs extra air circulation, she hooks up a box fan to help move air.

The greenhouse has an automatic watering system, but Zoë prefers to water by hand with a hose and water breaker. When the greenhouse is at its peak capacity in the spring and there are many different-size pots and plug trays, all with different watering needs, it is easier for her to water them by hand. Later in the year when there's more work in the fields and more of the plants are in similarly sized plug trays, she turns on the automatic water.

Zoë uses a wide variety of plug tray sizes and small pots. She has a small collection of Winstrip trays, but she also uses cheaper versions when she runs short. She uses 128-, 98-, 72-, and 36-cell trays and 2- and 4-inch pots for potting up. She fills the trays with Black Gold organic potting mix with coir (coconut fiber), adding Nutri-Rich organic fertilizer.

ABOVE: *One of Betsy's tunnels with ripening peppers*

SPREADING AMENDMENTS

Groundswell Farm spreads the bulk of amendments in the early spring, using an old cone spreader on the back of the tractor. The farm has an Allis-Chalmers Model G converted to electric that runs on golf-cart batteries. The farmers spread compost by loading it into

a trailer and then pulling it slowly through the field, either with the Allis-Chalmers cultivating tractor or with Maude. As the trailer moves, compost is shoveled out of the trailer to cover the field evenly.

For side dressing, Roberto modified a feed sack, inserting a length of PVC pipe into a hole in the bottom corner and adding some straps for carrying. Metering out the material is controlled by feel, but they fill the bag with one bed's worth of material at a time to make sure the correct amount is applied.

SEEDING AND PLANTING

The farm uses Corona transplanting trowels for transplanting; spacing is primarily set by sight and experience. Measures on the trowel can be used to double-check spacings. Spacing depends on the crop: 4, 6, 8, 12, or 24 inches and one, two, or three lines per bed. Impressively, the farm can space this closely and still cultivate with a tractor.

For direct-seeded crops, Groundswell primarily uses an Earthway seeder, but for carrots they prefer to use their Jang JP-1 Clean Seeder. An Earthway bag-type broadcast spreader seeds cover crops. After spreading cover crop seed, Zoë pulls a Cultipacker ring roller through the field with Maude to press the seed into the soil for better germination.

ABOVE: *A Winstrip tray with basil seedlings, sitting on one of Zoë's greenhouse tables, farm-built with wood frames and plastic tops*

CROP CARE

Weed-control measures include a cultivating tractor, horse-drawn cultivation, hoes, and flame weeding, as well as mulch in the perennial crops and berries. The farm uses the Allis-Chalmers tractor for cultivating one- and two-row crops and has a selection of different tools, including a basic set of sweeps, hilling disks, and a Lely rake. For single-row crops, Maude pulls an antique walk-behind cultivator with adjustable width.

The farm also employs a Glaser wheel hoe, hula hoes, and Japanese scrapers when necessary. For slow-germinating root crops such as carrots, the farm uses a single-burner flame weeder with a 5-gallon propane tank carried in an old backpack.

For weed control in fall-planted strawberries the farm uses woven weed mat with holes burned in at the proper spacing. The berries come out the following fall, but the weed mat can be picked up, cleaned, and reused for many years. Cane berries are mulched with compost covered by sawdust.

The primary pest-control tool is floating row cover, employed for flea beetle, cabbage maggot, and rust fly. Scoops of soil hold down the edges of the row cover; coastal winds complicate the use of hoops with row cover, so they are only used when absolutely necessary.

Cucurbit seedlings get a dip in kaolin clay before being planted out in order to deter cucumber beetles.

Berries are an important crop for the farm and the spotted wing drosophila has recently become a significant pest. Groundswell doesn't spray for spotted wing, finding it not worth the time and expense. Instead, they rely on rigorous sanitation to prevent problems, keeping the field picked clean and getting all old berries out of the field.

The only Groundswell crop that needs trellising is snap peas, since Betsy's operation grows most of the typically trellised crops for Valley Flora. The peas grow on 8-foot T-posts with earth anchors at the ends of the rows. Wire runs along the top and bottom and twine zigzags between the wires. Horizontal runs of twine provide extra support when needed.

The farm's coastal location keeps it cool through the summer, so to help create a warmer environment for watermelon and eggplant Groundswell uses chenilles, low tunnels covered with lengths of greenhouse poly secured by ropes and easily vented. The chenilles, over hoops of 0.5-inch EMT conduit, straddle two beds at a time.

ABOVE: *Chenilles are used for watermelons and eggplants, which need a little extra heat in the cool coastal climate.*

HARVESTING

Rubbermaid totes are the primary harvest containers. Most are the 18-gallon size but there are some 10- and 14-gallon versions. Crops that don't need to be covered to maintain humidity in the cooler go into vented Ropak stack-and-nest yellow lugs. A broccoli harvesting backpack from Vegetable Growers Supply in California allows more ergonomic harvesting of some crops. For harvest knives, the farmers use short-hooked grape knives and larger lettuce field knives.

For transporting bins around the field, the farm has a custom farm cart, with a flat bed that straddles the beds, and a garden cart. For strawberry harvest, little wire carts hold a strawberry flat up off the ground and roll along with the picker. The packing barn is slightly down the road from the fields, so an old Toyota pickup moves the harvested produce to the barn.

ABOVE: *A simple wire cart with a wheel makes it easy to roll the flats along the pathway as the berries are harvested.*

POST-HARVEST

WASHING AND PACKING

Zoë started out washing in the shade of a tree on the edge of the fields and packing in a shared space with her mom and sister, but she quickly grew out of that space. In 2010, she built her own barn with a walk-in cooler, washing and packing space, and lots of storage. The cooler is 11 by 12 feet; two dry rooms — one 6 by 12 feet and one 10 by 12 feet — are rodent proofed and insulated with dehumidifiers. The smaller room is on a concrete slab and shares a wall with the cooler, so it is cooler and damper; the other is on the south side of the barn and is a little warmer and drier, great for winter squash.

The main washing area is on a concrete slab and has a long stainless steel table for washing roots. There's a repurposed bathtub for dunking greens and lettuces and there are multiple hoses with pistol-grip sprayers on industrial-strength hoses. The water pressure is very high, which is great for roots, but a lower-flow pre-rinse restaurant-type sink sprayer hanging above the wash table is gentler on leaves.

The barn also has storage space for the tractor and all of the boxes and bins.

ABOVE: *Roberto, Zoë's right-hand man, cleaning harvest totes*

DELIVERY AND SALES

Zoë, Abby, and Betsy all hire a delivery driver for Valley Flora. Betsy sets up the farmstand twice a week, and Zoë just has to make sure that boxes are packed and clearly marked in the cooler and dry spaces on the night before deliveries and market days.

OFFICE, COMMUNICATION, AND RECORD KEEPING

Zoë uses QuickBooks to keep track of all farm expenses. The farm has a website, based on the Drupal platform, set up by a local information technology professional. He also helped train Zoë on the website and answered questions for the first few years, but now she is able to make most of the changes she needs on her own. All CSA sales are handled through the website. She uses MailChimp to send out a weekly CSA newsletter and other CSA communications, and a weekly fresh sheet to the restaurant accounts.

The farm accepts SNAP (Supplemental Nutrition Assistance Program) benefits for both the farmstand and CSA members. There isn't a good Internet connection at the farm, so Zoë takes care of these tasks through prepared vouchers in her home office.

ABOVE: *Groundswell sells under the name Valley Flora and sets up a farmstand at the edge of the fields twice a week.*

MELLOWFIELDS URBAN FARM

THE BACKSTORY

In regard to soil, *mellow* indicates a soft, loamy consistency; in regard to fruit, it means tender and sweet. The name stands as a reminder to the farmers of where they want to be, connecting healthy soil with healthy food in an urban setting.

KEVIN PRATHER AND JESSI ASMUSSEN

Space in Production: 3 acres

Location: Urban and peri-urban — Lawrence, Kansas

Crops: Mixed vegetables, culinary herbs, and a few berries

Markets: CSA and farmers' market

Year Started: 2009

Jessi Asmussen and Kevin Prather started gardening together after college and got a little carried away. They continued to garden while following other career paths for a few years, during which they both found summer jobs on farms where they learned more about food production. After a couple of summers working on other people's farms, they started farming a collection of urban yards, at one point spreading out their production over five separate sites. In 2009, they started marketing their produce with a very small 10-member CSA and at a small neighborhood farmers' market.

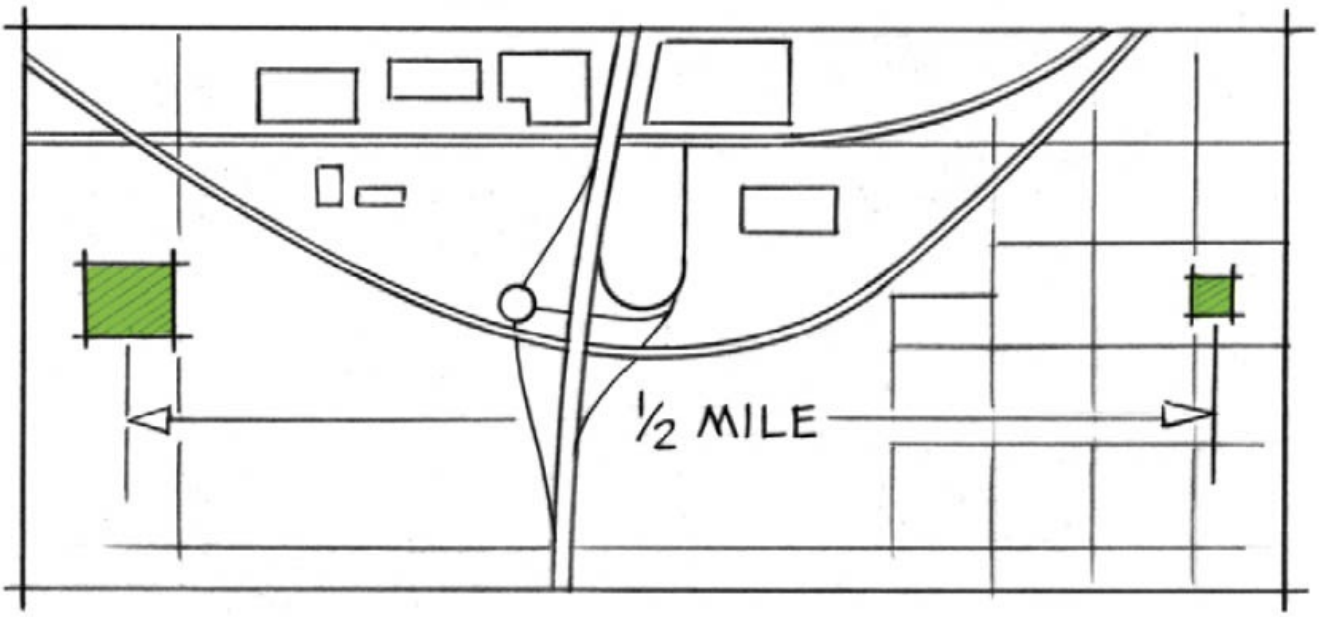
Jessi left a career in social work in 2010, and in 2013, Kevin left his job as a middle school teacher when they managed to work out a lease with the new Common

Ground Program in Lawrence. According to the City of Lawrence website, this was a city initiative to “transform vacant or under-utilized city properties into vibrant sites of healthy food production.” The leased site is a little more than 2 acres, and it is five minutes from their home — where they also have another half acre to grow crops. Since 2013, they have both worked full-time on the farm and provide all of its labor themselves.

The Common Ground Program gives the couple a three-year rolling lease for $1 per acre per year. The arrangement allows them to make some investments in the soil and infrastructure without fear of losing access to the land in the short term. In exchange, the city spends fewer resources mowing and maintaining the property, and a source of local produce is available to the community. Mellowfields is actually part of a 5-acre property shared with several other smaller urban farms.

MELLOWFIELDS URBAN FARM

MAP



ABOVE: *Double-tap the image to open to fill the screen. Use the two-finger pinch-out method to zoom in. (These features are available on most e-readers.)*

KEY

1. Hoophouse

2. Walk-in cooler
3. Garage
4. House
5. Mixed fields
6. Common Ground Fields (leased site)

THE BASICS

Mellowfields is an urban farm inside the city limits of Lawrence, Kansas, growing mixed vegetables, herbs, and a few berries. Because Mellowfields is relatively young and has good access to land, the couple has been able to grow larger quantities of some less-intensive crops such as potatoes, corn, and winter squash that aren't usually grown on compact farms. As Jessi and Kevin increase their labor force and customer base, they intend to shift their focus to the more intensive and profitable crops.

CUSTOMERS AND MARKETS

Mellowfields Urban Farm sells produce through two main channels, a CSA and farmers' markets, with a small portion going to local restaurants and grocers. The farm grows a wide variety of annual vegetables and fruits to give its CSA members a good selection through the season. Its strongest and most reliable crops are chard, kale, various roots, summer squash, and winter squash.

The CSA runs from May through October and constitutes about 25 percent of sales. In the past, Jessi and Kevin started selling at markets as early as March with overwintered produce, finishing in mid-December with a holiday market. In 2015, they decided to start harvesting later in the spring to give themselves more time to prepare their fields and take advantage of the heavier traffic at spring markets.

LABOR

Until 2015, Jessi and Kevin ran Mellowfields by themselves. In 2015, they increased the number of CSA shares to help pay for a part-time worker, in hopes that they'd be able to stay on top of everything a little more effectively, have more time for their child, and maybe even take an occasional Sunday off. By the end of that summer, they saw a nearly 40 percent increase in market sales as a result of adding harvest labor.

WATER

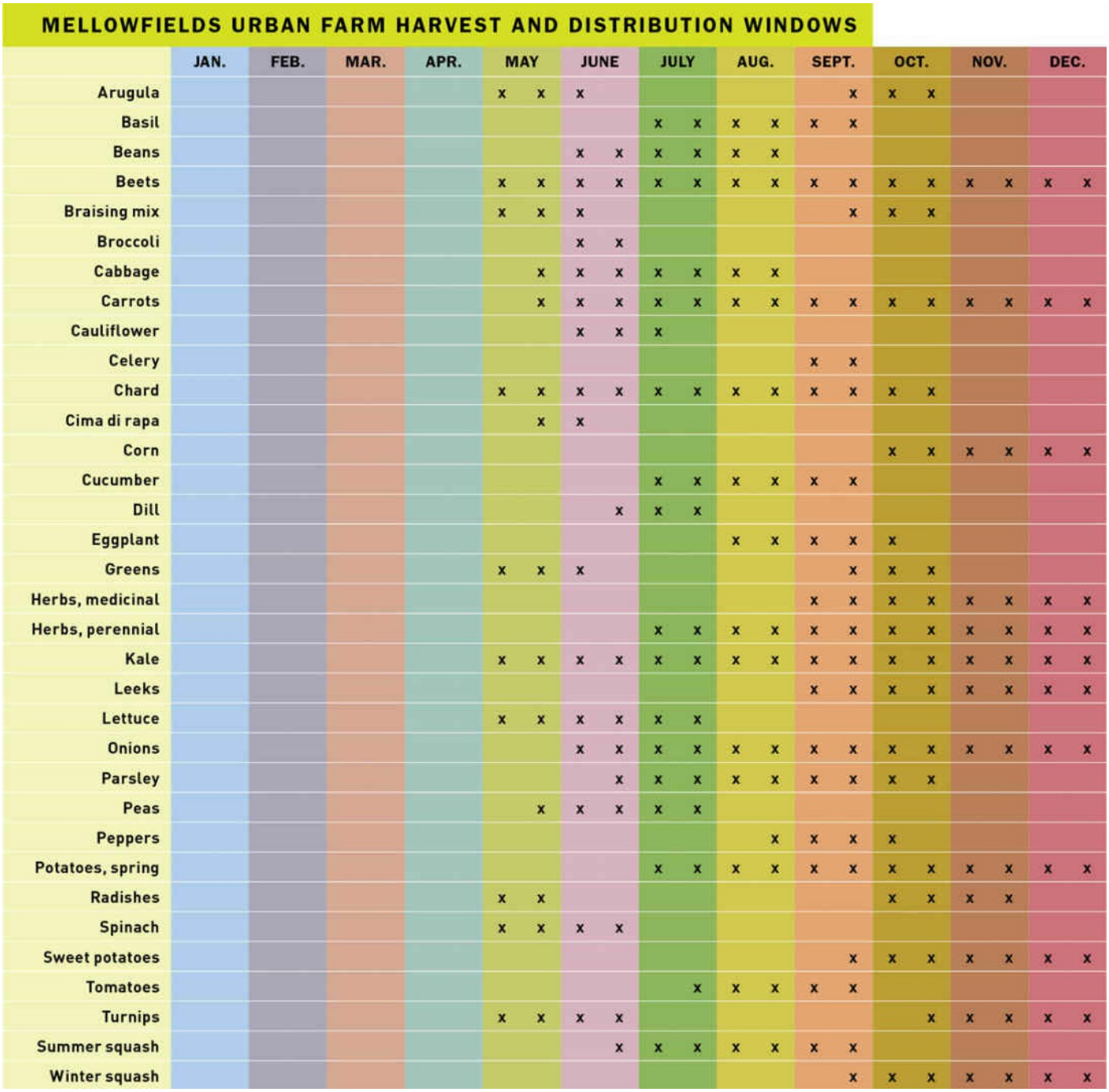
Water for the farm is metered municipal water. The couple farms two sites; the water at the larger site, which they lease from the city, initially had only one hydrant. Jessi and Kevin irrigated for two years by running hoses the full length of the farm (approximately 600 feet). In the fall of 2014, they won a grant from a local foundation that enabled them to bury pipe to the back of the property and install several hydrants.

They set up drip lines in crops that have a longer season, such as tomatoes, eggplant, and peppers. For most other crops, they irrigate with impact sprinklers on tripods that

have adjustable height, plus a few on stakes that push into the ground. In 2014 and 2015, wetter-than-usual years, the irrigation equipment got very little use.

FERTILITY

After many years of farming properties only for a single season, learning to manage long-term fertility is a new project for Jessi and Kevin. The Common Ground Program gives them access twice a year to free compost made from city yard waste. They are starting to learn about and practice cover cropping, and they use a variety of amendments, such as crumbled chicken manure and bone, feather, kelp, and alfalfa meals, to supplement fertility. They water transplants with liquid fish and kelp, which they also use on plants in the greenhouse or field when necessary.



MELLOWFIELDS URBAN FARM HARVEST AND DISTRIBUTION WINDOWS

	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
Arugula					x x	x			x	x x		
Basil							x x	x x	x x			
Beans						x x	x x	x x				
Beets					x x	x x	x x	x x	x x	x x	x x	x x
Braising mix					x x	x			x	x x		
Broccoli						x x						
Cabbage					x	x x	x x	x x				
Carrots					x	x x	x x	x x	x x	x x	x x	x x
Cauliflower						x x	x					
Celery									x x			
Chard					x x	x x	x x	x x	x x	x x		
Cima di rapa					x	x						
Corn										x x	x x	x x
Cucumber							x x	x x	x x			
Dill						x	x x					
Eggplant								x x	x x	x		
Greens					x x	x			x	x x		
Herbs, medicinal									x x	x x	x x	x x
Herbs, perennial							x x	x x	x x	x x	x x	x x
Kale					x x	x x	x x	x x	x x	x x	x x	x x
Leeks									x x	x x	x x	x x
Lettuce					x x	x x	x x					
Onions						x x	x x	x x	x x	x x	x x	x x
Parsley						x	x x	x x	x x	x x		
Peas					x	x x	x x					
Peppers								x	x x	x		
Potatoes, spring							x x	x x	x x	x x	x x	x x
Radishes					x x					x x	x x	
Spinach					x x	x x						
Sweet potatoes									x	x x	x x	x x
Tomatoes							x	x x	x x			
Turnips					x x	x x				x	x x	x x
Summer squash						x	x x	x x	x x			
Winter squash									x	x x	x x	x x

ABOVE: *Double-tap the image to open to fill the screen. Use the two-finger pinch-out method to zoom in. (These features are available on most e-readers.)*

TOOLS AND INFRASTRUCTURE

BED PREPARATION

In the early days, Jessi and Kevin used a walk-behind rototiller exclusively, but they've since upgraded to a 37-horsepower Kubota utility tractor with a bucket and a tiller. After a season of using the tractor, it became obvious to them that they needed something

more than just a tiller, so they now use a single-bottom moldboard plow before tilling. They still use the walk-behind tiller for narrow spaces.

The tiller on the Kubota is 5 feet wide so the original bed spacing was 5 feet on center. The farmers are now transitioning some crops to 4-foot centers to save space and make it possible to use the tractor for more than just preparing the beds.

ABOVE: *Indispensable implements at rest*

ABOVE: *Jessi with a Rubbermaid tote of beautiful fennel*

GREENHOUSES AND PROPAGATION

Jessi and Kevin start all of their own seedlings, except for onions, leeks, and sweet potato slips, in the basement of their house. Two racks with lights hold 16 flats each and plastic covers on the trays keep the humidity high and hold in the warmth. In April, the plants move out to the unheated hoophouse in the yard. Plants that continue to need supplemental heat, such as tomatoes and eggplants, sit on thermostatically controlled electric heat mats that hold five flats each. The farmers cover the plants with wire hoops and row cover to keep the heat in and save on electricity costs. Kevin and Jessi bought the mats used from another grower, who also bought them used, so they are well loved.

They constructed their hoophouse with fencing top rail and a bender from Johnny's Selected Seeds. It's 12 feet wide and 60 feet long with hoops every 5 feet. Early crops grown in the ground in the hoophouse include carrots, beets, and lettuce mix. Barrels of water in the greenhouse supply water for the seedlings and eliminate problems with frozen hoses. The barrels also hold some stored heat from the day into the evenings. As the plants grow and space becomes limited, Kevin and Jessi remove the barrels from the

greenhouse. All hoophouse ventilation is manual, with roll-up sidewalls and doors in the endwalls.

ABOVE: *Planting garlic*

ABOVE: *Planting leeks in trenches*

SEEDING AND PLANTING

The farmers use string lines or tracks marked with their Earthway seeder to plant seedlings in straight rows. Kevin has also experimented with quick clamps on the gate of the tiller; the clamps drag lines behind the tiller in the soft soil. Transplanting is by hand.

Mellowfields utilizes an Earthway seeder for direct seeding. In 2015, they bought extra seed plates to give them a wider range of options, and that has worked well for them. They also have a Glaser one-row seeder for smaller-seeded crops, though the Glaser takes a particular soil texture to work well, and they are still figuring out the best way to incorporate it into their systems.

CROP CARE

The couple cultivates with a combination of hoes and the walk-behind tiller between rows. The walk-behind tiller seems to create more weed problems in the long run, so they are moving away from that and using a Hoss wheel hoe more. The wheel hoe fits Kevin well but it needs modifications to fit Jessi, who is shorter. They also like collinear hoes for tightly spaced crops and working around drip tape. They use stirrup hoes for bigger crops. In 2015, they purchased a few cultivating attachments for the tractor and are learning how to best utilize them.

Kevin and Jessi protect crops from cooler temperatures in the early and late season with row cover suspended above the crops with wire hoops and some larger conduit hoops bent with a Johnny's bender. On some crops, the row cover also helps with insect control. The taller conduit hoops are good for covering larger, mature plants, but the row cover sits higher; to avoid problems with wind, they make divots with a shovel to set the row cover in and replace the soil to secure it in the hole. Soil bags also work well, but they prefer carrying a shovel to heavy bags of soil.

For trellising tomatoes, Kevin and Jessi use a stake-and-weave method. They started with cages they made from 5-foot-wide 6-by-6 remesh, but those cages are used only for beans now. The cages are easy to set into the ground by pushing the exposed wire on the bottoms into the soil, but they take a lot of time to move and require a lot of storage

space. For the stake-and-weave, they use 6-foot T-posts sunk 1 foot deep, which are much faster to remove at the end of the season and take up less space in storage.

HARVEST

Jessi and Kevin harvest everything on the farm by hand. For cutting greens, they use scissors, any brand that they can find with a metal pivot. They use knives to harvest bunching greens, head lettuce, cabbage, broccoli, and summer squash; spring-loaded pruning shears work for harvesting crops such as winter squash, as well as for pruning tomatoes. Bulb crates and 5-gallon buckets serve as harvest totes. Items that need to stay moist are stored in Rubbermaid tubs with lids.

The farmers transport produce from the bigger fields in the back of the farm's Chevy Colorado extended-cab pickup truck.

ABOVE: *Jessi with a Rubbermaid tote of beautiful fennel*

POST-HARVEST

WASHING AND PACKING

The farm's outdoor washing and packing station is at the couple's house, where they have a two-bin stainless steel sink and a single-bin plastic utility sink. Water for washing comes from a garden hose with a spray attachment that has a simple shutoff behind it. An old pop-up market tent shades the table and sink area, and wood mulch below keeps the ground from getting muddy. The drain has a hose that can be moved so the water doesn't always end up in the same spot.

There are two 2.5-by-5-foot wash tables with hardware cloth tops for spraying down vegetables and letting them drip dry. Salad greens are spun dry in a salad spinner. Some crops, such as summer squash and cucumbers, are washed in the sinks and allowed to drip dry in black bulb crates on top of the wash tables.

Jessi and Kevin built a walk-in cooler close to the packing area. It's an 8-by-12-foot freestanding shed that can be moved if necessary. The shed is insulated with closed cell foam and divided into two 8-by-6-foot rooms. The back "cold room" has an air conditioner with a CoolBot that keeps the space at about 38°F. The front "cool room" averages about 55°F and is where they store tomatoes. They also use the cool room for some storage crops, such as onions, potatoes, and garlic, but they struggle with humidity management and have had trouble with condensation on those crops when they bring them out into the warm, humid outdoors.

DELIVERY AND SALES

The farm pickup truck delivers all produce to markets and the CSA pickup site. Produce for the CSA and markets is packed and transported in clean Rubbermaid totes and bulb crates. Produce for restaurant sales is packed in reused wax boxes from the natural foods co-op.

At the farmers' markets, Jessi and Kevin have a 10-by-10-foot E-Z Up tent and up to three tables with tablecloths. They display their produce in baskets and use chalkboard signs for product prices and names.

OFFICE, COMMUNICATION, AND RECORD KEEPING

Mellowfields Urban Farm uses QuickBooks for most record keeping. Kevin and Jessi are working to track hours for enterprise budgeting using Google Calendar, synced

together with specific terms for searching and consolidating records; they are also experimenting with Toggl, a smartphone application for tracking time. They've found these methods to be good at providing snapshots of specific tasks, but they still find complete records difficult to maintain daily throughout the season. They make their planting plan in Microsoft Excel; they find it useful to transfer the plan to a wall calendar to help keep track during the season.

FULL PLATE FARM

THE BACKSTORY

Danny was forced to come up with a name to get his tax ID number so he could open a bank account for his business. He was then raising meat birds and vegetables, so he thought the name fit with a well-rounded meal — that, and he was busy with a bit of everything at the time, and still is.

DANNY PERCICH

Space in Production: 3 acres

Location: Peri-urban — Ridgefield, Washington

Crops: Mixed vegetables for winter harvest

Markets: CSA, stores, restaurants

Year Started: 2010

Danny started working on farms in 2000 while still in college. He worked for different CSA farms, mostly in the Northwest, before starting a small garlic farm with a friend on a half acre, selling at farmers' markets and to restaurants. After a couple of years growing garlic, he took a break and worked as a carpenter doing remodeling work, building his skills.

In 2007, he returned to farm work, eventually moving back to the Northwest, where he really saw and began to understand the interesting crops and varieties he could grow there in the winter. A few years later, he and his wife, Michelle, bought a mobile home and put it on her parents' land in Ridgefield, Washington, where she had grown up, just north of Portland, Oregon. During his first two years on that land, Danny farmed only part-time — he was too busy working on their house and managing another farm for a Portland restaurant to sell anything during the summer from his own place. The land was also very soggy in the spring, which led him to offer a winter-only CSA.

FULL PLATE FARM

MAP

ABOVE: *Double-tap the image to open to fill the screen. Use the two-finger pinch-out method to zoom in. (These features are available on most e-readers.)*

KEY

1. Well
2. Packing area
3. House
4. Home garden
5. Greenhouse
6. High tunnel
7. Orchard
8. Carrots
9. Beets
10. Miscellaneous roots (parsnips, parsley root, salsify, etc.)

11. Alliums (shallots, leeks, onions)
12. Popcorn
13. Long-season brassicas (kale, collards, cabbage)
14. Road
15. Winter squash
16. Root brassicas (turnips, rutabagas, radishes)
17. Short-season brassicas, braising greens (tat soi, arugula, mustards)

THE BASICS

Full Plate Farm produces mixed vegetables for a winter CSA season that goes from November through March. April is a bit of an off month for the farm, with no harvest, and planting doesn't start until the beginning of May. Having started with 12 members, the CSA nearly doubled its membership every year for the first four years. It is now up to 90 members. The winter CSA schedule spreads out the work over the year more evenly and leaves Danny more time to spend with his family. In the summer, he plants, waters, and cultivates; in the winter, he harvests, washes, packs, and delivers.

Michelle's parents live on the same property and own the land. The property is 10 acres, with about 5 acres of forest and 5 acres of open fields. Michelle and her parents are an important part of the farm but aren't directly involved in the day-to-day operations. Michelle is an artist and created the inspired "Farm Seeks Artist" project, which invites local artists to create art in conjunction with the farm. One of those projects was a beautiful illustrated journal that followed the 2013 season of the farm. Michelle's father, Russ, owns and runs a transmission shop and is the farm's resident mechanic, rebuilding motors and fabricating parts to repair implements.

CUSTOMERS AND MARKETS

The farm has 90 CSA members in the Portland/Vancouver area. There are two sites for a market-style CSA pickup, where all of the produce is laid out and people pack their own

bags. There are five other pickup sites where prepacked CSA shares in totes wait for members to pick up.

Some years, when he foresees surplus, Danny sells to stores or to restaurants in January or February.

LABOR

During the summer, Danny hires one part-time worker to work with him two to three days a week. For the harvest season, there are a handful of CSA members who work in trade for their shares, coming to the farm on the biweekly harvest days and adding about four extra pairs of hands.

Danny works roughly half- to three-quarter-time on average, spending the rest of his time looking after his three young children. He works from 8 A.M. to 4:30 P.M. on workdays, saving office work and irrigation moving for nighttime, but from 4:30 to 8 P.M., he makes sure he spends time with his family.

ABOVE: *Danny next to his root washer made from old bicycle rims and fence boards. He uses a metal carport for his wash and pack area.*

WATER

There is one well on the property that serves both houses and the farm fields. There's no permanent distribution for the irrigation system, so a 450-foot poly hose works to get water to the fields from the well. The well has a Cycle Stop Valve on it to improve the life of the pump and its efficiency.

Nelson Windfighter sprinkler heads, mounted on sled bases with poly hose running between them, distribute the water. The fields are in line with each other, so one person can easily pull the lines from one field to the next in just 15 to 25 minutes twice a day. There is some drip irrigation, but Danny prefers sprinkler irrigation to make cultivation easier.

FERTILITY

Danny uses a combination of cover crops, pelletized manure, dry amendments, and foliar sprays for fertility. He tests the soil every March and addresses specific deficiencies every other year with a custom blend of fishbone meal, feather meal, Azomite, sulfate of potash, and other trace minerals. In the interim years, he uses a 4-3-2 pelletized chicken manure that is easy to spread and addresses the soil and plant needs. In the first three years Danny limed, but he hasn't since.

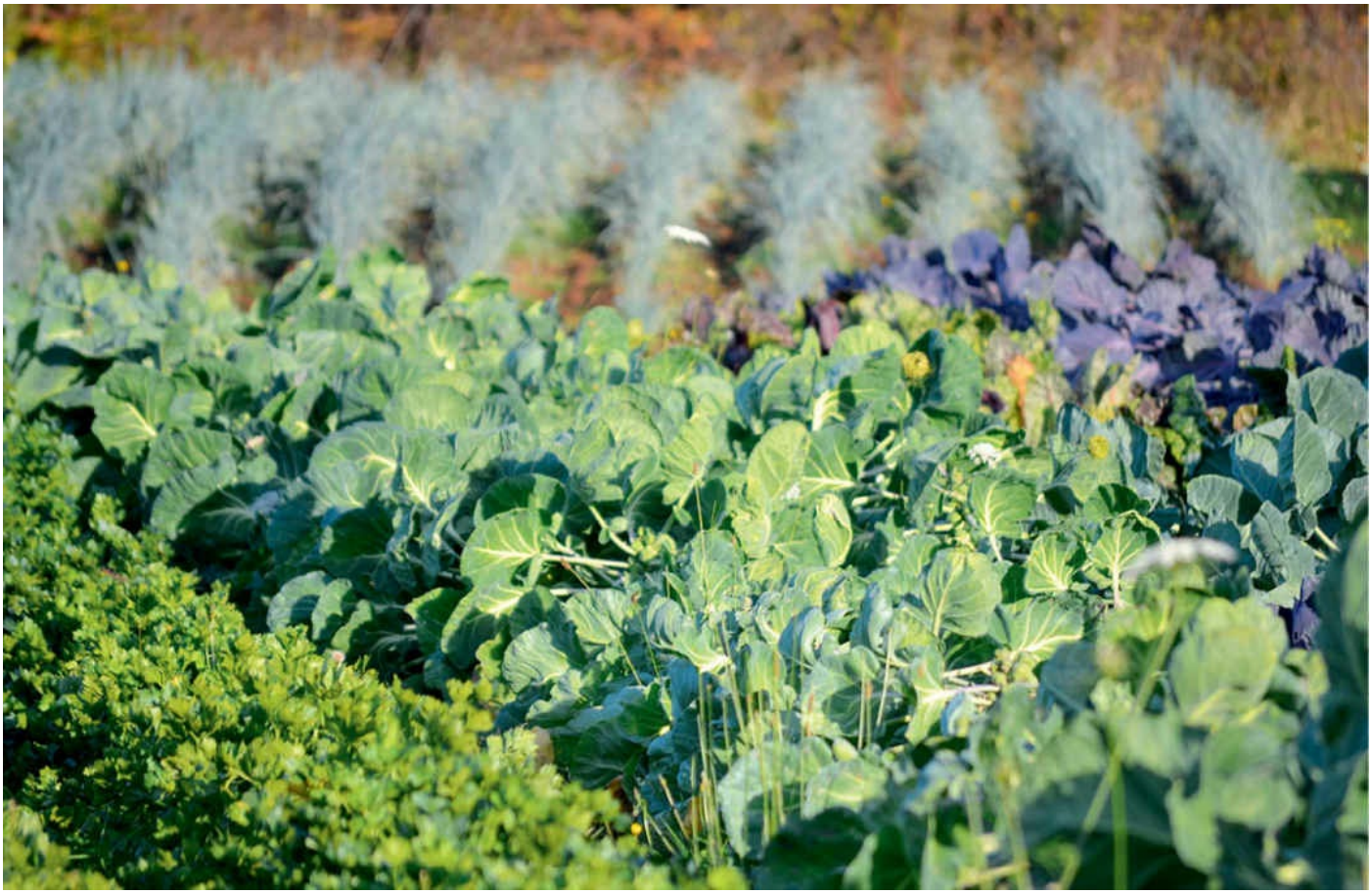
The farm has a boron deficiency, so he sprays Solubor two or three times a year to get the amount the plants need. A fish/kelp blend is also sprayed every other week during the growing season to promote healthy growth.

For any fields that aren't used through the winter he seeds in the fall a cover crop mix of cereal rye, common vetch, and crimson clover. In the pathways of cropped fields, he uses a fair amount of crimson clover for winter cover, starting to seed it at the beginning of August in the winter brassicas. He continues to spread the clover in the paths for the rest of the crops throughout the month. The clover helps with fertility, erosion control, and ease of walking in the fields when they are wet, which is most of the winter. For summer cover crops, the choice is Sudan grass and buckwheat.

FULL PLATE FARM HARVEST AND DISTRIBUTION WINDOWS

	JAN.		FEB.		MAR.		APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.		DEC.	
Beets		x		x	x	x								x		x	
Brussels sprouts	x														x		x
Cabbage		x		x	x	x										x	x
Carrots	x	x	x	x	x	x								x	x	x	x
Celeriac				x											x		x
Celery			x		x										x		
Chard														x	x	x	
Collards	x		x	x	x	x											
Endive														x	x		
Escarole														x	x	x	x
Fennel														x	x	x	
Garlic	x		x		x									x		x	
Kale	x	x	x	x	x	x								x	x	x	x
Kohlrabi			x		x									x	x		
Leeks	x	x	x	x	x	x									x		x
Onions			x			x								x		x	
Parsley		x		x		x								x		x	x
Parsnips	x		x			x											
Popcorn						x											
Potatoes	x	x		x	x										x		x
Radicchio	x	x	x	x	x	x											x
Radishes		x	x			x								x			
Root parsley				x												x	
Rutabaga	x				x	x											
Salad greens	x					x									x	x	
Shallots	x				x												x
Stinging nettles						x											
Turnip greens					x	x											
Turnips	x	x	x														x
Winter squash	x	x	x	x	x	x								x	x	x	x

ABOVE: *Double-tap the image to open to fill the screen. Use the two-finger pinch-out method to zoom in. (These features are available on most e-readers.)*



ABOVE: *Danny's offset rototiller on the back of his tractor with the rebar row markers*

TOOLS AND INFRASTRUCTURE

BED PREPARATION

Danny has a 45-horsepower 1973 International Harvester Hydro tractor. He likes it because it will drive very slowly, a benefit in his clay soil. When there is abundant plant material, he mows first and then disks. A first disking is typically done 4 to 6 weeks before planting, and he may undertake a second and even third disking in the subsequent weeks, depending on soil conditions, weed growth, and what kind of crop will be planted in the beds. Usually Danny makes just one pass at a time with the disk but sometimes two are necessary. For final beds for planting, he uses a 48-inch rototiller off the back of the tractor.

Most of the fields get disked in the spring at times when conditions are dry enough. Any beds not planted to a cash crop get seeded to a cover crop. Danny chisel-plows

most fields, although he doesn't have a standard timing for that — sometimes it's before mowing, sometimes after, sometimes after disking. His beds run cross-slope but he chisels down the slope to improve drainage and make the work easier for the tractor.

Danny welded three 0.75-inch pipes to the back of the tiller 15 inches apart to mark the planting rows as he tills. Pieces of rebar in the pipe mark the tilled soil, or he can remove the rebar and not mark the bed. Danny's beds are 5 feet on center with a 4-foot bed top, but his tractor is wider, so he offsets the tiller on the back of the tractor to cover up one of his wheel tracks.

GREENHOUSES AND PROPAGATION

The farm has a 20-by-50-foot greenhouse with double-wall, inflated plastic and roll-up sides. There are removable panels in the end walls, next to the doors, for extra ventilation in the summer. The greenhouse is unheated and not used in the early spring since the crops are planted in the summer.

The greenhouse has one big table for potting and seeding. Danny uses 128-cell trays for most crops and 60-cell trays for starting squash. He fills the trays with Black Gold organic potting mix and feeds the seedlings with fish and kelp, when he remembers.

There are 35 feet of standard 40-by-48-inch wooden pallets propped up on cinder blocks to keep the plug trays off the ground. The rest of the greenhouse (about half of it) is used for the family's personal summer crops; in the winter, Danny grows brassica greens in it.

The greenhouse has an automatic watering system, controlled by a simple DIG high-flow battery timer that mounts on the hose bib. Micro sprinklers are mounted on stiff risers held up by stiff wire supports salvaged from an old greenhouse and in need of replacement. Slugs are a problem in the greenhouse and they are dealt with by a combination of handpicking and applying Sluggo every couple of weeks.

ABOVE: *The farm's high tunnel, greenhouse, and fields, with a neighbor's house across the street in the background. The fields face south, collecting sun on clear days.*

SPREADING AMENDMENTS

Danny uses an old 10-foot drop spreader pulled behind the tractor. The drop spreader works for all of the mixes: lime, custom mix, and pelletized chicken manure. For foliar spraying of fish/kelp and boron, he uses a 4-gallon backpack sprayer.

SEEDING AND PLANTING

Danny mostly plants either one, two, or three lines on a bed, using the marks made by the modified tiller. In-row spacing of transplants is by sight and experience, sometimes double-checked with feet or stride length. Most crops are planted at either 6, 8, 12, 18, or 24 inches. Transplanting is all done by hand.

For direct seeding the farm uses an Earthway seeder with modified seed plates. By covering a portion of the holes in the standard plates with electrical tape Danny is able to make small adjustments to the seeding rates for different crops. He seeds some crops, such as radishes or greens, with more than three rows on a bed top.

Danny uses an Earthway bag-type broadcast spreader for seeding cover crops. After the seed is spread on the field, he detaches the power takeoff (PTO) shaft from the tiller and rolls the tiller over the seeded area. The tines dig the seed in shallowly and the gate on the back of the tiller presses them in and smooths the ground.

For planting potatoes and leeks, Danny converts his chisel plow into a furrower and pulls two trenches per bed. He plants potatoes, with leeks set at the bottom of the

furrows, and then fills in; he hills them later in the season.

CROP CARE

Danny uses an Allis-Chalmers Model G tractor ("The G") for cultivation. It has a tool bar with basic sweeps, a tine weeder, and hilling disks. He and his crew also use hula hoes to get the in-row weeds and weeds the tractor misses.

Most of the growing on the farm is out in the fields, but there is a 30-by-70-foot tunnel purchased with the help of a grant from the Natural Resources Conservation Service. In the summer Danny grows sweet potatoes in the tunnel and in the winter he uses it for greens and herbs. The ends of the tunnel are open, allowing the tractor to pass through.

For long periods of very cold weather, Danny uses 1-ounce floating row cover to protect the crops in the field, usually in conjunction with hoops to keep the fabric up off the leaves. Over time, he has reduced the use of row cover because he found that the reduced airflow was causing problems.

For insect pest control, he uses PyGanic when there are areas with bad cucumber beetles, flea beetles, or aphids, but he doesn't use it every year. In 2015, he only needed a spot spray on some of the butternut squash. He uses Hubbard squash, much loved by cucumber beetles, as a trap crop. Sometimes Danny sprays only the trap crop plants, or he just lets the beetles overrun them while the rest of the fields get a good strong start. To reduce slug pressure, Danny uses Sluggo and keeps the grass down around the edges of the field and greenhouse.

Deer are a major pest on the farm in the fall and winter. To keep them from eating the carrots, chicories, and sweet potatoes, the farm preemptively lays 17-foot-wide bird netting directly on top of the crops starting in September.

Craigslist, According to Danny

"My friend George always says, 'If you have three months to look and don't need something right away, you can get it off Craigslist.' It's true. You also need a truck or trailer to haul stuff or a good friend with a truck or trailer. But I believe in Craigslist.

"Here's what I've gotten off Craigslist: drop spreader, chisel plow/furrower, The G, cultivators for The G, hoes and hand tools, Earthway seeder, 20-by-50-foot greenhouse, International Harvester 544 Hydro tractor, Massey 7-foot disk, 8-by-12-foot reefer box."

HARVESTING

Danny keeps all of the knives, sharpeners, rubber bands, and other harvest aids in a tool bucket. The farmers use lettuce field knives for all of the cutting tasks during harvest.

Rubbermaid 18-gallon totes serve as harvest containers for kale and collards; 14-gallon totes hold chicories. Most other crops are harvested into bulb crates. To move produce from the fields to the road at the top of the fields the farmers use a garden cart. From there, the farm's big orange 1977 Chevy pickup shuttles the produce to the wash area.

POST-HARVEST

WASHING AND PACKING

An old 20-by-20-foot metal carport serves Full Plate Farm for washing and packing the harvest. For the first three years, Danny used a tarp-style carport, but the wind eventually destroyed it.

A slatted washing table made with wood lath holds bins while they are washed, and short benches on the sides hold bins that have been or are waiting to be washed. For roots, there is a small barrel-style washer made from old bicycle rims and cedar

fencing. Danny may eventually motorize it but for now operates it by hand. Greens get dunked in livestock water troughs.

In the middle of the packing area, the crew packs the CSA shares on tables. The market-style pickup produce goes into bulb crates. CSA shares headed to bin pickup sites are packed into 14-gallon Rubbermaid totes.

Danny found an insulated box off the back of a refrigerated truck on Craigslist and has plans to outfit that with a CoolBot for storing vegetables. He would also like to put up another carport for storing the tractors and all of the other miscellaneous gear.

DELIVERY AND SALES

Danny delivers most of the produce himself. Sometimes the harvest crew helps deliver, if it's on their way home, and Danny's mother takes bins back to her house, which is a CSA pickup site. All of the prepacked bin drops are delivered on one day and the market-style CSA pickups occur on another day.

OFFICE, COMMUNICATION, AND RECORD KEEPING

Full Plate Farm uses homemade spreadsheets to keep track of everything. Danny takes care of all farm communications through e-mail and the farm's website.

FLYWHEEL FARM

THE BACKSTORY

Justin and Ansel think of healthy soil as a flywheel that stores and slowly releases energy. They expand that further to include their work as something that helps perpetuate the positive momentum of their community.

JUSTIN COTE AND ANSEL PLOOG

Space in Production: 2 acres

Location: Rural — Woodbury, Vermont

Crops: Certified organic mixed vegetables and culinary herbs, noncertified eggs and rabbits

Markets: Farmstand and wholesale

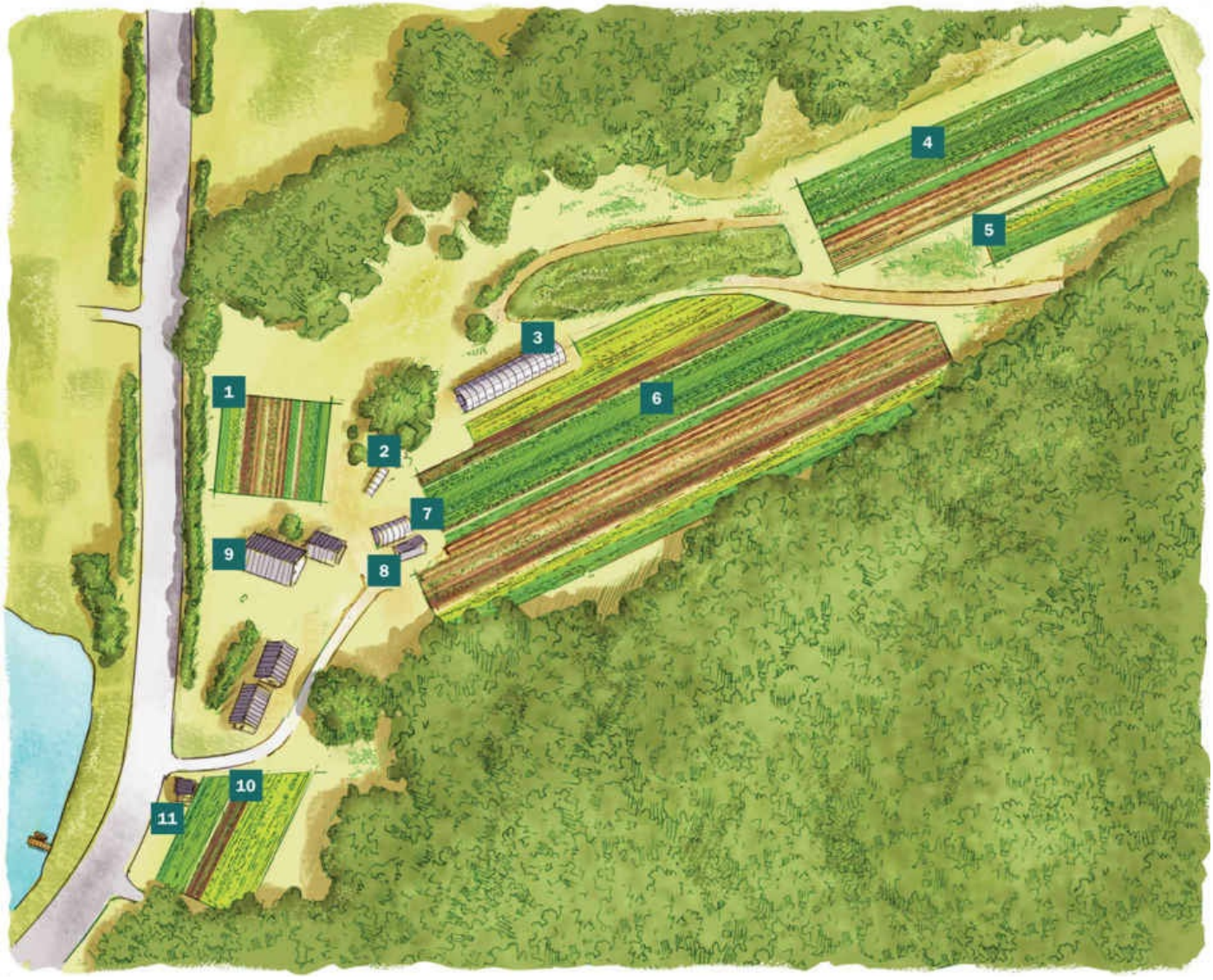
Year Started: 2013

After apprenticing in 2009 and 2010, respectively, Justin Cote and Ansel Ploog spent the next two years gathering skills working on other people's farms in Maine and Vermont. In 2013, they found a small piece of land to start their own farm and worked out a favorable rolling five-year lease with the owners.

Flywheel Farm has a total of 4 acres of farmable land, but when we spoke Justin and Ansel were cultivating less than 2 acres. For these young beginning farmers with limited resources, the small size felt more manageable as a starting point. Their plan is to concentrate on careful stewardship of their little piece of land and to not take on too much at first. They have spent their first years carefully developing the farm systems and converting the sod into annual vegetables and herbs.

FLYWHEEL FARM

MAP



ABOVE: *Double-tap the image to open to fill the screen. Use the two-finger pinch-out method to zoom in. (These features are available on most e-readers.)*

KEY

1. Annual field
2. Cold frame
3. High tunnel
4. Annual field
5. Perennial field
6. Annual field
7. Hoophouse
8. Wash/pack shed
9. Barn
10. Annual field
11. Farmstand

THE BASICS

The farm produces on less than 2 acres, but Justin and Ansel intend to expand into the 4 available acres as their systems develop and they get a better handle on the work. Although vegetables are the mainstay of the farm, the two have experimented with small livestock in the form of laying hens and rabbits. They see potential for the animals and enjoy having them on the farm, but the systems for animals have been harder to scale to their size, as feed is very expensive and regulations limit them to direct marketing.

CUSTOMERS AND MARKETS

The farm has good traffic to its roadside farmstand and sells eggs and rabbits exclusively through the stand. They primarily sell vegetables and herbs to local stores, institutions, and distributors.

LABOR

Ansel and Justin are currently the only workers on the farm. In the future, they expect to hire workers, but they are waiting until they have their systems more coordinated, and until they have established strong markets to ensure good cash flow.

WATER

Water for the farm comes from an underground spring, which is typical in the area. With assistance from an Extension Service agricultural engineer, they built a new spring box and installed 1,500 feet of pipe to gravity-feed the water to the farm. The spring gives them 3 gallons per minute and enough pressure to run a spray nozzle for washing produce. To help improve the flow rate for short periods of time, they use a 250-gallon IBC tank as a cistern. The tank sits about 50 feet above the farm and raises the flow rate to something closer to 7 to 10 gallons per minute.

For supplemental irrigation, they use drip tape on some of the hot-season crops. The farm gets regular summer rain so most crops are on their own after an initial watering. There is a water tank for the back of the tractor that they can use in emergency situations.

FERTILITY

Initially, Justin and Ansel purchased and spread compost and lime. Now in their third year of farming, they are using more bagged fertilizer, a 5-5-5 mix and a 6-0-6 mix, depending on the crop. They also use fish emulsion for watering in transplants and they can run it through the drip lines if crops look like they need more fertility later. For chard, they spray boron to make up for any deficiencies. All amendment choices are based on annual soil testing.

Cover cropping is also part of building fertile soil at the farm. Oats and buckwheat are the mainstays, but they are experimenting with sorghum and annual ryegrass in pathways between beds that are covered with plastic in the summer. Legumes are a major part of the farm's cash crops and are left out of the cover crop mixes.

Justin and Ansel apply compost to the entire farm every fall.

FLYWHEEL FARM HARVEST AND DISTRIBUTION WINDOWS

	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
Carrots									x x			
Chard						x	x x	x x	x			
Corn							x	x x	x			
Cucumber						x	x x	x x	x x			
Eggplant							x	x x	x			
Favas							x x	x				
Green beans							x	x x				
Head lettuce						x x	x x	x x	x x	x x		
Herbs						x x	x x	x x	x x	x x	x	
Kale						x x	x x	x x	x x	x x		
Melons								x x	x			
Mesclun					x	x x	x x	x x	x x	x x		
Mustards					x	x x	x x	x x	x x	x x		
Onions							x	x x	x x			
Peas					x	x x	x x	x x				
Peppers							x	x x	x			
Potatoes							x x	x x	x x			
Shallots										x	x	
Small greens					x	x x	x x	x x	x x	x x		
Strawberries						x	x					
Summer squash						x	x x	x x	x x			
Tomatoes							x	x x	x x			
Winter squash										x x		

ABOVE: *Double-tap the image to open to fill the screen. Use the two-finger pinch-out method to zoom in. (These features are available on most e-readers.)*

ABOVE: *Laying plastic mulch on beds*

ABOVE: *The farm has added a number of tunnels for season extension since their first few years.*

TOOLS AND INFRASTRUCTURE

BED PREPARATION

Flywheel Farm has a 50-year-old 40-horsepower Ford tractor with a heavy 6-foot disk and a chisel harrow used for preparing fields. The wheels on the tractor mark pathways, and occasionally they'll mark planting lines with tines off the back of the tractor. This makes beds 6 feet on center with 18-inch pathways. Hot-season crops of solanums and cucurbits get a plastic mulch layer. Beds in the hoophouse are all prepared using just a broadfork and a rake.

GREENHOUSES AND PROPAGATION

Flywheel Farm has a 12-by-30-foot greenhouse that Justin and Ansel made with hoop benders from Johnny's and two layers of inflated plastic. A 27,000 btu Modine forced-air heater keeps the space warm in the winter and spring; electric heat mats on benches keep some crops warmer. The greenhouse is outfitted with benches along the walls and a center aisle. An insulated germination chamber provides more heat for starting seeds. Everything is watered by hand.

SPREADING AMENDMENTS

To spread compost, Ansel and Justin use a 6-foot wide manure spreader pulled by their tractor. For other fertilizers, they use a cone spreader on the back of the tractor.

SEEDING AND PLANTING

To spread compost, Ansel and Justin use a 6-foot-wide manure spreader pulled by their tractor. Transplanting is done with bare hands.

CROP CARE

For insect and frost protection, Justin and Ansel use Agribon AG-19 row cover. Potato beetle and flea beetle are their main insect pests. Crops grown on beds with plastic mulch also get hooped and covered with the row cover to add heat early in the season.

For trellising, peas are grown on Hortonova plastic mesh held up with 5-foot wooden stakes. In 2015, the farmers acquired a new 21-by-96-foot hoophouse where they are growing all of the summer crops. They run wires on the hoops and trellis crops using a double-leader pruning technique. They plan to use the tunnel for early and late greens as well. The greenhouse also serves as a space for curing shallots and some dried herbs later in the season.

To control weeds, the main tools on the farm are a wheel hoe and a trapezoid hoe. Past bed preparation methods left a lot of trash in the field, which makes hoeing difficult. ("Trash" is the common farming term for un-decomposed plant material large enough to clog implements.) After three years the soil has changed, making hoeing much easier. Justin and Ansel find a four-tined cultivator a good tool for pulling out grass

roots. Sometimes they cultivate with the chisel harrow on the tractor by removing some of the chisels.

ABOVE: *The wash/pack area with the greenhouse behind and a new caterpillar tunnel nearby*

ABOVE: *Inside the compact wash/pack area*

ABOVE: *Tool storage outside the wash/pack area*

HARVESTING

The preferred harvest knife on the farm is the red-handled Victorinox knife sold by Johnny's. Justin and Ansel use both the serrated blade version and the straight blade, which is easier to sharpen. For harvesting cabbage, they use a machete. Harvests go into bulb crates and 5-gallon buckets, depending on the crop. The truck hauls produce from the field.

POST-HARVEST

WASHING AND PACKING

Justin and Ansel built a compact, well-designed wash-and-pack area to help streamline this labor-intensive part of the operation. The structure is just 8 by 20 feet but incorporates a 5-by-7-foot walk-in cooler, areas for washing and packing, and access to phone, Internet, and electricity. The space is designed for one or two people to work in and allows efficient movement of product.

A trio of utility sinks on one side stands next to a 5-gallon hand-crank salad spinner placed in a hole in the counter. The setup is plumbed so it can drain easily. Next to the spinner is a lower slatted draining bench, and behind the sinks is a larger flat counter for sorting and packing.

The cooler was built using design ideas from the CoolBot website (storeitcold.com), and a CoolBot keeps the space cold. Removable low shelves in the cooler keep produce boxes off the floor and allow cold air to circulate.

The entire structure was built with food safety in mind, featuring easily cleanable surfaces, good signage, and clear areas for different types of containers and materials. A hand- and tool-washing area is outside.

Why We Farm

We want to be a part of a vibrant and sustainable agricultural economy in our region. Farming has such a rich history in New England, and the way it has transformed the landscape is part of what makes this place so beautiful. There is something intensely satisfying about hard, physical work.

We are pursuing wholesaling because we believe that integrating small farms into regional food chains is crucial for a sustainable food system. There is a lot of mystery around this method of selling for beginning and small farms, and we'd like to help make this easier to understand and ultimately break into for others.

Our definition of "success" and "profitability" on our farm is that the farm not only pays for all the labor (including the owners') that goes into running it but also generates a profit above expenses. We have "quality of life" goals to make time for other activities in our lives, including pay for nonfarm work that we do. So, I'm not

as concerned with being a full-time farmer as I am that the farm pays me appropriately for the hours I spend working at it.

This is the first season that Justin and I are explicitly trying to limit our hours working on the farm. We are trying to train ourselves to farm more efficiently. Our goal is to make $10 an hour on the farm, then $20 or maybe even $30 an hour when we're working on financial planning or marketing. We may not reach that $10-an-hour goal until next year.

I (currently) have the progression of our financials only from 2013. What I'm looking for is an increase in sales right now, because finding markets is the biggest hurdle in our area. Each year, we will try to bring up gross sales and keep labor hours steady or declining. Marked improvement each year is what I call success.

Because we're such a new farm, each year has been hugely different from the last; once things even out I imagine I'm going to have to have a more specific measure of improvement and success.

— Ansel Ploog

DELIVERY AND SALES

Ansel and Justin deliver most of the produce with their pickup, with the exception of the produce sold to the distributor, who picks up at the farm.

OFFICE, COMMUNICATION, AND RECORD KEEPING

Flywheel Farm uses QuickBooks for invoicing and records for enterprise budgeting. Using class tracking in QuickBooks has made it easier for Justin and Ansel to plan from year to year. They also use Microsoft Excel to plan for markets, make budgets, and plan out timing.


Cal-Organic
Vegetables
ORGANIC S
Vegetables

LEAP FROG FARM

THE BACKSTORY

First, spring nights on the farm are full of the chorus of frogs. Second, when we are transplanting, we "leapfrog" over each other to give our backs a break from bending over. Third, we grow a lot of heirloom varieties and use organic methods, so we are "leapfrogging" over industrial agriculture.

ANNIE HEHNER

Space in Production: 2.5 acres vegetables, 3 acres fruit trees

Location: Rural — Guinda, California

Crops: Mixed vegetables, fruit, some culinary herbs, goats

Markets: Farmers' markets and some restaurant sales

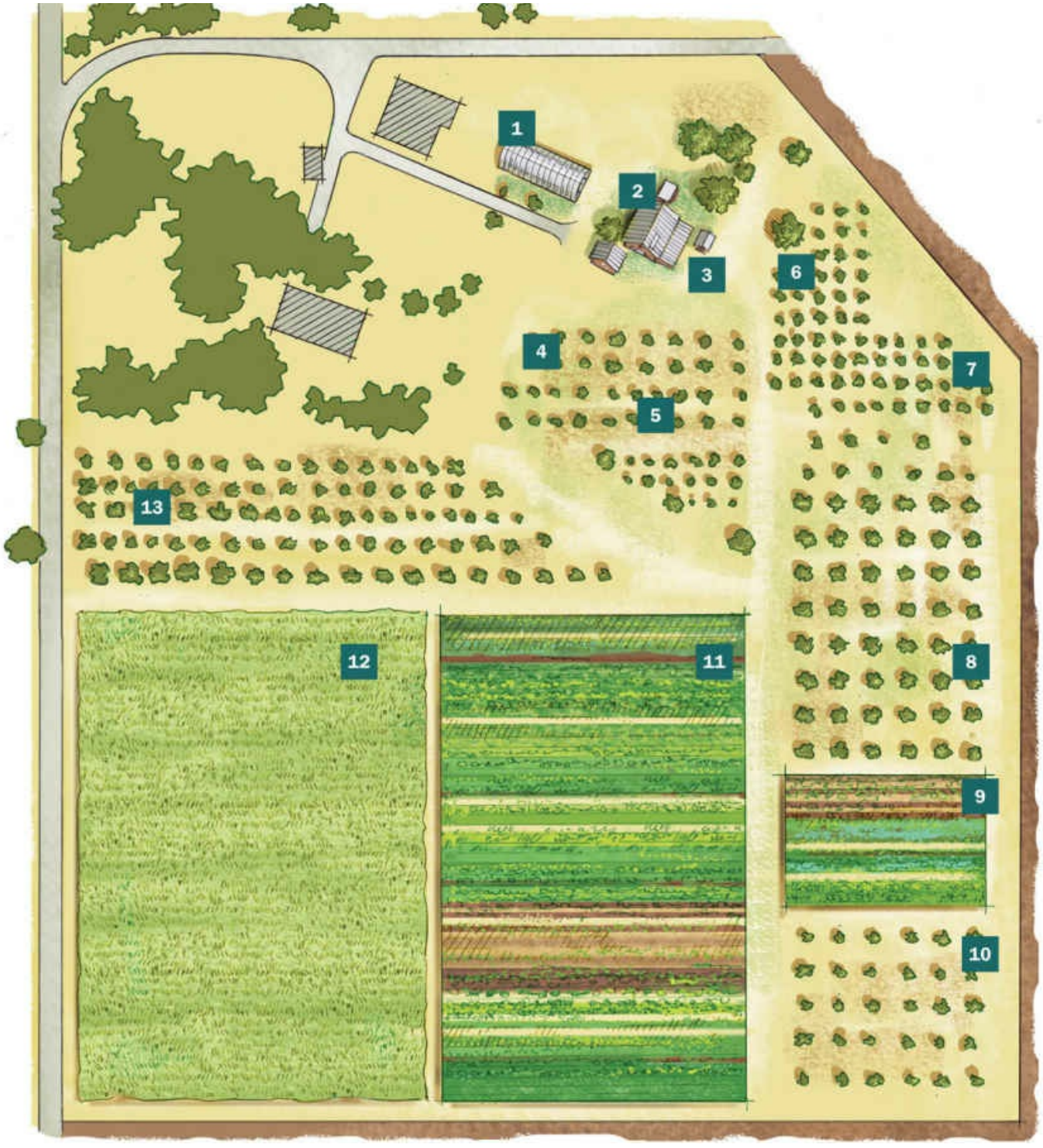
Year Started: 2012

Annie Hehner grew up around farms in the Central Valley of California but she didn't really start thinking about farming until she went away to college in Humboldt County. As a college student on a budget wanting to eat good vegetables, she started volunteering on a little farm near her house. That initial experience sparked her interest and led to volunteering on more farms, then to an internship on a small livestock farm, and eventually to a three-year stint on a fruit and vegetable operation in the surrounding hills.

While she was away at college and learning to farm, her parents bought a piece of land in the Capay Valley, surrounded by some of the best organic growers in California and not far from her childhood home of Woodland. Annie lives on the property in a little shack that was going to be a big chicken coop and uses a barn there as the hub of the farm. She pays agricultural rent for the land she cultivates, but no rent for her housing, which allows her to keep her expenses very low. She has applied the methods she learned in Humboldt County and has transferred many of the same crop varieties she grew there to her new farm, and she is finding her niche in a small farming community, surrounded by bigger growers.

LEAP FROG FARM

MAP



ABOVE: *Double-tap the image to open to fill the screen. Use the two-finger pinch-out method to zoom in. (These features are available on most e-readers.)*

KEY

1. New greenhouse
2. Barn
3. Greenhouse

4. Almonds
5. Peaches
6. Asian pears
7. Plums
8. Walnuts
9. Row crops (1 acre)
10. New orchard — plums and peaches
11. Row crops (about 3 acres)
12. Hay
13. Mixed fruit orchard

THE BASICS

For the first three years, Annie ran the farm as a solo operation. She planted 3 acres of fruit trees, and while waiting for them to mature she grew vegetables in the aisles between the trees. As the trees have matured and more space becomes available in the fields that used to be leased by neighbors, she has expanded her operation, and now she farms 2.5 acres of vegetables with the help of a friend she hired to work with her. Annie grows a lot of heirloom vegetables because she likes food with stories. Melons and tomatoes are her major crops, but she grows a wide mix.

She also raises goats, using them to eat down old crops and milking the does to make cheese for her own use. Eventually, Annie would like to find a way to fund a community cheese-making facility that would allow Leap Frog and other small farms in the valley to make cheese for sale. At her small scale, the individual investment to go commercial would be too much, so for now the goats just feed her and help do a little mowing around the farm. In the spring of 2015, Annie had two milking does, a “teenager,” and five kids.

The Capay Valley, where the farm is located, is just northwest of Sacramento. In the summers it’s very hot and dry there with virtually no rainfall. Winters are mild, with

average daytime highs in the 50s and 60s and light frosts; hard freezes occur only occasionally. Generally, all of the annual precipitation comes in the winter, with average amounts coming in around 23 inches, but that number can vary widely, with some winters receiving as little as 7 inches and some over 40. Because Annie lives on the farm, in the hot months she typically works in the cooler mornings and evenings and takes a long midday break.

The farm is intentionally small but has been growing slowly, and there is potential for the farm to expand in the future. Annie finds inspiration from Good Humus Farm in Capay, a 20-acre operation in business for 40 years (in fact, she was named after Annie Main, one of the founding farmers at Good Humus). As a part of this community with lifelong connections to farmers in the area, she is surrounded by excellent resources, in terms of both tools and mentorship.

CUSTOMERS AND MARKETS

Annie harvests all of the farm's produce for farmers' markets. She sells year-round at the Marin market, and when she has excess produce she sells the surplus to restaurants in the area. She also sells at markets in Davis and Guinda. Just down the road from her farm, the Guinda market is very small but lets her sell to neighbors in her immediate community who don't farm or garden.

Because Annie sells mostly at markets that aren't close to the farm, she decided it was important to her to get organic certification to let her customers know her practices. The certification also allows her to sell through the Davis Co-op or other stores she can sell at as an organic producer. Certification was available through her county's department of agriculture, which made the process easy and inexpensive.

ANIMALS

Goats are primarily kept in a fenced-in permanent area that is about 100 by 50 feet. They also browse areas around the farm, contained by temporary electric fencing. The goats' permanent area includes space for some feed storage and milking as well. Annie buys feed a few bags at a time and also gives the goats some alfalfa. The mama goats are Nubian Alpine mutts, bred with Oberhaslis. For breeding she takes the does to a friend with a buck, and while her goats are at her friend's farm, she keeps her friend's goats to offset feed and care expenses.

LABOR

For the first three seasons, Leap Frog Farm was a one-woman show. In 2015, Annie hired a friend, full-time, to work alongside her.

WATER

Water comes from a 250-foot-deep well on the property. In 2014, the farm had a bad year with the well and burned through three pumps in short order as water tables fell around the valley due to the drought. To avoid future problems, Annie installed a large holding tank and now has a 5-horsepower well pump to fill that tank. The well pump is also used to irrigate the crops through drip tape in the fields and the orchard. Domestic water comes out of the tank and is pressurized by a booster pump.

One of the big expenses when well pumps fail is getting a crane to the farm to pull the pump. To alleviate this problem, Annie hooked the new well pump to a continuous length of poly pipe and a strong rope. With the help of a winch, the pump can be pulled by hand if anything goes wrong.

FERTILITY

Purchased compost is the main fertility addition used at Leap Frog Farm, although that's starting to change. As the farm grows, Annie wants to give more space to cover crops

and let the goats do more work grazing down finished crops. Purchased feed for the goats currently becomes goat droppings that help fertilize the fields. The only mined amendment Annie has used is gypsum to deal with early blossom end rot problems on some of her tomato crop.

Annie has not yet run soil tests on the farm. Compost application rates vary by crop but are typically in the 15-ton-per-acre range. Annie buys compost made from municipal yard waste, delivered in bulk to the farm, where it is dumped in a large pile by the road before it gets spread.

LEAP FROG FARM HARVEST AND DISTRIBUTION WINDOWS

	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
Apricots					x	x x						
Basil						x	x x	x x	x x	x		
Beets	x x	x x	x x	x x	x x						x x	x
Broccoli	x x	x x	x									x
Cabbage	x x	x x	x									x
Carrots	x x	x x	x x	x x	x x						x x	x
Cauliflower	x x	x x										x
Chard	x x	x x	x x	x x	x x						x x	x
Cherry tomatoes						x	x x	x x	x x	x		
Cucumbers						x	x x	x x	x x	x		
Eggplant								x x	x x	x x		
Garlic						x x	x x	x x	x x	x x	x x	x
Grapes							x x	x x	x			
Kale	x x	x x	x x	x x	x x						x x	x
Melons							x x	x x	x x	x		
Onions					x x	x x	x x	x x	x x	x x	x x	x
Peaches					x x	x x	x x	x x				
Peppers								x x	x x	x x		
Plums						x x	x x	x				
Pomegranates										x	x x	x
Radishes	x x	x x	x x	x x	x x						x x	x
Rutabagas	x x	x x	x								x x	x
Salad greens (arugula, mizuna, tatsoi, lettuce, baby kale, etc.)	x x	x x	x x	x x	x x						x x	x
Snap peas				x x								
Summer squash						x	x x	x x	x x			
Tomatillos							x x	x x	x x	x		
Tomatoes							x x	x x	x x	x		
Turnips	x x	x x	x x	x x	x						x x	x
Winter squash	x x	x x	x x							x x	x x	x

ABOVE: *Double-tap the image to open to fill the screen. Use the two-finger pinch-out method to zoom in. (These features are available on most e-readers.)*

TOOLS AND INFRASTRUCTURE

BED PREPARATION

Annie uses a neighbor's 25-horsepower Ford 1710 tractor for preparing fields. She starts by mowing down any plant material and then borrows a disk from another neighbor to work it into the soil. She shapes her beds with a funky tool bar built from spare parts she got from another neighbor.

Using a BCS rototiller, Annie incorporates compost into the bed tops and creates finished beds for planting. Her bed tops are about 40 inches and the Ford tractor tires set the pathways 57 inches on centers. She uses a pair of rippers on the back of the tool bar to mark planting rows on the beds.

Although Annie has an Allis-Chalmers Model G cultivating tractor, she hasn't used it. As is typical of many of these with old gas motors, it seems to start on its own schedule, and she hasn't had time to tinker with it when it's not starting.

ABOVE: *An old disk holding rocks for extra weight, with the Ford tractor Annie uses in the background*

GREENHOUSES AND PROPAGATION

Annie typically grows all of her own seedlings. She uses a very funky greenhouse that she built into the front of her barn. Occasionally she has planted extra seedlings obtained from her neighbor, Full Belly Farm.

In the greenhouse Annie sows seed into open trays filled with Black Gold potting mix she buys by the tote and blends with purchased compost. For most crops, she sows five rows per flat and gently separates them at transplanting; onions are pulled and bare-rooted before planting. The open flats are a low-cost method for now, but eventually she would like to invest in durable, hard plastic cell trays.

Annie would like to build a better greenhouse in the future. The current one has no supplemental heat. The side rolls up for ventilation and there's a vent that can be opened up higher for extra airflow. In the summer, she uses shade cloth to keep the greenhouse cooler. All watering is done by hand with a water breaker on a hose.

ABOVE: *Annie's straw-bale cooler for produce storage*

SPREADING AMENDMENTS

A truck delivers purchased compost and dumps it across the road. In the past, Annie would load her truck with the tractor, then drive that across the road and load wheelbarrows from the truck. Now with two people working on the farm, she picks up tractor bucketloads of compost, and as one person drives the tractor down the beds, the other scoops out the compost gradually from the bucket with a shovel. A full bucket on the tractor covers a 185-foot-long bed.

SEEDING AND PLANTING

Annie direct-seeds with an Earthway seeder. She hand-seeds some of her beans. Usually the spacing between rows is just estimated.

Transplanting is done by hand as well. Drip tape pulled on the beds marks the rows. She uses drip tape with 8-inch spacing and the drips mark her in-line spacing.

CROP CARE

Pests don't pose much of a problem at Leap Frog Farm. Annie does find worms in her salad turnips sometimes, and for that she uses powdered mustard from the grocery store and makes a slurry. Pouring this slurry near the rows seems to keep the worms away.

Annie believes it is too hot in her climate for row cover, and now that insect netting is more commonly available she plans to experiment with it to help keep pests off the plants.

Cultivation is done almost entirely with 5-inch hula hoes. She does use the walk-behind rototiller between lines on single-line crops.

Tomatoes are trellised on T-posts with bailing twine in a weave. Beans and peas grow on 4-foot-tall wire mesh fencing held up with T-posts. She puts the fence to the south of the rows to keep the north wind from blowing the plants off the trellis.

HARVESTING

For harvesting, Annie uses a standard harvest knife or cheap clippers with pointed blades. Most crops are harvested into common plastic storage totes from Sterilite. She fills the totes with water for washing once the crop is back in the barn. Many of the summer crops are harvested straight into wax boxes. Cherry tomatoes go straight into little green plastic pint baskets.

POST-HARVEST

WASHING AND PACKING

Greens are usually washed in the same Sterilite totes they are picked into. There are tables in the barn to keep produce off the floor at a good working level when washing. Annie uses a 5-gallon salad spinner from Johnny's Selected Seeds to spin the greens dry before packing them into wax boxes. Before she had the spinner, she was putting them in a mesh bag and swinging the bag around in the air to dry them.

For storing produce, Annie built a straw-bale cooler with a CoolBot in a corner of the barn. It only needs to be turned on in the summer. In the winter, she opens the cooler at night to let cool air in, and during the day it stays cool if closed. The walls are made from straw bales and clay plaster, the roof is typical wood framing, and a tarp covers the dirt floor. The total cost to build it was about $1,800.

DELIVERY AND SALES

The markets where Annie sells provide tents and tables, but she brings her own folding table and a variety of tablecloths. Color is important to her and she arranges her stands to make the produce stand out. She has a collection of special baskets for displaying her produce, and she posts signs she's made with historical information on varieties and cooking instructions.

OFFICE, COMMUNICATION, AND RECORD KEEPING

Annie's bare-bones office consists of a small desk and filing cabinet in the corner of her shack. She does create load lists for market days to keep track of harvests and deliveries. She has a simple file of all purchase receipts and handwrites out a record of all of her plantings.


MELONS
Canary
EDENS GEM
Heirloom
TOMATOES
Cherry Tomatoes
TRY ONE! A great sweet
veggie snack!
$3 basket

CULLY NEIGHBORHOOD FARM

THE BACKSTORY

After considering a bevy of more outrageous names, Matt very simply named the

farm for the neighborhood in Portland, Oregon, where it sits.

MATT GORDON

Space in Production: 0.5 acre

Location: Urban — Portland, Oregon

Crops: Mixed vegetables

Markets: CSA, restaurants

Year Started: 2010

Cully Neighborhood Farm was started in 2010 by two friends, Michael Tevlin and Matt Gordon, who wanted to start a small farm but weren't ready to leave Portland. The land

is owned by a neighborhood church. Michael passed by at one point, noticed the open land, did the research, and found the owner was the adjoining Trinity Lutheran Church and School. After attending council meetings at the church and talking to church leaders, he wrote up a proposal for a lease arrangement.

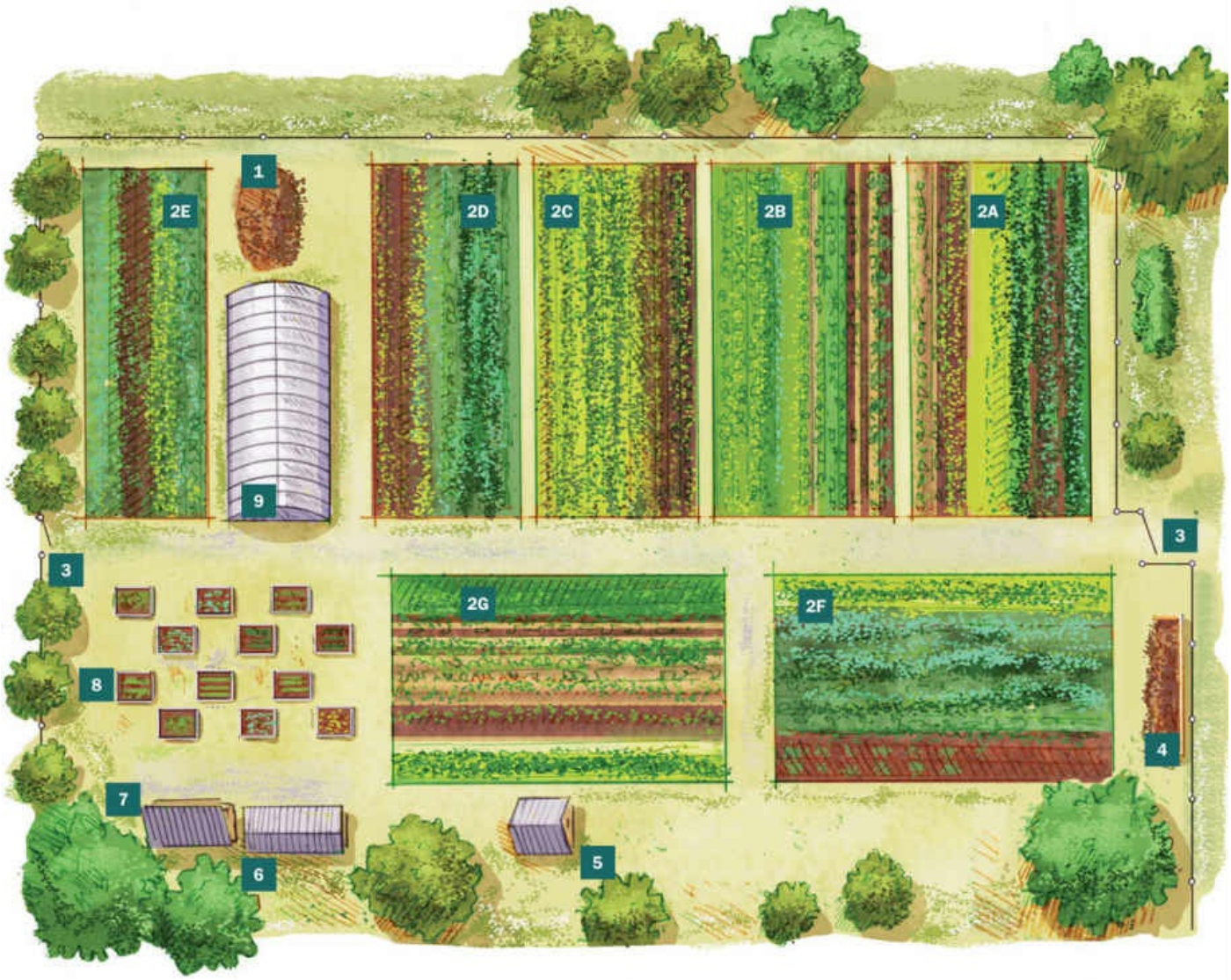
The agreement lets the farm operate on the land in exchange for delivering some excess produce to the church's food pantry and maintaining the site. In the first year, they farmed only 0.25 acre and sold at a small neighborhood farmers' market. In their second year, they started a garden education program for the church's K–8 school children called the Cully Young Farmers Project, funded by a grant from the Soil and Water Conservation District. After two seasons Michael moved to California, but Matt has continued the farm, slowly growing into the space and experimenting with various markets.

Education wasn't a part of the farmers' initial vision of the farm, but it fit well with the site and their desire to give back to the community. The project dovetails nicely with their original intent to have a little urban farm close to where they live and demonstrate a productive use of vacant land in a neighborhood with a lot of large lots and yards.

The description that follows is a snapshot of the 2014 season. Systems are changing and evolving on the farm each year.

CULLY NEIGHBORHOOD FARM

MAP



ABOVE: *Double-tap the image to open to fill the screen. Use the two-finger pinch-out method to zoom in. (These features are available on most e-readers.)*

KEY

1. Compost area
2. A–G = vegetable field blocks

A

B

C

D

E

F

G

3. Access
4. Rock pile
5. Tool shed
6. Wash/pack shed
7. Outdoor classroom
8. Children's garden
9. Hoophouse

THE BASICS

Cully Neighborhood Farm has taken an urban lot at the back of a church property and turned it into a productive vegetable farm that feeds the community and provides space for local K–8 schoolchildren to learn about nutrition, plants, gardening, farming, and where food comes from.

One corner of the property is the children's garden, which is run separately but supported by the farm. The mostly grant-funded Cully Young Farmers Project uses the children's garden for most programming but all the participants take a full farm tour at some point during the season. The kids that participate are from the neighboring Trinity Lutheran School. Each class visits the garden about once a week during the spring and fall. The hope is that the project will expand to serve more neighborhood children during the summer.

In 2014, Matt ran the production part of the farm solo as his full-time job, after several years of splitting his time between multiple farms and music gigs.

CUSTOMERS AND MARKETS

In 2014, Cully Neighborhood Farm grew produce for 40 CSA members and also sold to a handful of neighborhood restaurants and a local juice company.

LABOR

To make it all work, Matt puts in about 40 hours a week during most of the season and about half of that from December through February. From June through August, he employs an apprentice farmer who works about 30 hours a week; two CSA members bartered for about 2.5 hours a week of harvest help for their CSA shares.

In addition, Matt holds occasional work parties to involve more community members. Many people contact the farm with interest in volunteering and Matt adds them to an e-mail list. When he has a good amount of work for a party, he sends out an e-mail to volunteers. This typically happens every week or two in late spring and summer, and one or two people commonly show up. Volunteers take extra vegetables as a thank-you, but usually folks are happy to just get their hands dirty and contribute physical work.

WATER

Cully Neighborhood Farm is on municipal water, which is a major expense. In 2014, the farm paid about $1,000 for water and spent a significant amount of labor hours switching water from one section to another, since the flow from available spigots is limited.

The farm's water is fed by typical garden hose spigots and runs first through a sub-meter to get an accurate accounting of the quantity used (so that it can be paid for separately in the water bill). The water then passes through a 200-mesh filter before being distributed to the different areas of the farm through 0.75-inch polyethylene tubing. A wind-up two-hour timer ensures that the water doesn't run too long; pressure regulators ensure that the pressure is optimal for the application method.

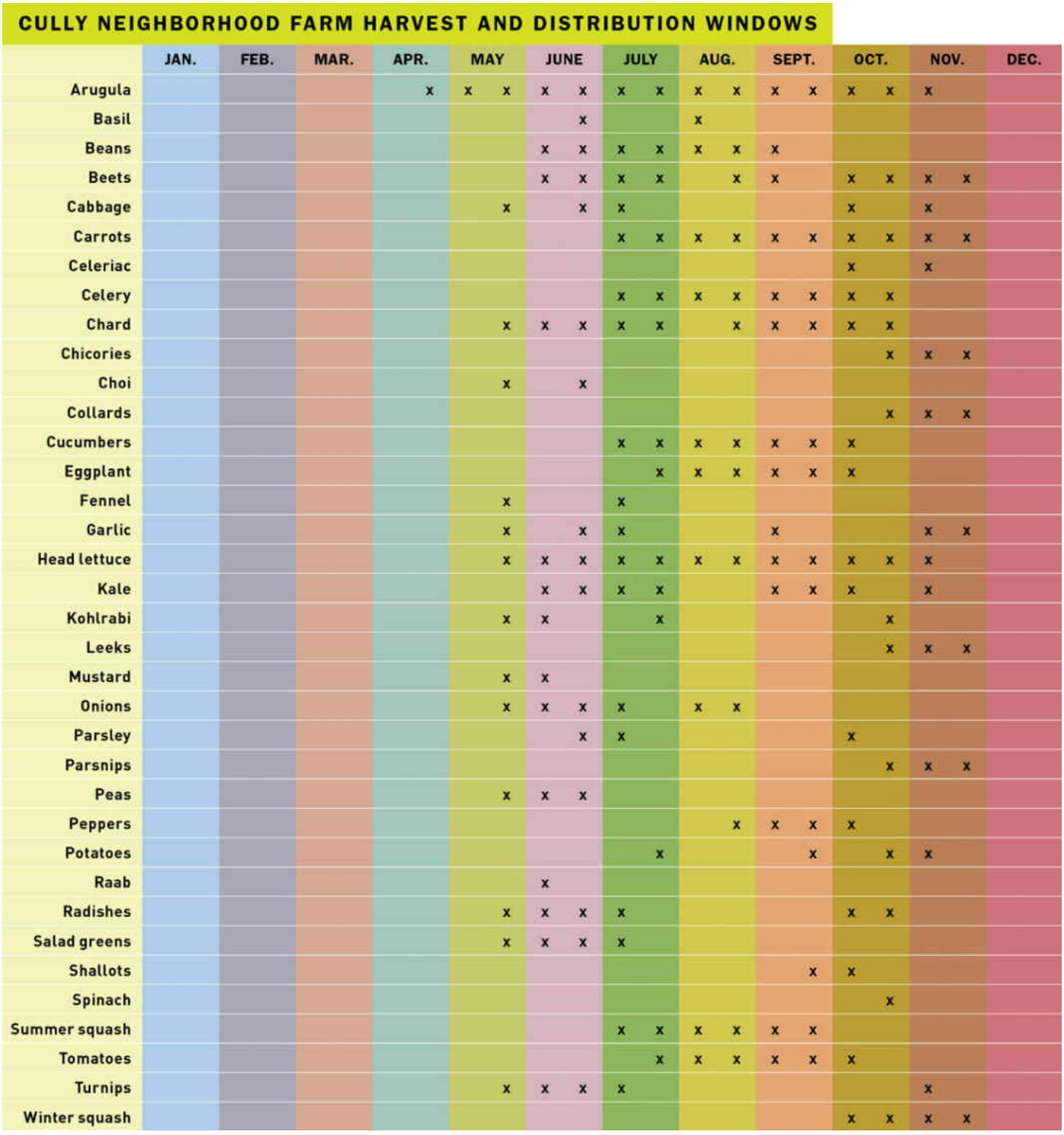
The farm uses both drip irrigation (T-Tape) and sprinklers (Wing Sprinklers from DripWorks). The drip is set up to run about ten 75-foot lines at a time; each bed has two or three lines (it is 4 feet from the center of one bed to the center of the next bed). The sprinklers will water four beds at a time and only two 75-foot lines of sprinklers can be run at a time. The soil is well drained, so everything must be watered twice a week during the summer, which makes for a lot of moving of water supply hoses and turning of valves.

FERTILITY

Cully Neighborhood Farm uses Logan Labs in Ohio for soil testing and subscribes to OrganiCalc (growabundant.com) to get recommendations for amending the soil. Based on those recommendations, Matt adds feather meal for nitrogen, soft rock phosphate for phosphorus, agricultural lime for calcium, gypsum for calcium and sulfur, Azomite or kelp for trace minerals, and occasional small applications of borax for boron. All of

those materials are readily available locally through several farm supply stores that specialize in serving small organic farms.

Matt also adds at least 0.25 inch of compost to beds before planting and plants cover crops in beds when they aren't being used for cash crops. He buys compost from Recology, a Portland compost producer that composts yard and kitchen waste. His cover crop of choice in the cool season is crimson clover, because it's easier to mow down and turn in than grasses. The clover can be seeded until the middle of October; for later seedings he sometimes uses a mix of cereal rye and vetch, but that is harder to incorporate the following year. In the summer, when it's warm, buckwheat is his preferred cover crop.



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TOOLS AND INFRASTRUCTURE

BED PREPARATION

To prepare beds, Matt primarily uses a Valley Oak broadfork in combination with a BCS 725 tiller with a 27-inch rototiller. A garden rake evens out beds. Matt mows before tilling when there is a lot of plant material on the bed. He uses a heavy-duty lawn mower (Scotts 6.5 horsepower) but it is a challenge to get through tall or thick crop residue. Matt has also used an Echo string trimmer for tall plant materials, but it doesn't work well for thick stalks, so he has upgraded to a BCS 749 tractor with a flail mower.

GREENHOUSES AND PROPAGATION

Matt is fortunate to live just one block from the farm, and he has a generously sized backyard with a 20-by-20-foot unheated greenhouse. The greenhouse has power, so he uses electric heat mats for germination. There is space for a total of 13 seedling trays on the mats; temperature is regulated by a thermostat with a soil probe. The probe turns on the heat mats when the soil temperature drops below the set point, and it turns off the mats when the soil rises above that set point.

Automated overhead irrigation, plus hand watering, waters plants in the greenhouse. Matt has hanging Ein Dor sprinklers (from DripWorks) running on DIG battery timers. He monitors these during the week and makes adjustments to the program, depending on weather and seedlings' water needs.

A thermostatically controlled exhaust fan and vents provide automatic cooling, and shade cloth and side roll-ups help ventilate and keep the space cooler in the summer.

Different types of 1020 cell trays scavenged from different sources range from 32 to 168 cells per tray. Matt also uses 3-inch pots for potting up solanums and open trays for seeding alliums.

ABOVE: *The tool shed with the farm's collection of hoes, rakes, broadforks, seeder, drop spreader, and a prototype single-wheel cart from* farmhandcarts.com

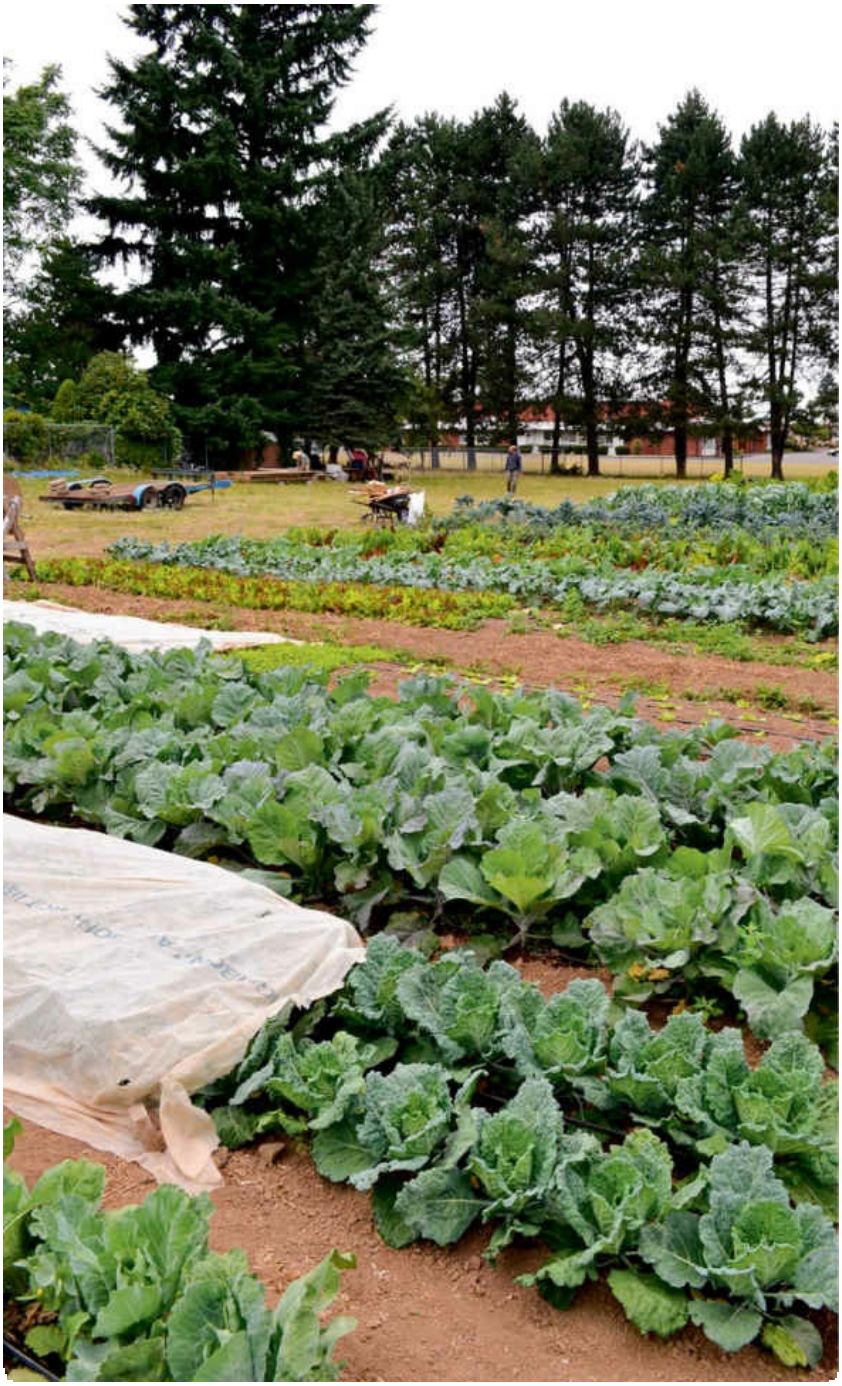
ABOVE: *The wash tub (previously a bathtub) and distribution tables under the shade of a small pole structure. In Portland structures under 200 square feet don't require a building permit, so the farm has two covered areas and a tool shed, all just under that size.*

SPREADING AMENDMENTS

For spreading materials such as feather meal and lime, Matt uses a Scotts lawn drop spreader with a 22-inch-wide drop. This works well for individual beds and doesn't spread any material on adjacent beds. If he's spreading larger areas, Matt uses a push-type broadcast spreader that holds up to 60 pounds of material. He spreads compost with a wheelbarrow and a shovel and rake.

SEEDING AND PLANTING

An Earthway seeder serves as the primary means of direct seeding. Transplants are put in the ground by hand; a small shovel starts larger holes for plants such as tomatoes. Lines for planting are marked with the Earthway seeder and spacing is determined by pulling a reel tape measure along the length of the bed while planting.



ABOVE: *In the farm's first year, when this photograph was taken, only half the lot was farmed and there were no structures. In the background, behind the trees, are the church's elementary school and playing fields for the kids.*

CROP CARE

On the farm site, a 20-by-48-foot unheated tunnel with roll-up sides aids heat-loving crops: tomatoes, cucumbers, basil, peppers, and eggplant. In the field, Agribon AG-19 (0.5 ounce/square yard) floating row cover is used for frost and insect protection.

Matt uses T-posts to build trellises for tomatoes in the field and ties them up using the Florida weave method. In the hoophouse, he runs twine up to a piece of 0.5-inch conduit hung along the length of the roof. When the tomatoes get too big between prunings for just pinching, Matt uses bypass pruners to trim the branches.

For cultivation and weeding, Matt uses a standard garden rake, a Valley Oak wheel hoe with 8-inch stirrup hoe, Ammann stirrup hoes, a Rogue 55F field hoe, a 3.75-inch collinear hoe, a DeWit diamond hoe, and a propane flame weeder.

HARVESTING

Matt harvests crops by hand with a variety of tools: Johnny's lettuce knives, Opinel knives, and bypass pruners. Harvested crops go into Rubbermaid Roughneck totes (10-, 14-, and 25-gallon), Ropak yellow stack-and-nest totes, and 9-inch-deep bulb crates.

POST-HARVEST

WASHING AND PACKING

In the farm's washing and packing area, there is a repurposed bathtub raised on a 2×4 frame and a spray table with a top of 0.5-inch hardware cloth stretched over a 2×4 frame. Salad greens are dried with a 5-gallon hand-crank salad spinner, and bins are set on an angled shelf to drain water when they are full of wet produce. The Rubbermaid totes with lids are set upside down on the shelf to allow excess water to drain.

DELIVERY AND SALES

CSA shares are distributed on the farm. Harvested crops are laid out, farmers' market style, in bins with labels that let folks know how much to take of each item. Matt has a 40-pound Torrey market scale for weighed items.

Deliveries to restaurants are made in his personal vehicle. Typically, he packs the produce in Rubbermaid totes that he either empties into the restaurant's own containers or leaves at the restaurant for the week if needed.

OFFICE, COMMUNICATION, AND RECORD KEEPING

Matt uses Microsoft Excel for crop planning and printing out to-do sheets for greenhouse seedings, field plantings, and maps for the fields. Record keeping on the farm is all done by making notes in pencil on the paper to-do sheets and maps. He pays particular attention to recording planting and harvest times on the maps and harvest weights by the date and crop.

An iPhone handles business communications: texts, e-mails, and phone calls. For bookkeeping he started with GnuCash but is switching over to QuickBooks. He uses the TimeTrack application on his iPhone to keep track of his work hours.

BROOKLYN GRANGE

THE BACKSTORY

In the U.K. a grange refers to a house with farm buildings attached to it. This farm's name is a play on that: a farm attached to a building.

BEN FLANNER, ANASTASIA COLE PLAKIAS, GWEN SCHANTZ, AND CHASE EMMONS

Space in Production: 2.5 acres

Location: Urban — Brooklyn and Queens, New York

Crops: Mixed vegetables, emphasizing intensive crops

Markets: Wholesale, CSA, and farmers' market

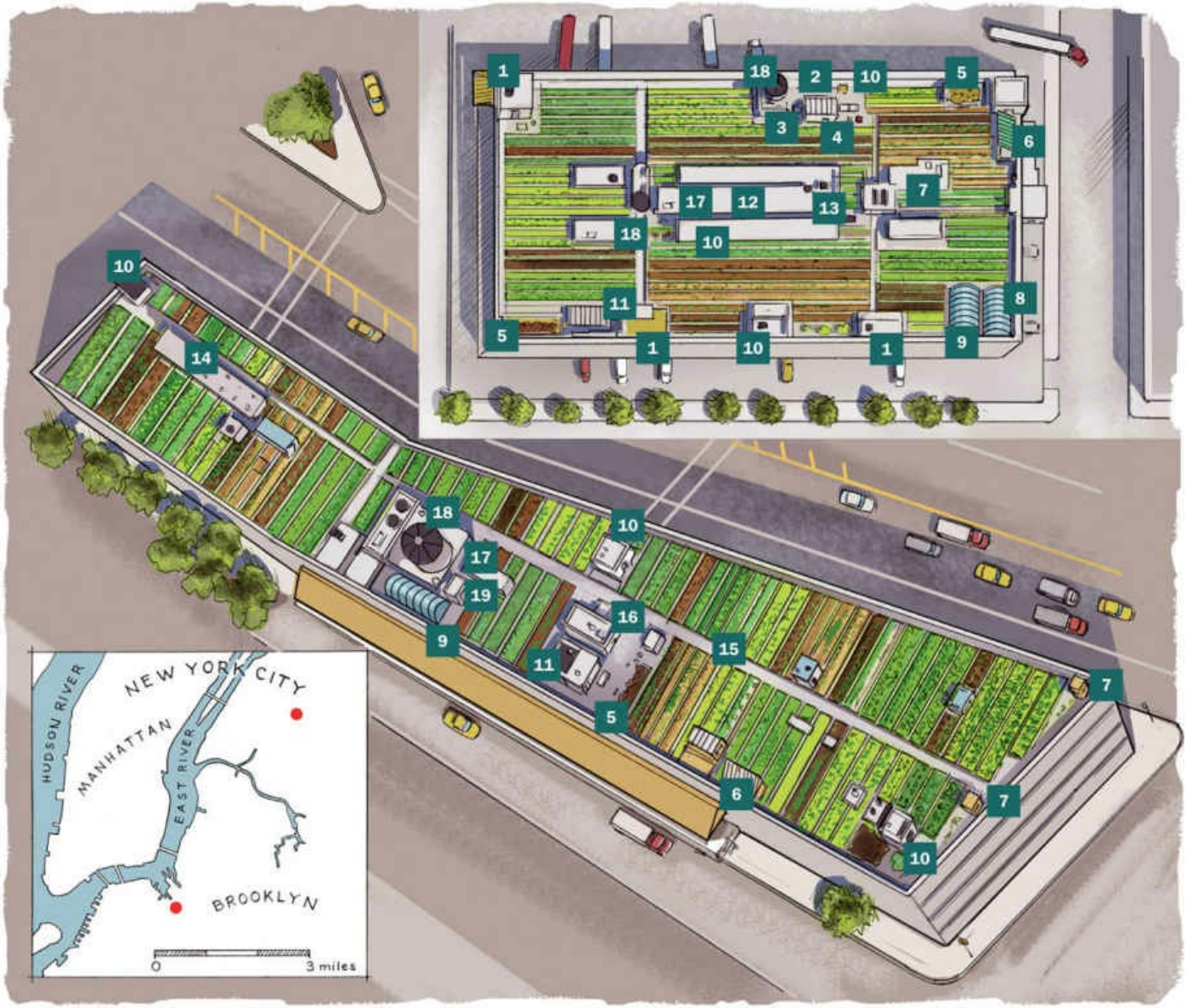
Year Started: 2010

A quartet of partners started Brooklyn Grange; all were interested in growing food in an urban setting. Initially, the goal was to create a model for urban agriculture that was financially self-sustaining and could turn unused spaces and resources into healthy, delicious vegetables for the community.

In the spring of 2010, the partners broke ground or, more accurately, started moving soil up, six stories, to a rooftop in Long Island City. That first rooftop has now become two rooftops, totaling 2.5 acres of farmed space. The second site is 12 stories up on a building in the historic Brooklyn Navy Yard, and Brooklyn Grange has added a number of elements to the farm beyond simple vegetable production.

BROOKLYN GRANGE

MAP



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KEY

1. Storage
2. Irrigation hub
3. Service elevator
4. Storage container — includes walk-in cooler
5. Compost
6. Chicken coop

7. Bees
8. Greenhouse
9. Hoophouse
10. Stairs
11. Office
12. Greenwall
13. Events area
14. Table
15. Main path
16. Elevator
17. Wash/pack area
18. Water tower
19. Walk-in cooler

THE BASICS

Brooklyn Grange is a for-profit urban food production business. Given the space limitations and the high value of New York City real estate, Brooklyn Grange has specialized in salad greens and other intensive crops. It has also expanded beyond vegetables into honeybees and laying hens, along with value-added products such as hot sauce. The rooftop farm hosts events, dinners, new-farmer training, and, in conjunction with a partnering nonprofit, farm education.

The green roof aspect of the farm provides other nonmonetary benefits in an urban environment. Millions of gallons of rainwater per year are diverted from the city's sewer system. The farm and other green roofs help keep neighborhood temperatures lower during hot summer days, because roofs that would have absorbed and re-radiated solar heat now absorb and use the solar energy to grow food instead.

A unique aspect of the rooftop farm is the need to transport produce and supplies from the ground up to the roof and back down. For large items, such as the initial soil and shipping containers, the staff used cranes. Most things go up and down in a freight elevator, and on busy days there can actually be a significant wait for the elevator.

ABOVE: *Salad greens at the Navy Yard rooftop*

CUSTOMERS AND MARKETS

The farm grows a wide mix of crops for 30 or so restaurants and specialty retailers, as well as for one of their own farmstands, a stand at the McGolrick Park Farmers' Market in Brooklyn, and a 60-share CSA.

LABOR

The farm operates with four full-time staff members and additional seasonal crew. Others in the organization work on related aspects, and some share time on different tasks. Brooklyn Grange also leases out a small portion of the rooftop bed space to other organizations that grow food, flowers, and other plants and align with its mission.

WATER

Aside from natural rainfall, all water used is municipal water. Drip tape covers the entire farm and is run with timers that control a complex system of separate zones, allowing the entire area to be watered multiple times per day. Each bed has two lines of drip tape with 8-inch emitter spacing to give fairly even coverage. Due to the light, shallow rooftop soil (only about a foot deep) there is limited water-holding capacity; the roof can get quite hot and windy, requiring frequent watering.

To help with germination of high-density crops, the farmers use sets of mini-Wobbler sprinklers on timers in zones that need them. The irrigation controllers have wireless capability that enables the staff to adjust the watering using a cell phone application. The farm is working with a researcher from Cornell University who is looking closely at the rooftop water use. He has installed sensors in different locations

and at varying soil depths; flow meters on all of the irrigation zones track total water use.

ABOVE: *Wobbler sprinklers help with germination of high-density seedlings.*

FERTILITY

Compost is a major component of the fertility program at Brooklyn Grange. The staff makes compost from plant material stripped from the beds, along with waste brought back from the green markets, compost from neighbors, and wood chips from tree companies. For growing microgreens in trays, the farm also buys top-quality potting mix made with a large quantity of compost. When the microgreens are finished, the used potting mix is added to the farm beds.

In addition to compost, the farmers add various dry amendments to beds, and some are mixed with water and distributed by fertigation, using a Mazzei injector built into the irrigation distribution system. Dry amendments are typically worked into the soil when turning the beds. Currently the farmers use a balanced 10-2-8 organic fertilizer mix, adding extra sulfate of potash since the soil typically tests low in potassium.

A mix of white and crimson clovers serves as a cover crop wherever possible. The clovers stay in the pathways for larger crops that aren't overwhelmed by it, and they are stripped by hand or with shovels or a tiller when beds are prepared for more delicate salad greens; the stripped plant material is added to the compost. Cocoa bean husks, a by-product of local chocolate producers, serves as mulch; the husks add nutrients as the mulch breaks down.

BROOKLYN GRANGE HARVEST AND DISTRIBUTION WINDOWS

	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
Anise hyssop					x x	x x	x x	x x	x x	x x		
Arugula					x x	x x	x x	x x	x x	x x		
Basil						x x	x x	x x	x x	x x		
Bronze fennel						x x	x x	x x				
Carrots						x x	x x	x x	x x	x x	x	
Chard					x	x x	x x	x x	x x	x x	x	
Chives					x x	x	x		x x			
Cucumbers						x	x x	x x	x x			
Eggplant							x	x x	x x	x x		
Flowers					x x	x x	x x	x x	x x	x x	x	
Ground cherries							x	x x	x x	x x		
Kale					x	x x	x x	x x	x x	x x		
Microgreens	x x	x x	x x	x x	x x	x x	x x	x x	x x	x x	x x	x x
Parsley						x x	x x	x x	x x			
Peppers							x x	x x	x x	x x	x	
Radishes					x x	x			x	x x	x	
Salad greens mix				x	x x	x x	x x	x x	x x	x x	x	
Scallions					x	x x	x x	x x	x x	x		
Shiso						x x	x x	x x	x x	x		
Sunchokes											x	
Tomatoes (heirloom)							x	x x	x x	x		
Turnips					x x	x x			x	x x	x	
Weeds					x x	x x	x x	x x	x x			

ABOVE: *Double-tap the image to open to fill the screen. Use the two-finger pinch-out method to zoom in. (These features are available on most e-readers.)*

TOOLS AND INFRASTRUCTURE

BED PREPARATION

The farm's beds are 40-inch-wide raised bed tops with 16-inch walkways between them. These are raised beds in the agricultural sense, with extra soil simply moved from the pathways to the bed tops when preparing the beds for planting, but not in the garden sense, where wood or other barriers separate the pathways from the bed tops and raise the surface.

The rooftop soil is fluffy and not difficult to work with hand tools. The farmers prepare beds with shovels and hoes to loosen and turn the soil, leveling the bed tops with garden rakes. They shake amendments from cans, spreading them evenly over the bed tops. For direct-seeded crops they firm the bed top with a Johnny's seedbed roller.

Because the soil is shallow and space is tight it's tricky to use a rototiller, since hitting the liner between the soil and the roof could cause serious damage. The farm has recently started to carefully incorporate a tiller in bed preparation.

GREENHOUSES AND PROPAGATION

The operation has three small greenhouses on the rooftops for propagation and for growing microgreens. High-quality bagged potting mix is put into 1020 plug trays ranging from 50 to 128 cells for the seedlings and open flats for the microgreens. Crops

such as tomatoes go into 3- or 4-inch pots to give them a head start on the season before they venture out of the greenhouses. The farm packs as much into the greenhouses as possible by using benches and the floor below when the benches are full.

The crew seeds by hand and waters the seedlings using an automatic system with hanging Netafim sprinklers. The houses have roll-up sides for ventilation and the doors and vents in the endwalls also open for cooling. Fans inside the houses keep air circulating, and electric radiant heaters keep the structures from freezing in cold weather. Propane heat isn't allowed on the rooftops, so the farm is limited to electric heat until it can find a way to access natural gas or the building's steam heat system.

SEEDING AND PLANTING

Transplants are spaced out using marker sticks cut to the exact center-to-center spacing required by each crop. Planting densities are typically high and the Grange crew is careful to be precise, so there are many different marker sticks for the different spacings.

The farm uses a Johnny's four-row seeder for direct seeding; the four-row seeder requires that they roll the bed before and after seeding. Before acquiring their seedbed roller, they rolled a barrel over the bed to get a firm, even surface.

Dense plantings are designed to increase the productivity of the limited and expensive space and to outcompete weeds. Turnover is very high in the beds, with many greens having turnarounds close to 45 days. Weekly successions of plantings occur throughout the season for consistent harvests.

CROP CARE

A number of crops, such as peas, tomatoes, and cucumbers, are trellised on bamboo poles. Hortonova mesh is hung from the bamboo for the pea trellises. Tomatoes, cucumbers, and zucchini all get light pruning as they are trellised.

The rooftops are too windy for row cover and low tunnels. To control weeds the farmers use plastic mulch for some crops (for example, tomatoes and cucumbers) and stirrup hoes, garden hoes, a tiller, and hand weeding for others.

HARVESTING

The harvest crew uses 4-inch serrated knives for cutting greens; with many other crops, they simply pull by hand. Crops are harvested into collapsible plastic totes.

ABOVE: *Tomatoes trellised with bamboo; in the background, part of the ventilation system for the building*

POST-HARVEST

WASHING AND PACKING

Both sites have their own stainless steel sinks and spray tables for washing and sorting the produce. The crews use the same collapsible plastic totes to harvest and pack out the crops, with plastic bags as liners for many of the tender greens.

The Brooklyn site has a shipping container with an insulated room that has a CoolBot walk-in refrigerator. The rest of the container provides space for sorting and storing crops like tomatoes that don't need refrigeration. The Queens site has an insulated cooler with a CoolBot, but less unrefrigerated space for storage.

The farm uses washing machines to spin-dry salad greens.

DELIVERY AND SALES

For most of the season the farm works with a distributor who has a refrigerated truck and aggregates product from Brooklyn Grange and other farms around New York and makes deliveries. Grange staff takes care of sales, invoicing, and collections, and the

distributor picks up at the sites and delivers to restaurants and stores. In the early spring and late fall, there are fewer deliveries to make, so the staff handles them, using a farm-owned van.

OFFICE, COMMUNICATION, AND RECORD KEEPING

There is a small shipping container office at the Brooklyn site; a small indoor space at the Queens site functions as an office. The staff keeps sales records on QuickBooks, linking that data with Microsoft Excel to analyze crop profitability and sales numbers. Staff keeps a tight eye on reporting, always looking at year-to-year comparisons to minimize surprises and to stay on top of things. The farm sets goals for increasing sales and pays attention to how successfully it meets those goals. This has helped define the crop mix over time.

ABOVE: *The farm office on the edge of the fields*

PART 3

NUTS AND BOLTS

"In anything at all, perfection is finally attained not when there is no longer anything to add, but when there is no longer anything to take away, when a body has been stripped down to its nakedness."

— Antoine de Saint-Exupéry

PLANNING AND DESIGNING YOUR OWN

Trying to plan a small farm without any framework or starting point can be overwhelming; there are so many pieces to think about and it's not always easy to find a starting place. I'm going to lay out a series of four questions to suggest a path that will lead you through all of the options and, ultimately, to a good plan. Although the word "path" suggests a linear process with a clear start and end, the reality is that any holistic planning process for something as complex as a farm is anything but linear. This path will continuously loop back on itself and intersect with earlier parts of the plan, requiring modifications along the way.

The good news: if you follow the process, you'll end up with a great plan. Farming on paper can be a lot of fun and will help speed the learning process, which helps you make better decisions in the long run. Unfortunately, making a plan for a farm on paper isn't like making a plan for building a house. Houses are basically mechanical. They are structures built from relatively uniform, predictable materials. Farms have mechanical aspects, but they are primarily biological, constantly growing and evolving. This means you must be flexible in how you use your plan, and you must update it continuously as the farm evolves. If the farm plan is a good one, most of it will come to fruition, and the simple act of creating a plan makes it easier to arrive at good decisions all season long and in the years to come.

What follows is a framework for making a plan, starting with a series of questions.

QUESTION 1

WHAT DO YOU WANT?

Although financial planning is a useful tool for decision making, especially as a rough tool for measurement, remember that it is not the ultimate goal.

The real question is, "What do you want?"

Start writing these "wants" down. Your list should be expansive and go beyond answering what kind of farm you want, but it should also include specifics. Get personal: what do you want for yourself? If there's a financial measure for the "want," write it down. For example, if you want to save for retirement, assign a number to the retirement savings goal.

If there's no financial measure, that's fine, too. For example, if you want time to sit in the hammock on sunny afternoons, write that down.

This will become a circular process and you'll check back in with the list later. Just because you've written your wants down doesn't mean they're set in stone. You can add more at any point. Start with a good list and then go on to the next question.

Sample List of Wants: Examples to Get You Thinking

Personally I want to:

- Make enough money to cover my expenses, have some spending money, and save for retirement ($60,000 per year personal income)
- Work on the farm not more than 40 hours a week
- Have time to ride my bicycle
- Have time to bake bread weekly and make good dinners from scratch at least five nights a week
- Have time and funds for vacations in the summer and the winter
- Throw monthly pizza parties for my friends and neighbors

I want the farm to:

- Be small enough to be worked by only myself, including all aspects of the business
- Be supported by a network of farmer friends
- Not require a tractor
- Grow food ecologically
- Make good food available to people of all income levels
- Have a strong connection to the local community
- Be a place where other growers are welcome to visit
- Be a testing ground for new tools and techniques

Plan the Way a Jazz Musician Practices

Remember, you can change the plan anytime! Some people's aversion to planning stems from a fear that it will be too restrictive. The plan is just a plan; it's not what actually happens. It's a practice round for real life — similar to a jazz musician who practices scales for hours but never actually plays one in a gig. With a plan, you're setting yourself up with good fundamentals so that when it comes time to perform, the decisions flow more naturally, with a kind of ingrained muscle memory. And like a jazz musician, I've found that the practice doesn't end after the first gig. Over the years, the process evolves and less practice (or planning) is necessary; but in the beginning, before the first gig, it's all practice.

QUESTION 2

WHAT DO YOU NEED?

The question of *need* sets a low bar, asking, "What is the minimum you require to be happy and to get by?" The question of *want* is a high bar — possibly out of reach now but attainable someday. Most folks create plans using that top bar, but having a bottom bar up front is really useful in assessing both immediate success and progress as things move forward.

Sample List of Needs: Examples to Get You Thinking

Farm site requirements:

- Half acre of good growing ground
- Reliable clean water with a minimum of 3 gallons per minute delivery
- A restroom and hand-washing station
- Storage for tools and supplies

- A shady spot for packing vegetables

QUESTION 3

WHAT DO YOU WANT TO DO?

This is slightly different from the first question of "What do you want?" This is asking, "What do you want to do on a day-to-day basis?" and "What do you want to accomplish?" If you've been dreaming of a small farm, you probably have a lot of this in your head already. Get as much of it out of your head and onto paper as possible. Giving the idea form helps move the process forward, and it communicates your goals to other people who might help, even in small and barely perceptible ways.

Many of the farmers profiled above made decisions to farm small because of how they want to work day-to-day. For many of them, including myself, part of the decision to stick to the compact scale was the desire to continue working in the fields, hands-on with all of the crops, as opposed to becoming managers coordinating big crews.

Refer back to this list regularly. The plan is just a tool, and you can simply change the plan, but you must do it consciously. It's easy for little decisions to cause you to veer away from the plan without really noticing that it's happening. Every few months, every year, or every few years, check back regularly to keep the plan current and relevant.

Sample List of Goals and Accomplishments: Examples to Get You Thinking

Goals for daily work:

- Spend more time in the field and less in the office
- Avoid working with power tools
- Stop working by 5 P.M. every day

Goals for next season:

- Sell all of the CSA shares before the season starts

- Reduce the amount of time spent weeding while increasing effectiveness
- Tie up all trellised crops before they get too big

Accomplishments from last season:

- Brought 20 new beds into production
- Sold 50 CSA shares
- Successfully tracked all expenses and hours worked and calculated equivalent hourly wage
- Happy with the quantity and quality of the produce distributed to CSA members
- Improved systems for growing seedlings

QUESTION 4

WHAT DO YOU NEED TO MAKE YOUR FARM PLAN WORK?

Under each of these headings, write out a short plan — at least a sentence or two — for how you will fill the need on your farm.

LAND AND WATER CONSIDERATIONS

I've lumped these two together because land seems obvious, but land really needs water with it in order to be productive, especially on a small scale. Too many people acquire a very nice piece of ground but don't realize their options are severely limited without water for irrigation.

LOCATION

At some point, you're going to need to buy something, and at some point you're going to sell something. The more rural you are, the longer it will take anything to get to you, and the longer it will take you to get product to your customer. It is also likely that transportation will cost more in one form or another. Most farm supplies are available

by mail order these days, and often it's more convenient to order something through a catalog or the Internet and have it delivered than it is to take the time to drive to a store and pick it up. Still, some things are heavy and expensive to ship (soil amendments, animal feed, lumber). It's nice to have a local supplier for some things, including regionally appropriate advice, and it's good to support those businesses so that they stick around.

As the operator of a compact farm, you don't need to be near a huge population; you just need to be near enough to a population that wants what you're providing and is large enough to buy it all. If you already have a location for your farm, consider what people in the area will buy and how you're going to get it to them. If you don't have a location yet, remember that market distance is a critical factor.

Having a community of other growers and agricultural professionals can be desirable. The Internet and smartphones with cameras have made it easier than ever to get advice from distant places and to share information and stories across distances, but there's no substitute for occasional in-person farm tours to see how other folks are doing it and social get-togethers with those who are experiencing the same problems or joys of farming in the same climate. Unfortunately, many rural areas still don't have great cell phone coverage or Internet service, so if you're looking for land and a cell phone or Internet connection is an important part of your plan, make sure you are moving somewhere with good access.

Another resource I take advantage of is the land grant university in Oregon. I have had more opportunity to work closely with Extension Service agents and researchers on projects that help me improve as a grower because I'm close to a research station.

WATER

Irrigation takes a lot of water — far, far more water than all household uses combined. Water-conserving techniques help, but you still need a lot of water. In a typical growing season here in the Northwest, I put about 60,000 gallons per acre (138 gallons per 100 square feet) on my fields. If you're raising animals, they will also take a significant quantity of water. Laying hens, which are probably the most common animals on small-scale farms, require about 25 gallons of clean water a week for a small flock of 50 chickens (1,300 gallons a year). A single milking dairy cow could require more than 200 gallons a week (10,400 gallons a year).

For a compact rural farm you may be able to get away with watering from a domestic well, especially if you receive regular rainfall in your area during the growing

season. Five gallons per minute per acre of production is considered a minimum for effective irrigation. This is irrespective of location and climate, although it is true you'll need more water in hotter, drier climates, and you might get away with less where there is regular rainfall.

In the Northwest, I've had success with giving fully mature plants a maximum of only 2 inches of water on hot, windy weeks, but in some conditions they might prefer more than 3 inches in a week. The Extension Service is a good place to get more detailed information about how to calculate water needs for your particular crops and soils. Remember that good irrigation not only conserves water, it also feeds the plants and reduces problems with pests and diseases.

Water requirements are similar across the country because crops tend to need about the same amount of water to grow and produce, regardless of climate. Sure, when it's hotter they'll need more moisture to cool themselves, but not by orders of magnitude — maybe twice as much at the far outside. And when it doesn't rain for a week or two in the summer, the amount of water you'll need to irrigate for that week is the same regardless of where you are, meaning that your system must supply the same amount of water in Connecticut as in Montana.

It is possible to grow crops without supplemental irrigation in nearly all parts of the country. This can be done by selecting appropriate crops, appropriate techniques, and appropriate soil conditions; however, the less water there is available, the less productive a limited space will be. When you're trying to maximize productivity for a very small space, having enough water is essential. Even in an area where there is normally good rainfall in the growing season, a couple of weeks of no rain will mean reduced productivity if irrigation isn't available (and used effectively).

The Extension Service as a Resource

There are agricultural Extension agents all over the world and their basic role is to help farmers use scientific information to improve their farming practices. In the United States, each state has a public Extension Service connected to the land-grant college. The states and counties, as well as the U.S. Department of Agriculture, provide funds for their Extension agencies, making each agency look different from state to state and county to county. Because of multiple funding streams, the program is often called the Cooperative Extension Service. Extension agents

usually work with any scale farm, and many states now have specific programs to help new, small farmers.

When the USDA took over the regulation of the term "organic" in 2000, the land-grant universities' research and Extension efforts shifted to help support organic growers, whereas past efforts were focused on chemical agriculture. Despite funding cutbacks over the past few decades that have limited the Extension Service's role in the agricultural community, there are now many excellent programs around the country available for organic growers, and corresponding research from the land-grant colleges and universities. Many farming issues are common between chemical and organic growers, and Extension agencies can often provide information and resources to help growers address all sorts of questions.

Calculating Water Needs

Plants vary in their water needs, depending on a variety of factors: size and growth stage of the plant, and weather considerations such as temperature, humidity, and wind. For mixed plantings where you might be watering plants at different stages of growth, I've found 1 inch of water per week to be a good starting point; this is a commonly cited average. The frequency of watering depends on your soil's water-holding capacity and the rooting depth of the plants. In most cases, I've found one or two waterings per week to be sufficient, but I know growers who irrigate much more often than I do.

To calculate the water need for an area, you must convert the 1-inch measurement to something more useful, usually gallons. The 1 inch of water measurement simply means the amount of water necessary to cover a given space 1 inch deep if the water didn't soak into the soil and there were barriers around the area to keep it from running off.

When calculating water use with sprinklers, take into account that they are not 100 percent efficient; some percentage of the water will be "wasted," or at least not used by your crop plants. You may have to put as much as 50 percent extra water (1.5 × your calculated need) through the sprinklers in order to get the full 1 inch of water to the plants. Good design and timing of irrigation can minimize this loss;

drip tape is much more efficient and will use only a little more water (1.02 × your calculated need).

Converting 1 inch of water for a given space into gallons is easy.

1. Measure a growing bed. For example:
   - 30 inches wide (2½ feet)
   - 40 feet long
   - You want to cover that bed with 1 inch (1/12 foot) of water.
2. Do the calculations. You have 2½ × 40 feet of growing space, or 100 square feet. 100 square feet × 1/12 foot = 8⅓ cubic feet of water. There are 7½ gallons in 1 cubic foot; therefore, 8⅓ cubic feet equals 62½ gallons.
3. Plan to give every 100 square feet of planted space 62½ gallons per week, depending on conditions.

Water Quality

The total quantity and flow rate of water are important considerations, but so are quality and cost. For irrigation, surface water sources such as ponds and streams are commonly used, usually with some filtering. Water used for washing and packing fresh vegetables typically requires more treatment; potable water is the best choice. For animals, their drinking water must also be clean.

There are a few water quality issues to pay attention to, although there isn't much consensus about where to draw the safe lines for different contaminants and different uses, and likely contaminants vary from water source to water source. You should check with experts in your area when testing water. Actually testing the water is relatively simple once you figure out what you're looking for, since we as a society already do so much testing to make sure water is clean for drinking. Find a local lab, or a mail-order one, and get sampling instructions and containers. Depending on what you're testing for, it probably won't be too expensive for a one-time test, but if you must test regularly (as can be the case with surface water), the costs can add up.

The U.S. Department of Agriculture has recently released rules for irrigation and wash water for fruits and vegetables as part of the Food Safety Modernization Act (November 2015). Their rule only addresses *E. coli* as a potential water contaminant, and it sets up testing schedules for farms covered by the rule (most compact farms will be too small to be covered by the rule). Do some research on the topic and make your own decisions based on the available science. Indeed, food safety is paramount, but keep in mind that with all of the food produced here in the United States in gardens and on farms, and with all of the food imported into this country, there is only a minuscule quantity of contamination from bad water. Though the risk of food safety problems is a small one, the consequences can be deadly, so it is something to be aware of and to deal with in informed, commonsense ways.

Designing In Safety Factors

When engineers design anything, they always have a safety factor in mind. For example, when a critical car part is designed, the engineers will usually use a safety factor of 2, meaning that the part is twice as strong as needed to handle the highest expected stress it will see in normal use. If a part isn't critical it might be designed with no safety factor, meaning it is just strong enough and it will break if used beyond the limits that the engineer anticipated. Typically, the lower the safety factor, the lower the initial cost, but the higher the risk of failure.

On the farm it's good to think about including a safety factor when designing systems, and to take this concept beyond simply thinking about strength. With irrigation systems I typically leave a 1.5 to 2 "safety factor" in the maximum flow. This means I don't design the system just big enough to handle my biggest anticipated week of irrigation, I design it so that if I miss a few days of irrigation (due to an unanticipated problem) I have enough flow to catch up. Similarly, when I'm thinking about labor scheduling, it's nice to have little safety factor, in case someone gets sick or has a family emergency.

Cost

Pumping surface water usually involves some expense in setting up a pumping system. The actual cost of running the pump is usually low as long as the labor to turn the pump on when it's needed isn't too great and electricity or fuel is readily available. Depending on how clean the surface water source is, filtering can get quite expensive, especially if there's a lot of algae, which is one of the hardest things to filter out.

Productive wells can be quite economical if they aren't too deep and the water is clean and plentiful. The initial expense of drilling and installing a pump and the related plumbing is relatively expensive, but well pumps typically run on electricity and are fairly clean and efficient.

Municipal water is usually very expensive, in terms of both access (especially if there is no existing water meter and hose bibs on-site) and the water itself. In most cases little filtering and no additional treatment are needed.

The rules about use of water vary quite a bit from state to state and county to county. Just because there is water on the property doesn't necessarily mean you can use it. There can be restrictions on what you use the water for and how much you can use. In some cases, limits can even apply to rainwater that falls on your land, so it's worth researching the regulations in your locality.

LAND

With the basics of water behind us, we finally get to the land. The most obvious aspects of the land are the topography and the vegetation. The topography, in conjunction with the climate and the soil types, is very important in determining what uses are appropriate. Steep slopes are usually inappropriate for annual crop production, due to

erosion concerns. Shallow south-facing slopes are warmer and collect more sunlight than shallow north-facing slopes. Flat and bowl-shaped spaces tend to have less airflow than slopes do; lack of airflow can cause disease problems, although it also helps conserve moisture — two sides of the same coin.

The desirability of a piece of land's topography depends on climate and the crops. Grass for grazing might benefit from a north slope in a hot, dry summer, but tomatoes prefer a south-facing slope in a wetter, cooler climate.

Look at existing vegetation (if there is any) to learn about the soil and the growing conditions in a plot of land. Lush grasses or pastures usually indicate high fertility with good moisture and are often an indication of heavier, richer soils. Thin, weedy patches could indicate the opposite, or they can be a sign of compaction or water-logging. Even in seasons where plants aren't actively growing, you can check the residue from the previous season (if it hasn't been disturbed) and get an indication.

Digging in the soil, touching it, feeling the texture, and smelling and tasting it (touching your tongue to it) can also tell you something about it. Is it gritty and loose or smooth and sticky? What color is it? Does it smell sweet, earthy, or sour? Are there rocks, pebbles, or earthworms? How does it change from one place to another and from depth to depth? Soil is complex and the variations are endless, but they also exist on a continuum, and the best way to learn about them is to physically work with them and pay attention. There's no substitute for just paying attention to the real thing that's all around you every day.

Note how quickly water infiltrates (soaks in), how hard or loose the soil is, how easy it is to break up into small pieces, how easy it is to penetrate with a stick or a shovel, the color, and how fast it dries. These traits tell you something about how often you'll need to water your plants, and they can also indicate potential fertility, or the soil's ability to hold onto nutrients. Color is frequently an indicator of the organic matter content, with darker soils containing more organic matter, a quality that is almost always beneficial. The texture and tendency toward compaction will indicate how sensitive the soil is to tilling when moisture levels aren't exactly right, and they may also say something about how difficult it may be for plant roots to penetrate.

Experienced farmers may be able to "read" the plants growing in the soil and get a good idea of what nutrients it lacks, and even the rates at which they should be added. As you get started, it is much simpler, and not at all expensive, to send soil samples to a lab for testing and recommendations — and frequently this is how the experienced farmers learned to read their plants in the first place. Soil testing is an excellent tool for deciding what amendments to add to the soil to get good production and improve the

land long-term. Still, it's no substitute for good observation and a bit of historical knowledge of the specific land use, its geology, and the local climate; all of these approaches to learning your soil characteristics complement each other well.

INFRASTRUCTURE

If you want to start on the cheap and you're smart about it, you can get away with very little infrastructure on the farm. Compact farms typically rely on adding value to their products in some form, and that almost always requires a bit of extra infrastructure. This may be as simple as cleaning up the produce and packing it nicely so it looks appealing, or it may go to the level of creating a ready-to-eat packaged product. Because, by definition, there is limited land on a compact farm, the land that is there needs to be very productive and the grower needs to be extraordinarily efficient to succeed. Smart investments in infrastructure will pay off with increased productivity and efficiency on the farm.

Water Distribution

A water distribution system for irrigation, livestock water, and cleaning produce is an absolute must on the farm. What that distribution system looks like will vary widely depending on the source of water, what it's being used for, and local regulation about water use. In many rural settings, a well with an electric pump might be common; so is a pond or stream with a pump powered by a gas motor. If the property has a gravity-fed spring, the farmer can rig up a system with a holding tank or pond to maintain pressure or allow higher flows for short periods of time. There are also clever pumping systems such as water rams that require no electricity but use excess water flow to move water uphill. In more urban settings, municipal water is often the only option for watering. Rainwater catchment might provide some backup water or even be sufficient by itself, in consistently rainy areas, to provide irrigation and washing water.

When planning for water distribution, give some thought to how the water will get to the areas of the farm where it is needed. It's important to calculate flow and pressure so that pipes and hoses are all appropriately sized. For areas that freeze, think ahead to winterizing water distribution systems to avoid broken lines. Most irrigation suppliers can help with these issues, often for free with the expectation that you'll buy the materials from them. Start out, though, by reading up on irrigation design and get a good understanding before talking to the salespeople; this will help ensure the professionals

are really designing the system that you need, and not just one that is convenient for them to sell you.

Storage

The second required piece of infrastructure is a place to keep tools and supplies. For tools, this means a dry place out of direct sunlight. Except for metal, sunlight breaks down other materials over time: plastic, rubber, paint, wood. To keep your tools in good shape, you want them dry and in the shade.

There are many other supplies besides tools that need storage on the farm. Seeds and amendments, especially organic nitrogen sources, need dry, dark storage that is also rodent-proof and, if possible, insect-proof. Seeds need a space that is consistently cool. Very hot conditions can damage seeds, and wide temperature swings can cause moisture to condense. You definitely don't want your seed stock to get wet while it's in storage, as it will usually ruin it, or at least reduce its shelf life. If you have livestock, you'll need a dry and rodent-proof place to store feed.

Other things requiring storage include irrigation supplies, trellising materials, row cover, greenhouse plug trays, harvest totes, fencing, feed and water troughs, and other miscellaneous and task-specific items. Some of those might be able to live outside, but they will all last longer and stay in better working order if you store them in a dry place out of the sun when they're not being used.

Storage could be as simple as a corner in your house, but typically it's going to be a shed or small barn space. Used shipping containers can be good options as they are typically dry, weathertight, and rodent-proof. Depending on where you live and the price of scrap steel, a shipping container may be cheaper than building a similar structure, and containers can be moved if needed. Storage spaces don't have to have heat, water, or even electricity; as you design your storage spaces, however, keep in mind how you'll use them — maybe it would be helpful to have a light for the back corner of a dark space, or an electric outlet for charging batteries, or heat for those cold months you'll spend working on equipment repairs.

Roads and Paths

I often think of the farm as a microcosm of a city. Water and power are commonly distributed around the city as they are within a farm, creating a robust and functional system. There's also a need for transportation around the farm, a network of "roads,"

which on a compact farm may just be pathways. Someone once told me that farming is just moving piles from one place to another. Creating good pathways for moving those piles is important to the success of any farm.

There are many options for surfaces. My personal preference, in my climate, is grass wherever I can get away with it. Grass sod requires mowing, but there are commonly available tools for that and the clippings contribute to soil organic matter. Grass offers habitat for other small animals and insects, both good and bad. Grass is flexible in the sense that if you ever decide you want to move the road, it's relatively easy with farm tools to turn where it was into something else, whether plantable or buildable.

At the opposite end of the spectrum is hard paving, with gravel, asphalt, or some other hard surface. Paving is mostly impermeable to water, requiring a corresponding way to take care of runoff when it rains. Typically, runoff is diverted to a low spot, a ditch next to the road, or just a wide expanse of grass. Paving is relatively expensive to install, and if you ever want to move the road it's similarly expensive to uninstall, but a paved road does allow heavier traffic and is essential if you want to get big trucks into places when soil is very wet (important if you want people to deliver supplies to your farm). There is less maintenance for paving than for grass, but gravel roads still need regrading and new gravel applied every so often, and even asphalt has to be resealed over time and the potholes filled.

There are other options between those two extremes. On compact farms, wood chips are one of the most common pathway materials for footpaths or hand-cart paths in heavy traffic areas. Wood chips work well, but they require quite a bit of work to install thickly, and they must be reapplied regularly to maintain weed control, because the bottom layer is continually breaking down and reabsorbing into the soil. If you can find a local tree service to dump wood chips (and you have a place to have them dumped), you may get them for free, although you'll still have to move them to apply them to the pathways.

I've used woodchips around greenhouses and typically need to re-chip the paths annually. You can underlay the chips with cardboard or weed cloth to make the layer more weed-proof. I haven't done that and as a result I get quite a bit of blackberry and dock coming through the chips. It's a bit of a pain but I'm successful in hoeing those out every month or two with big chopping hoes. (For this task my current favorites are Rogue 55F and 70F hoes.)

Greenhouses

For vegetable production on compact farms, it is the norm to transplant most crops, and for that you need "starts," or seedlings. Most small farms produce their own starts, which gives them more control over the varieties they are planting, the timing of planting, and the quality of the plants. It is possible to work with a larger nursery and to "buy in" starts; in many cases, this may actually be less expensive than the full cost of building and managing a space for propagating seeds to produce them. On the other hand, propagation houses are usually capable of generating more income per square foot than field crops, so the investment in extra propagation space to produce plants for sale can provide a good return for compact farms, especially if there's local demand from gardeners who can't start their own seedlings.

People use numerous overlapping terms to describe greenhouses and similar structures these days: propagation houses, solar greenhouses, hoophouses, cold frames, low tunnels, high tunnels, field houses. I think of greenhouses as spaces set up to propagate seedlings, most typically having some supplemental heat and active ventilation, and I use the terms "hoophouses" or "tunnels" to describe other covered growing spaces, most often used for in-ground production. There are specific meanings behind all of the terms, but they are often misused and interchanged; the reality is that on compact farms, greenhouses are frequently used for nonpropagation purposes, and tunnels frequently get used to help produce seedlings as well as in-ground crops.

Greenhouse designs can be very climate-specific. Here in the Northwest, we can get away with very little supplemental heat, but we need as much light as possible coming in from all directions because it is frequently overcast in the winter and spring, and we are far enough north that the early and late sun can be quite low in the sky. In colder climates with sunny winters, north walls are frequently solid insulated walls to save on heating costs. In warmer, southern areas, propagation spaces might be just a shaded area open to the outside air with no supplemental heat at all, but providing protection from intense sun and pounding rain.

No matter where you are, the ideal conditions for most seedlings are the same, and that's what you're trying to create with a propagation house: temperatures between 60 and 85°F, even moisture and humidity, light airflow, and gentle watering. Some vegetable crops prefer the higher end of this temperature range, and some prefer the lower. Most flowers and herbs also follow this pattern, although there are a few that have special germination requirements. Seed packets will typically give specific instructions for those.

For propagation, the most common type of greenhouse structure for small farms, across all climates, is a hoop structure, covered with 6-mil (0.15mm) greenhouse

plastic. Hoops are typically steel, but to keep the cost down on very small structures, some folks get away with hoops of Schedule 40 PVC. In the long term, steel hoops are probably more cost-effective, and they are definitely stronger. If you are going to use PVC, Schedule 40 is counterintuitively stiffer and more suitable than the heavier Schedule 80, but it's not UV stable so it degrades in sunlight unless it is painted. Schedule 40 PVC also interacts with and degrades the greenhouse plastic, so painting PVC pipe does double duty to slow that process.

There are endless variations on the design of endwalls for hoophouses. For very small houses (roughly 12 feet wide), it's typical to frame a simple door on either end, using two 2×4 or 4×4 posts sunk in the ground, which also help support the end hoop. For 20-foot or wider houses I usually build wood-framed endwalls with French double doors that allow me to open a small passage when it's cold out, but get a cart in when necessary or open up for more ventilation when it's warm. In addition to the doors I usually add ventilation louvers or windows and an exhaust fan to move air through the house.

The more internal volume a hoophouse has, the more slowly it will heat up during the day and cool down at night. The cost per square foot can also be a little lower since there are similar numbers of parts and proportionally less steel per area. For this reason, 30- or 35-foot-wide, very tall hoophouses or even "gutter-connect" houses are common on large farms. In a "gutter-connect" layout, larger hoophouses, as well as more highly engineered greenhouses, are created by setting structures side by side with shared interior walls; gutters at the top of the shared walls drain rainwater.

Greenhouses benefit from having access to utilities: water, electric, and gas. Water is an obvious and essential need. Electricity is usually used for ventilation fans, automatic ventilation louvers, and HAF (horizontal airflow) fans that keep air circulating in the house, evening out the temperature and humidity. Electricity is also useful for plugging in all sorts of items such as heat mats for improving germination, vacuum seeders, and lights for late-night visits or to reduce eyestrain on stormy days when working with small seeds. Gas is useful for heat and is commonly used in conjunction with electricity for forced-air heaters or for water heaters for bottom-heat systems.

There are many ways to work around lack of electricity and gas in propagation houses. Ventilation control can be manual or supplemented with thermally expanding wax cylinder vent openers. Kerosene heaters, or other heaters with a self-contained fuel supply, can provide supplemental heat. I've used portable 100-pound propane tanks to run a water heater for months at a time, and 20-pound cylinders in a pinch.

Finding What Works for You

With greenhouses, I'm comfortable in a 20-foot-wide low-profile Quonset-style hoophouse. It's a bit more expensive per area than larger houses, but the smaller size is easier to install and to change the plastic on, a task that happens every eight years or so in my neighborhood. It's big enough to walk in comfortably; as I've developed my systems and "furniture" around that size, I've become familiar with how it works. The smaller span makes it a little stronger in our rare snowstorms, and a little easier to clear if it does snow. It's a style that's particular to my habits, climate, and needs.

Folks on different farms, and in other parts of the country, have different preferences based on their own needs. If you can find a good local greenhouse supplier, they will usually know the particular design considerations for your area. We happen to have a very good one, Oregon Valley Greenhouse; its staff knows our climate well and their recommendations have been excellent for my needs over the years.

Hoophouses

Beyond propagating seedlings, hoophouse structures are very useful for extending harvest seasons and for increasing yields on certain crops. Depending on the size, the structure, and the climate, opening up doors on the ends might provide enough ventilation when the sun is out. Roll-up sidewalls are also common for summer production; in hotter climates, shade cloth — or simply covering the plastic with a mud slurry to cut down on solar gain — also helps moderate temperatures while protecting crops from any damage that rain or direct sunlight may cause. The hoops also provide a structure for trellising climbing crops. In the winter, a tightly closed, but otherwise unheated hoophouse can provide enough protection in many climates to allow year-round production of hearty greens and roots.

As hoop structures have become inexpensive, it has become common for compact farms to have separate structures for propagation and for in-ground crop production. In many cases, the propagation space can double as in-ground production space when it's not being used for propagation.

Livestock Housing and Shelter

If you're going to have livestock on the farm, you're also going to need a place to house them when they're not on pasture and to shelter them when they are on pasture. Housing needs vary, depending on the type of livestock and your location's climate. Small livestock usually need protection from the weather and from predators; larger livestock may be fine in most weather but still need protection from the sun during particularly hot weather. Pasture ground also needs protection from overgrazing at times, and from compaction during wet weather.

Hoophouses can actually serve double duty as structures for livestock, although some of the construction details may be modified. Small versions of hoophouses or other structures can be made mobile with wheels or skids. Livestock housing needs access to water; regularly filled water tanks can fill this need. Electricity is not necessary, unless you need to provide warmth for young poultry.

It's not a good idea to mix livestock and crops that will be eaten raw in the same hoophouse at the same time; there is potential for fecal contamination of the crop through dust, water, or even boots.

For poultry and larger livestock, rotational grazing is a common practice. Electric netting and wire fencing can contain the livestock in the desired area and protect them from predators. Typically, this fencing is backed up by hard fencing; if the electric fencing fails, the animals still won't get onto neighboring properties or run out into the road. Hard fencing is usually some sort of wire held up by posts. The type of wire — woven, welded, tensile, barbed — will depend on the animal you want to contain or the predators you want to keep out.

Harvest and Packing

It is possible to farm without infrastructure that supports washing, packing, curing, storage, and distribution of products. I know of some very large farms that harvest straight onto trucks that take produce away to a processor or packer who does all of the packing work, and I've seen farms that field-pack on giant trailers pulled by tractors. But I know of no compact farms that don't have some little space dedicated to packing the farm's produce.

That said, the cost and sophistication of infrastructure to support these tasks varies from farm to farm based on product mix, marketing approach, climate, the personality of the growers, and the characteristics of the farm property. I do know of many compact

farms — including my own — that started out packing just in the shade of a tree, or under a tarp, but most eventually went on to more permanent structures.

When planning for cleaning and packing, I break vegetable crops into several categories based on my preferences and my particular processes.

Leafy greens usually get dunked in tubs of water to help them cool and hydrate and to rinse off any debris or soil. They usually drain on their own, but specialty salad greens can benefit from spinning in a salad spinner to keep them from holding onto too much water and suffering from soft rot. Some folks use a gentle spray in place of the tub, to prevent problems if the water in the tub should become unintentionally contaminated. Some folks pack without washing at all.

Roots (beets, radishes, carrots, and so on) are a different beast and they usually get sprayed down with water if they are in bunches, or if they are loose they might go through a tumbling root washer that agitates and soaks. Slatted or mesh tables are commonly used for both spraying down and sorting such crops.

A number of crops, particularly fruiting parts of plants and some fresh herbs, don't get any cleaning at all before packing — or maybe just get wiped off — but they require some type of sorting or grading.

Garlic, onions, and winter squash, as well as a few other crops, all require curing if they are to be stored. Curing requires a way to encourage good airflow; you must maintain temperature and humidity within a certain range during the curing time. This is frequently as simple as hanging garlic bunches from rafters in a barn or piling winter squash in the corner of a shed.

Markets sometimes demand a certain type of packing. Examples are specific case packs (such as 24 heads of lettuce per case) and size requirements for wholesale crops (such as potatoes that must be a minimum of 1⅞ inches in diameter); customers at a farmers' market may prefer bunched carrots to loose carrots. With the exception of large wholesale accounts (not a common customer for compact farms), such requirements are not standard from place to place. When it comes to selling directly to customers, you can usually be more flexible and explain choices that may be unconventional.

On the other hand, asking customers to change their expectations too quickly could cause sales problems if they already have a strong opinion about how clean or uniform they want their vegetables. Knowing your customers' wants in advance and creating the

tools and space to meet those expectations can make a big difference in your ability to sell products and build a strong customer base.

Harvest and packing are two of the biggest costs of production on most farms, taking more labor than any other single task. It always makes sense to streamline these processes as much as possible while still keeping in mind quality. Upgrades to systems and tools to cut costs, improve ergonomics, and increase yields and quality in washing and packing are often some of the best investments you can make to increase profitability on the farm.

Product Storage

Some compact farms are able to get away with little or no storage space for their products by harvesting and selling them all within a day, but such harvest days can be very long and stressful. I got away with it for four years by specifically designing my systems around the idea of having no storage on the farm. However, having storage for different types of crops can make a big difference in the quality of the crops — specifically, how long they keep for the end customer — and can greatly simplify and streamline harvest days.

There are several basic types of storage space for produce. Most produce must be stored with high humidity to keep it from wilting. Cured crops such as onions and garlic need a drier space, still with some humidity but not wet. Seed crops need very low humidity and usually benefit from good airflow to keep moisture moving away from the crop.

Many farms get away with just a cold space of some sort. Reach-in coolers (usually repurposed drink coolers from convenience stores) are not uncommon in very small-scale operations, and many farms, even compact ones, have a walk-in cooler. These coolers hold temperatures below 40°F. A warmer but rodent- and insect-free space is good for many fruits such as tomatoes and summer squash. Try to keep the space consistently below 55°F. Freezer space is less common, as it's expensive to install, run, and maintain, but a freezer can enable farms to extend the sellable life of highly perishable crops such as berries and meats.

For fresh produce, there is currently little regulation of washing, packing, and storage conditions, although farmers are liable for any illness that results from poor handling on their part. This is changing slowly, and the Food Safety Modernization Act rule the FDA has recently released includes material on testing and treatment of water, record keeping, and written procedures on the farm. Almost all compact farms will be

small enough to be exempt from inspections, but the rules still apply. (Check the FDA's rule for current exemptions; as of March 2016 the exemption is for farms with less than $500,000 gross sales, with the majority of sales direct to end users who are in the same state, or within 275 miles of the farm.)

Meat, eggs, and dairy, with higher risks of food-borne illness associated with them, are much more highly regulated, and regulations vary from state to state, and even from county to county. It's important to check with local health departments and Extension Service agents to learn what is required before you start your operation.

Mixing livestock and produce on the farm also introduces some extra risk of cross--contamination both in the fields and in storage. In storage, the two types of product must be segregated to prevent cross-contamination, just as you would put meat below produce in your refrigerator to prevent it from dripping on the produce. There is also potential for unintentionally moving manure from livestock areas to produce areas of the farm via boots, clothing, or, even worse, hands. Hand-washing stations are essential, as are places to change, or wash, boots and clothing in between working with animals and produce.

Product Distribution

Whether your product comes out of storage or straight from the field, give some thought to how your product will be distributed, not just how it will be washed and packed. The simplest method is to have a buyer's truck waiting to pick it up and take it away. If you're a big grower with a wholesale or processing contract, that might be possible. For most small farms, distribution is a little more complicated than that, but still pretty straightforward, with the product going into a truck that's loaded at the edge of the field — or more likely, from storage areas in the packing shed — and then driven to market or deliveries.

Even on a small scale, it might be worth building a loading dock and using pallets, or at least employing a loading ramp and a hand truck. These kinds of tools and infrastructure not only save time, they can significantly reduce wear and tear on the body over time.

Some farms are able to get the public to come and buy or pick up their produce on the farm. This might be at an on-site farmstand or, as is common with some CSA farms, in the corner of a barn.

More Resources for Season Extension

Eliot Coleman has written the most complete book on the topic I've ever seen. *The Winter Harvest Handbook* is a great resource for growers in northern climates and draws on Coleman's decades of experience growing through the winter in Maine.

Growing for Market, a trade journal for market farmers, has published many articles over the years on season extension in tunnels. Lynn Byczynski has collected much of this information into *The Hoophouse Handbook*, which is available on the Growing for Market website (growingformarket.com).

Processing

Harvesting and selling raw produce in "whole" form is considered packing, not processing, and processing carries with it another set of regulations and inspections to keep the public safe from food-borne illnesses. Once you start cutting up things, or mixing, or "washing" to make something ready to eat raw, you move into the realm of processing. For some produce, the line can be a bit hazy; for example, bagged salad mix has been a longtime product that many consider processed, but some farmers treat it as if it were "raw" product. Cutting fruit or squash also moves it from the raw to the processed category.

Processing regulations are typically designed for industrial-scale agriculture and are not well adapted to compact farms. Different states may have different rules for small-scale on-farm food processing with less stringent facility requirements than those in place for large-scale processors.

Commercial kitchen facilities with features such as washable floors and walls, hot water, refrigeration, and ventilation that meet specific standards, and regular inspections are typical of the minimum requirements for nonexempt processing. This can represent a significant investment; these on-farm facilities are allowed in many places but you should check your local zoning laws to determine if processing, or certain levels of processing, are allowed in your particular location.

Retail Space

As with processing, rules for retailing directly from the farm vary quite a bit from place to place; typically the county is the government body you'll need to check with to determine what is allowed. If you're in an urban environment, it may be the city. In my part of the country, land zoned as farmland can have an on-site farmstand by right. Even in Portland, Oregon, you can now sell produce grown on residential property directly from the property. There are still rules, though, about what can and can't be sold from the farm and how much of it can be sold.

Office

It's possible to do all of your office work at the kitchen table, but it's nice to have at least a little space dedicated specifically to the farm administration. Personally, I like to have a small desk for making notes, planning, and corresponding with customers and suppliers. There are always paper records to save for taxes, as well as paper records for planning and marketing. A filing drawer, with hanging files, is very useful for this. A single small-drawer filing cabinet has been more than enough for me, but as the years go by and paper records collect from previous years, I've found that I also employ a few boxes to supplement the filing cabinet.

Housing

Housing is not actually a requirement for a compact farm. For many, living on the farm is a primary goal, an integral part of the dream, but as the profiles in this book show, there are probably as many folks living off the farm as there are living on it.

I've lived on farms where I worked and I've lived off the farm. I like living on the farm, scheduling my days with big breaks in the middle and not worrying about commute time, not having to pack a lunch and snacks, and, of course, living in a beautiful setting.

Living off-farm has some advantages too. A physical separation can give a mental break from work. Living off the farm has taught me how to make more systems automatic and resilient, since I'm not there in off hours to take care of emergencies. Most small livestock operations, however, require more attention and it is much more difficult to design systems for livestock that allow you to be away from the farm.

Housing for workers is also something to consider. If housing on the farm isn't an option and there aren't good housing options in the area, you might have a harder time keeping good employees. I've found that one advantage of farming close to an urban

area is the big labor pool. Many of my more rural farming friends have a harder time finding people to work for them, especially if they don't have housing on the farm.

Bathrooms

Last but not least, having a bathroom on the farm is important. Especially in leased fields where there is no on-site housing, you and your coworkers must have access to a toilet and a good hand-washing station. If you have employees of any sort this is most likely a requirement. Hand washing can be taken care of with pretty much any clean water source — and from personal experience, warm water in the winter makes a big difference. Hand sanitizer is not considered a substitute for hand-washing stations on farms.

Renting or buying chemical toilets is an option where there isn't preexisting access and it would be too expensive to install new plumbing. Composting units might be an option, but they are regulated differently from area to area, so check your local regulations first.

Plan It All Out

By answering each of the following questions you'll come to a better understanding of the farm you want to create. This isn't a test; there are no right or wrong answers. Short answers are better than no answer at all, but the more complete your answers are, the better they'll help you to avoid problems as you move forward.

What do you want? If everything were going perfectly, what would that look like?

What do you need? What is the minimum to make this work for you?

What do you want to do? What tasks do you enjoy doing on a daily/weekly/monthly basis? And what do you *not* want to do?

What infrastructure do you need to make your farm plan work? How will you address each of the following?

- land and water
- water distribution
- storage for supplies and tools
- roads and paths
- greenhouse/propagation house
- hoophouses
- livestock housing and shelter
- washing and packing facilities
- cold and dry storage areas for produce
- distribution facilities
- processing facilities
- retail space
- office space
- housing
- bathrooms

MAKING IT WORK FINANCIALLY

Farming is fairly universally considered to be a low-paid profession. This is especially true of farming on a small scale, but the big guys don't necessarily make a lot either. Most folks know this when they get into it; they are in the farming profession for a love of the work more than for the paycheck. Even though no one is raking in millions by starting a compact farm, many people operating them live comfortable, happy lives.

Money, specifically personal or private business finance, is not a topic many people feel comfortable discussing. When I first became interested in farming, I looked for books and reports that would give me some sense of the actual numbers behind a farm business. I didn't find any. Over the years, as I've worked for a number of farms and seen some of the financial numbers, I've realized it is difficult to put a single number on how much a farm will make per acre, or what the one best crop will be for a particular farm, or even how to set prices high enough to make a living and low enough that people will still buy the produce. I asked the farmers profiled in this book about their financials and a few were willing to share some numbers with me, but most did not want to make those numbers public. I will address the subject in a general way to give you, the reader, a jumping-off point as you imagine what is possible for your own compact farm. In this chapter, I define some basic business vocabulary and offer a framework for achieving a better understanding of those terms and the numbers.

A few compact farm operators (myself included) have put out actual numbers from their farms, so I'll refer to those. There are two excellent books on the business side of small farms that have been published in the past few years and I recommend them for anyone wanting to learn more.

The Organic Farmer's Business Handbook by Richard Wiswall takes a look at Wiswall's own small farm in Vermont, with details on how he runs the business side of his operation. The Midwest Organic and Sustainable Education Service (MOSES) put out *Fearless Farm Finances*, an overview with profiles of different kinds of farms.

You can also find crop enterprise budgets from the land-grant universities around the country. The problem I've had with using these budgets is that they are typically set up for growing crops on large acreages, in the realm of at least 10 acres but more likely hundreds or even thousands; they are written for single crops with the expectation that the person reading them is already farming and just looking for a crop to switch to and improve profits. These budgets might provide a starting point for looking at individual crops, but every farm is different.

GROSS PER ACRE

Gross is the total amount of income generated; on farms it's typically presented in terms of gross per acre. This is an easy place to start when planning.

There's a huge range of gross-per-acre numbers. Big farms growing commodity crops gross hundreds or even thousands of dollars per acre — obviously too little to be able to make a living on a small acreage, even if you didn't have any expenses. But those farms also have expenses in the hundreds to thousands of dollars per acre, so they don't profit much per acre; they rely on farming at that scale to make their money.

Making a living on a compact farm is possible because growing mixed vegetables and other specialty crops, especially with direct marketing, has the potential for a high gross per acre. In the areas where I've worked, I've seen farms in the 10-plus-acre range commonly grossing between $15,000 and $25,000 per acre. On my compact farm, I had a target of $100,000 per acre, a number Jean-Martin Fortier cites as the high end for a "smoothly running market garden with good sales outlets." My actual gross per acre in my first four years hung around $65,000; Fortier tells me he is grossing about $75,000 per acre at Les Jardins de la Grelinette, although there is variation from year to year due to many factors. Stephen Cook was very open with his numbers, and he too is in the $55,000 to $65,000 range of gross per acre at Cook's Garden. I have heard of compact farms grossing more than $200,000 per acre, which is close to the top end of expectations.

To provide some perspective, consider these factors that have an impact on the gross per acre:

Crop selection. Choose a crop or crop assortment that has both a relatively high price in the market and a good yield. You have some control here, but you can't turn a typically low-yielding, low-priced crop into one that will make you a lot of money per acre.

Fertility and growing conditions. Fertility and growing conditions (weather, pests, diseases) play a role in determining the potential gross from a crop. Yields can vary tremendously from location to location. As a grower, you have some control over this, but only so much, so keep in mind that your production methods can affect your profitability both positively and negatively (see the next section on Expenses).

Markets. To get a good gross per acre, you need good sales outlets and to put energy into selling what you grow. Even if your yields are high, if you can't sell nearly all of what you harvest you'll have trouble getting a high gross per acre.

Length of season. Climate makes a big difference in your potential gross per acre because that number is the sum of annual income. If you live in the far north, your typical growing season might only be a few months, allowing only one or two crops on the same piece of ground in a year. If you have a 12-month growing season, you might be able to grow three or four or, with some plants, even a dozen crops a year on the same ground. The yield on any one of those crops might not be huge, but when you add them all up the gross can be very impressive.

EXPENSES

Out of your gross income, you'll need to pay all of your expenses. Expenses are typically divided into two types: variable expenses and fixed expenses. Variable expenses include seeds and harvest labor, costs that are easily and directly linked to the quantity of produce you are growing. Fixed expenses usually include insurance and leases or mortgages; these fixed expenses aren't always static, but they don't change significantly unless you drastically change your operation. By separating your expenses into categories (e.g., seed, harvest labor, insurance, lease) and separating those into variable expenses and fixed expenses, you will find it easier to see how changing your crop mix, or the size of your production space, or any other variable on the farm will impact your bottom line.

Expenses on small farms commonly run between 20 and 60 percent of gross income, not including labor costs. That's a huge range and speaks to the uniqueness of each operation. Obviously, you want to keep your non-labor expenses low in order to leave as much gross income as possible to pay yourself and any other labor on the farm. It would also be nice to have some left over to reinvest in the business or to save for a rainy day (see the section on cash flow). Many of the farmers profiled in this book credit their success to frugality and keeping their expenses very low. At Slow Hand Farm, I managed to keep my expenses at less than 20 percent of gross income, which I felt was very good, but whether it was sustainable is questionable, considering that the farm no longer exists in its previous form.

It is possible to keep your expenses too low. Avoiding an expense just because it is an expense does not always make sense. Some expenses will help increase your gross income enough over time to make up the cost. This is what is called an investment, and it may be a labor-saving tool, buying added fertility that increases yield, spending more on seed for a more productive variety, or even increasing a particularly effective employee's pay to keep her or him on staff.

CASH FLOW AND CREDIT

People who have never run a business often overlook the importance of cash flow and misunderstand the utility of credit. Usually, when people crunch numbers for a business, they look at how much money they think a business can bring in each year (gross income) and how much they will spend in that year (expenses). The problem in farming (and in most business) is that the gross income often arrives long after the expenses are due; businesses need a way to pay the expenses before they actually sell anything, and farms are no different. This is cash flow. These days, with credit card use and monthly billing, cash flow issues are often easier thought through on a month-to-month basis.

When planning out your business, make sure to do a cash flow budget estimate — calculate for each month of the year how much money the farm is expected to bring in and how much it expects to spend. This estimate can show you how much money you'll need to cover expenses in months where you don't have enough income or savings (cash flow) to pay for everything.

In months where expenses exceed income, many businesses turn to short-term credit or an operating loan. There are other creative ways to make up the gaps, sometimes as simple as delaying the purchase of supplies that won't be used until later in the season. One of the great things about farming on a very small scale is that these gaps are often small enough that personal savings and extreme frugality can go a long way toward closing them. One of the oft-cited benefits of the community-supported agriculture model is its ability to involve the consumers in eliminating cash flow issues, allowing the farmer to concentrate on growing crops instead of looking for lines of credit and paying interest.

Longer-term credit can also be useful when making investments in equipment and infrastructure that will generate income in the future. For example, buying a hoophouse to extend the season or increase yields of summer crops may help you make enough extra income that you will be able to pay off the investment in a few years and then start making more money for the farm.

WAGES AND PAY RATES

In comparing numbers from small farms everywhere, I find wages and pay rates for farm owners the least consistent and most confusing in terms of the way they are reported. Even when looking at straight dollar figures, it's difficult to compare how much people are making from farm to farm because there are so many variables in the ways they are accounting for the amount of time they work, nonmonetary benefits they take from the

farm (such as produce and on-farm housing), and the relative cost of living in different areas of the country.

People who own farms often don't count themselves as a labor expense if they are not "paying" themselves, which may work for them but does add some confusion. This is usually connected to the type of business structure the farmer chooses. Many compact farms are sole proprietorship, partnerships, or limited liability companies (LLCs). In these forms of business, there is usually just one owner, or a pair of owners, and the owners don't usually take a salary independent of the business profits. (Other business structures include corporations and cooperatives. If you are new to owning a business, you should look at the advantages and disadvantages of each before deciding how to structure your farm business.)

Typically, I find the most straightforward thing to do when trying to compare my personal income from the farm with that of other farmers is to look at the number of hours I worked and the dollars I personally took out of the farm business and compute an hourly rate for myself, even as the owner of the farm. (*Warning*! This may give you a depressingly low number, but it's not the full picture by any means.)

In my four years at Slow Hand Farm, my personal hourly wage ranged from about $7 per hour to more than $10 per hour. These are low numbers, and my target at the time was $15 per hour, so I obviously wasn't reaching my goal. There were a lot of nonmonetary and indirect benefits to me from the farm, however, so again, the dollar figure wasn't the complete story. This was also within the first four years of operation, years of building when I would expect the numbers to be lower.

A good friend of mine who has farmed for a long time in California once told me his annual income from the farm was low, but that he also had to realize that he owned a business that had a lot of assets and was profitable; even though his "wage" wasn't much higher than that of his workers (and possibly was lower), he was actually benefiting financially from the farm business more than they were. I have also heard a number of farmers who struggled in the beginning say that it took them between 5 and 15 years to get their farms established to the point where they were finally making money consistently.

SETTING PRICES

Figuring out how much to charge for any farm product is always a big question for new growers, and I'm not even convinced that many long-time growers do a great job of figuring this out (although some definitely have). There are two basic approaches to

determining prices: a pure market approach (a mix of customer-based pricing and competition-based pricing) and a pure cost approach (also called cost-based pricing).

In the pure market approach, you look at what everyone else is charging and try to get a feel for what your customers will pay; then you set your price as high as you can. If you don't sell as much as you'd like, you drop the price a little; if you sell out too fast, you raise the price a little. The price is whatever the market will bear.

In the pure cost approach, you figure out how much the product costs you to grow (taking into account all of your fixed and variable expenses). To arrive at your price, you add on a little to make a small profit to help grow the farm. This seems fairer to most people, but it is very difficult, if not impossible, to determine "accurately" how much it costs you to grow and sell an individual piece of produce. If you price from a pure cost approach but don't sell all of your produce, how do you cover the cost of the produce you didn't sell?

In practice, what I see most growers doing is primarily using the market approach, which is simpler, and at the same time thinking they should be using the pure cost approach.

The best farmers I know use a combination of the two approaches. They have a good sense of their actual production costs for any particular crop from doing their own crop budgets (costing out production on individual crops). They know the price below which they will definitely lose money (their break-even price), and they know what price they would like to get to be profitable. They then apply this information to constantly adjust their crop mix and their prices and to update their marketing and production plans.

INEVITABLE SPECIAL CIRCUMSTANCES

Every farm has its own unique and special circumstances that limit it in some ways and help it in others. Kristin Illick and Jeff Frank at Liberty Gardens were straightforward in saying one of the factors contributing to their success is having family land to farm. But that doesn't mean that people who don't have family land can't be successful. Alex and Betsy Hitt at Peregrine Farm didn't start out with family land, but they did start out with friends and family who were willing to support them and invest in their startup farm and who helped them finance the purchase of land.

There's no getting around needing the support of the community to start and run a successful farm, whether it's family and friends or just the people living in your area who buy your produce regularly. The form that support comes in is unique to every farm, but it is essential.

Looking at the numbers from someone else's operation might provide an interesting starting point, or comparison for your own operation, but don't just take the numbers at face value. Remember that every farm has its own unique and special circumstances, and it is important when using numbers to understand where they come from and how they relate to each other. My nonlabor expenses as a percentage of gross at Slow Hand Farm were very low, but they might not have been that low had I looked at them in another way. Because I worked the farm completely by hand, my labor expenses were actually quite high. Looking at the two numbers as percentages instead of absolutes would paint a different picture when trying to compare my operation to others.

What matters is the bottom line. As long as you're making enough money and you're happy with the way the farm is working, that's what matters. If you're not completely happy, take a careful look at the numbers that contribute to your bottom line. They may reveal opportunities to make positive changes.

Sample Budget from Cully Neighborhood Farm's 2016 Season

Write your budgets to cover your own needs with categories that make sense to you. This budget has some items I wouldn't include in my own farm budget (like crops from other farms) and is missing others that I would (like printing for advertising). Every farm's budget categories will be slightly different, but this is a good example.

Income

CSA shares (52 × $550)	$28,600.00
Other crop sales	$4,000.00
TOTAL GROSS INCOME	$32,600.00

Expenses

Equipment

Maintenance & repairs	$220.00
Fuel	$150.00
Clothes/gear	$50.00
Tools (bed rake, broadfork, hoes, knives, wheel hoe attachment)	$600.00

Propagation

Propagation supplies	$200.00
Seed	$1,000.00
Bought-in starts (onions)	$50.00

Advertising

Advertising	$80.00
T-shirts	$320.00

Field expenses

Soil testing	$99.00
Amendments	$500.00
Compost	$350.00
Cover crop seed	$200.00

Custom hire tractor work	$450.00
Field supplies (row cover, insect netting, trellising)	$500.00
Irrigation	$400.00
Water	$1,200.00
Lease fees	$0.00

Harvest Expenses

Harvest supplies	$180.00
Wash/packing supplies	$80.00
Deliveries (delivery bins)	$200.00

Office/Admin

Taxes	$200.00
County/state business fees & licenses	$0.00
Bookkeeping/accounting	$200.00
Insurance (under home/farm joint policy)	$150.00
Professional development	$115.00
Dues & subscriptions	$80.00
Office supplies	$60.00
Website	$100.00
Computer & communication	$200.00
Square/PayPal fees	$360.00
Misc	$200.00

Labor

Wages	$8,018.67
Workers comp	$500.00
Payroll services	$140.00

Infrastructure

Building (machine shed & bin storage)	$300.00
Infrastructure improvements	$80.00
Utilities	$0.00

Crops to buy in

Potatoes, 475#	$475.00
Winter squash, 900#	$740.00
TOTAL EXPENSES	$18,747.67
TOTAL GROSS INCOME	$32,600.00
NET INCOME	$13,852.33

Pricing Calculation Shortcut

To get a ballpark idea for a reasonable selling price on a product I've never grown, I usually start by keeping track of how long it takes me to harvest and pack the product. From past experience, I find this frequently falls somewhere around 25 percent of the price of the product.

For example, if it takes me on average about two minutes to cut and pack a head of lettuce (30 heads per hour) and my target wage (loaded, meaning including taxes and benefits) is $15 per hour, that means it cost me about 50 cents per head to harvest and pack the lettuce and my minimum price should be about $2 a head if I don't want to lose money.

I'll also do a quick estimate if the crop took relatively more labor to grow or is particularly low-yielding, in which case the markup should be more than four times the harvest and packing rate; if it's very high-yielding and was very easy to grow, I might be able to go slightly lower than $2 per head and still make money.

I can make these estimates more easily because I've looked at the costs of producing many of the crops on the farm, and from that previous analysis I have a fairly good sense of how much each operation costs and how long it should take. I recommend that you take a handful of your most important crops and construct detailed crop budgets using time studies for all of the operations involved in growing, harvesting, and packing to get a better sense of how big each of your production expenses really is.

Make sure also to account for marketing expenses (how much it's costing you to simply sell the produce), all of your other expenses (overhead, the cost of simply being in business), and a bit of profit in your pricing (seed money for the future). Those are the elements that make up roughly the other 75 percent of the price.

ABOVE: *Danny, Michelle, and daughter Ramona at Full Plate Farm in a field of kale*

"The ultimate goal of farming is not the growing of crops, but the cultivation and perfection of human beings."

— Masanobu Fukuoka

EPILOGUE

SMALL PLANS FOR THE FUTURE

When I met with Jac Smit from the Urban Agriculture Network almost 20 years ago, he was probably the only person working on ecological agriculture issues that I ever heard say anything positive about the suburbanization trend in the United States. While suburbanization had gutted city centers in some places and was swallowing up the surrounding farmland, Smit saw one potential long-term benefit: suburbanization created lot sizes that are more conducive to compact farms, and he saw potential for urban agriculture there, creating neighborhoods that feed themselves.

Similarly, in 1983, John Jeavons, J. Mogador Griffin, and Robin Leler published a book called *The Backyard Homestead, Mini-Farm and Garden Log Book*. Figure 2 in that book shows a possible configuration for a three-home mini-farm that looks like it would fit right into the larger lot sizes of many suburban developments. Both Smit and Jeavons were looking for ways to feed the world in a more ecological and equitable way, and they both came to see compact farms as the best model for making that happen.

In contrast, Earl Butz, the U.S. secretary of agriculture from 1971 to 1976, was famous for calling on farms to "get big or get out" and to "plant fencerow to fencerow." The most optimistic promise of Big Ag was that we could solve problems of hunger in the world and relieve a peasant class of backbreaking labor. It hasn't worked.

My experience with compact farms has been one of hard but rewarding work that feeds community and contributes to the well-being of the landscape. Maybe it's time for a flood of compact farms growing in this country, carefully cultivating the corners of our communities, planting to the fencerows, but leaving room for wild spaces, and creating a culture that works for everyone. Maybe it's time to take a cue from the early CSA movement and to start asking agriculture to benefit the farmers, the eaters, and the ecological systems that provide us all with clean soil, air, and water.

Maybe it's time to support an agriculture that supports all of us.

LEARNING MORE

Here are a few resources for learning more about growing crops sustainably, and successfully. They are not all specific to the very small scale, but all are applicable. If you're starting with no commercial farming experience at all I recommend finding a very small farm to spend some time on, and even better working on for a season, or three, before starting your own. Chris Blanchard, an experienced grower and farm educator, says, "Find successful farms — not farms that are a little bit successful, but farms that have withstood the test of time, that have respect in the community, that look like they work." I agree.

Books (in Suggested Reading Order)

Jeavons, John. *How to Grow More Vegetables (and Fruits, Nuts, Berries, Grains, and Other Crops) than You Ever Thought Possible on Less Land than You Can Imagine.* 8th ed. Berkeley, CA: Ten Speed Press, 2012. This is the book that really got me started and is a great place to begin.

Coleman, Eliot. *The New Organic Grower: A Master's Manual of Tools and Techniques for the Home and Market Gardener.* White River Junction, VT: Chelsea Green Publishing, 1995. In the years since first publishing this book Eliot has also written a number of other excellent books and his *Winter Harvest Handbook* is the best, most up to date accounting of his constantly evolving and improving techniques.

Fortier, Jean-Martin. *The Market Gardener.* Gabriola Island, BC: New Society Publishers, 2014. Great details on the systems Jean-Martin has developed on his

farm in Canada.

Wiswall, Richard. *The Organic Farmer's Business Handbook*. White River Junction, VT: Chelsea Green Publishing, 2009. A look at the business side of farming from an experienced vegetable farmer's perspective, with lots of practical ideas for improving the bottom line on the farm.

Blanchard, Chris and Paul Dietmann, and Craig Chase. *Fearless Farm Finances: Farm Financial Management Demystified.* Spring Valley, WI: Midwest Organic and Sustainable Education Service, 2012. A broader look at the business side of farming, with more details and examples of farm business models than Richard Wiswall's book.

Thériault, Frédéric and Daniel Brisebois. *Crop Planning for Organic Vegetable Growers.* Ottawa, ON: Canadian Organic Growers, 2010. Lays out a good method for planning out the season.

Mohler, Charles L. and Sue Ellen Johnson, eds. *Crop Rotation on Organic Farms: A Planning Manual.* Ithaca, NY: Natural Resource, Agriculture, and Engineering Service, 2009. Like many SARE-funded books this one is available for free download, or you can buy a print copy. A good reference book with lots of useful tables for planning long-term crop rotations.

Publications

Growing for Market. An excellent periodical published ten times a year by Lynn Byczynski, a long-time flower farmer. Its articles are written by market farmers and others closely related to the business, on the practicalities of market farming. I was a regular contributor for many years, and I still find the articles useful and interesting after all these years. There is an online searchable database of old articles. Highly recommended.

Mother Earth News. The longest-running magazine on sustainable living, with articles on homesteading and farming, and many related topics.

The Art of Eating. Covering the best of food and wine, this magazine publishes work by many excellent writers, including Barbara Damrosch and farmer Anthony Boutard.

Web Resources

Farmer to Farmer Podcast and Flying Rutabaga Newsletter

Chris Blanchard, former farmer at Rock Spring Farm in Iowa, runs a consulting business called Purple Pitchfork. He puts out excellent long-form interviews with successful farmers around the country, and has a monthly newsletter with good tips on running a farm business.

farmertofarmerpodcast.com

ATTRA

This is a long-time project of the National Center for Appropriate Technology and has published hundreds of titles on sustainable farming practices by experts in the field. Their website is easily searchable, and for years it has hosted the most complete database of farm internships in the U.S. and Canada.

attra.ncat.org

eOrganic

This is the organic specific side of eXtension, which is a centralized Internet site for all of the land-grant universities in the U.S. Land-grant universities are public colleges that specifically work on agricultural research. It has searchable articles on agricultural research and production.

eorganic.info

Conferences

Many excellent sustainable agriculture conferences take place every year all around the country, and there seem to be more and more all of the time. Here's a short list of some

conferences I recommend.

NOFA

The Northeast Organic Farming Association holds a summer conference in Massachusetts every August and there are winter conferences for each of the seven state chapters.

EcoFarm

The Ecological Farming Association in California puts on a conference for all sizes of organic agriculture every January in Pacific Grove, California.

Tilth Producers

Washington Tilth Producers hosts an annual conference for growers that rotates locations from year to year, visiting all parts of the state.

MOSES

The Midwest Organic and Sustainable Education Services holds the largest organic and sustainable farming conference in the country each February in La Crosse, Wisconsin.

Future Harvest CASA

An annual conference for sustainable growers of all sizes in the Chesapeake Bay area.

Young Farmers Conference

A sustainable agriculture conference hosted by the Stone Barns Center for Food and Agriculture in Pocantico Hills, New York, each December, geared toward young and beginning farmers.

Learning Opportunities

The Center for Agroecology and Sustainable Food Systems

The University of California in Santa Cruz

An Apprenticeship in Ecological Horticulture that combines classroom instruction with in-field training in their organic gardens and on their small-scale farm. The program has been running since 1967 and has trained well over 1000 students since the beginning.
casfs.ucsc.edu/apprenticeship/index.html

The Beginning Urban Farmer Apprenticeship (BUFA)

Portland, Oregon

A collaboration between Oregon State University and community partners. It trains new and aspiring urban farmers and offers varying tracks to suit different interests.
smallfarms.oregonstate.edu/beginning-famers/BUFA

The Collaborative Regional Alliance for Farmer Training (CRAFT)

Works to augment apprenticeships on individual farms by setting up farm tours and collaborative trainings for apprentices and member farms. The original CRAFT group is in the Hudson Valley of New York and the Berkshires and Pioneer Valley of Massachusetts, but there are now CRAFT groups around the country.
craftfarmapprentice.com

The Rogue Farm Corps

Connects apprentices and farms in three regions of Oregon and organizes classes and farm tours for the apprentices and the host farms.
roguefarmcorps.org

Doc Hammill Horsemanship

Runs workshops and trainings on working with horses, primarily on his ranch in Montana. He also sells DVDs and books on the topic through his website.
dochammill.com

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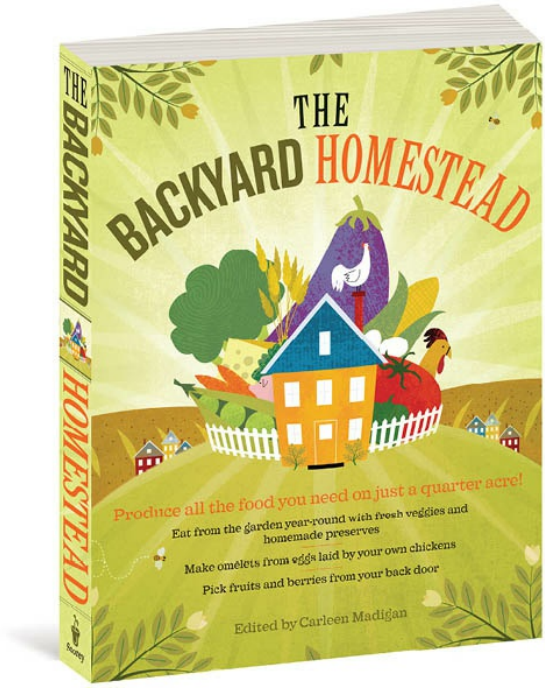

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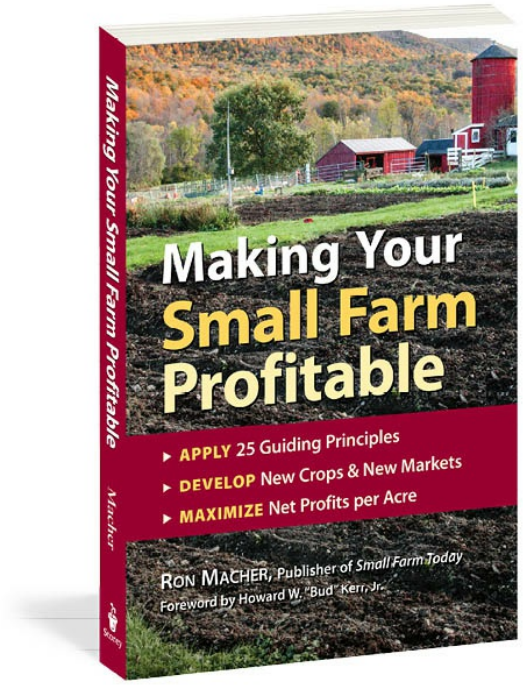

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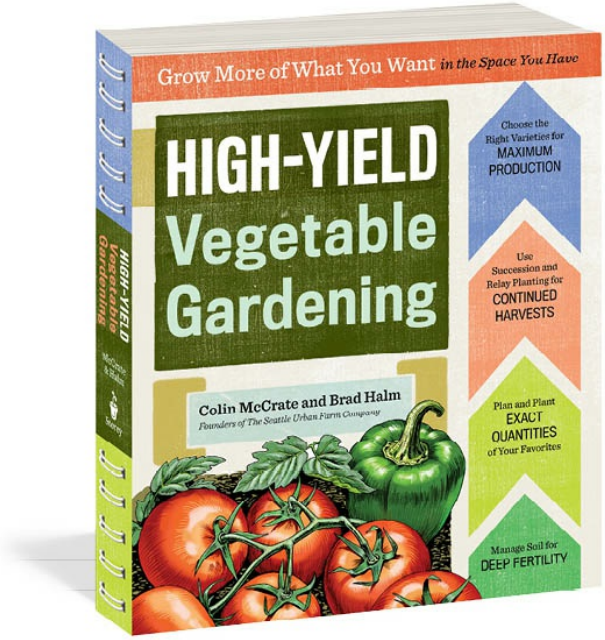

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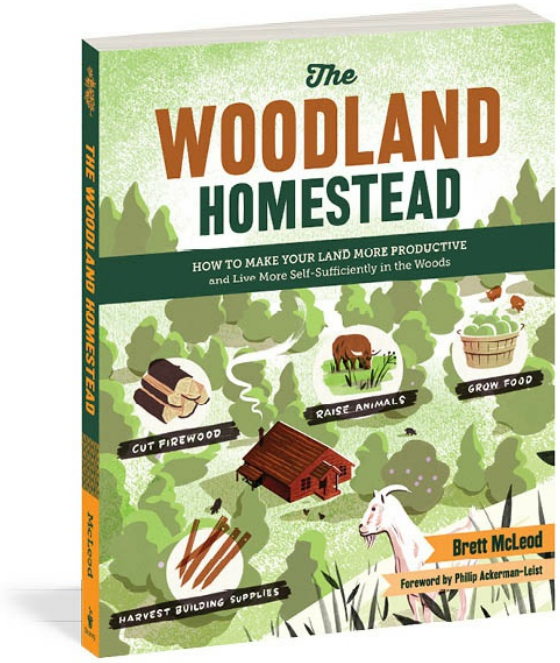

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