



The Lean Farm

How to Minimize Waste,
Increase Efficiency, *and*
Maximize Value and Profits
with Less Work

✕ Ben Hartman ✕



Praise for *The Lean Farm*

“Farming is not *just* a business, but it’s still a business, and Hartman’s application of Toyota efficiency principles to the farm is nothing short of profound. As I read this fantastic book, my mind literally skipped from procedure to place on our farm with new ideas on how to create efficiencies. *The Lean Farm* should be dissected, digested, and discussed—then applied—on every single farm: big or small, wholesale or retail, livestock or produce. It would make all farms more profitable, productive, and pleasurable.”

—JOEL SALATIN, owner of Polyface Farm
author of *You Can Farm* and *Folks, This Ain’t Normal*

“Anyone who thinks lean is only for a factory should read this book. Ben Hartman, with simple but eloquent prose and delightful figures and photos, demonstrates how all aspects of lean can apply to farming, a process of growing and selling living things. The mysterious uniqueness of farming under constantly changing conditions became clear as Ben learned to understand his customers and his value streams to increase value and eliminate waste. And lean reinforced, rather than replaced, the strong social values of the Hartman farm.”

—JEFFREY LIKER, author of *The Toyota Way*

“Farmers are good at farming—it is what they enjoy doing! At the same time, planning, organizing, and working out everything most efficiently is often not done as easily. *The Lean Farm* will help you all easily increase flow, production, and income. It is a treasure trove of possibilities without the need for increased investment!”

—JOHN JEAVONS, author of *How to Grow More Vegetables*
executive director of Ecology Action, and developer of
sustainable, biologically intensive mini-farming

“If you want to see, right now, what food farming will look like in the coming years, this is the book for you. Using the kind of super-efficiency that new-age manufacturing has perfected, author Ben Hartman describes, in great detail and with superb illustrations, how he and his wife reduced the farm size from three acres to one and still make a decent living on it.”

—GENE LOGSDON, author of *The Contrary Farmer*

“Ben Hartman is diversified farming’s Dean of Lean. He walks the talk, sharing insights on how lean principles helped his farm and how they can help yours. ‘Lean’ is the epitome of efficiency, an essential ingredient of any successful farm.”

—RICHARD WISWALL, author of
The Organic Farmer’s Business Handbook

“With lean principles, what’s good for the farm is even better for the farmer. As we invite new farmers back to the land, into vacant lots, and onto rooftops, we have to give them the tools for success and the ability to sustain. ‘Lean farming’ won’t leave you trying to turn a farm into an automotive factory, but you will get a whiff of what it means when the rubber hits the road.”

—PHILIP ACKERMAN-LEISS
author of *Rebuilding the Foodshed*

“We give every new employee a copy of Ben’s writing to study. Adopting lean principles has been critical for bringing organization, focus, and harmony to our 100-acre fully diversified vegetable farm. ‘A place for everything, and everything in its place’ is a refrain we repeat over and over.”

—PETE JOHNSON, organic farmer and
owner of Pete’s Greens, Craftsbury, Vermont

“Clay Bottom Farm is a gem of a place in northern Indiana, where we are repeatedly told that you need a thousand acres to make a living as a farmer. Ben Hartman and his wife Rachel disprove that ‘conventional wisdom’ every day by managing a thriving farm business, not on a thousand acres, but on just one. In *The Lean Farm*, Ben explains how their elegant approach can be applied by anyone. His writing, like his farm, is clean, well organized, and easy to follow—but his ideas are revolutionary. *The Lean Farm* is one of the most original and innovative books on food and farming to come out in the last decade.”

—STEVE HALLETT, professor of horticulture, Purdue University
and author of *Life without Oil* and *The Efficiency Trap*

The
Lean
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How to Minimize Waste,
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Ben Hartman

Illustrations by Emma Gerigscott

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Project Editor: Benjamin Watson

Copy Editor: Alice Colwell

Proofreader: Helen Walden

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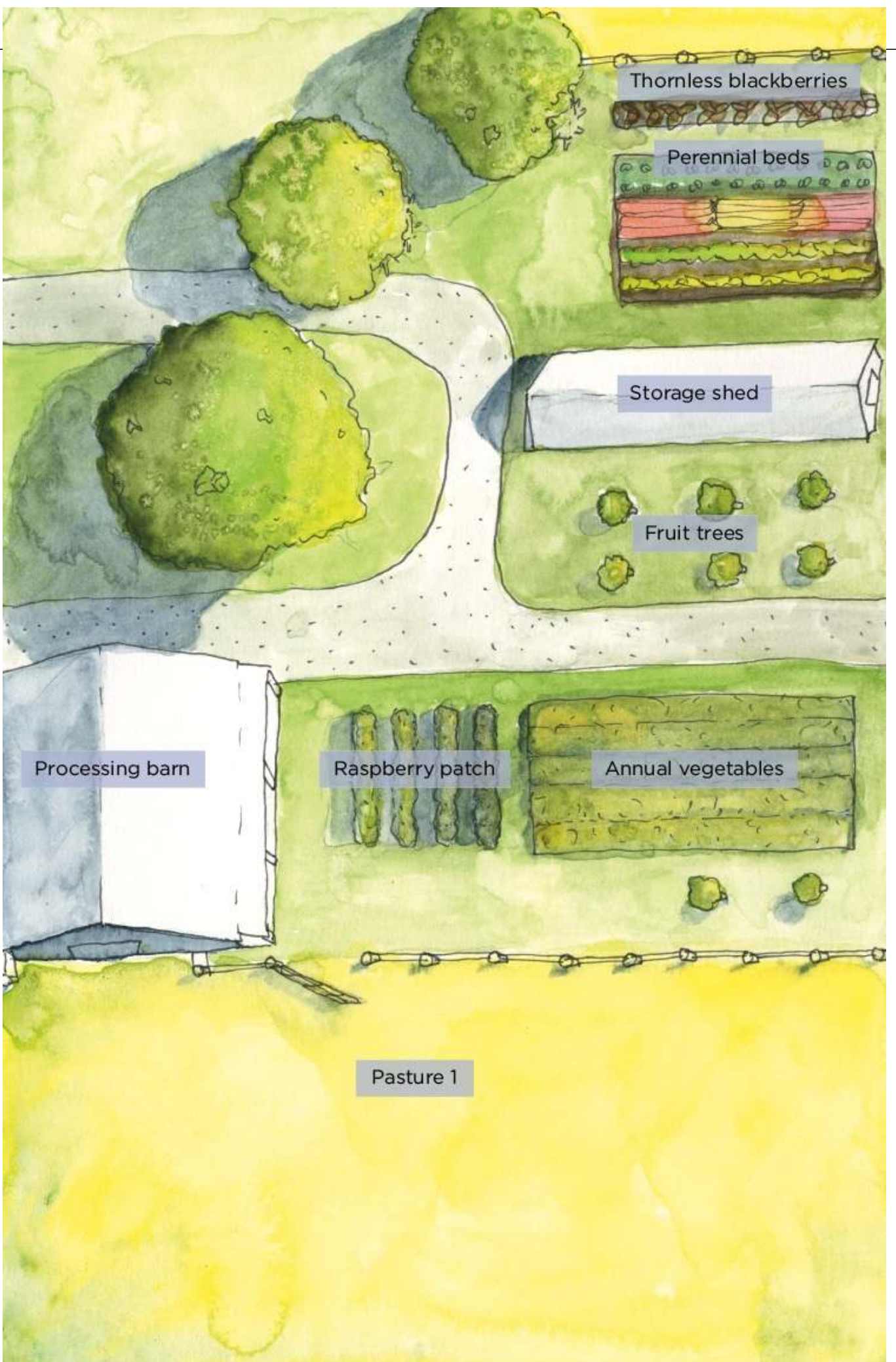
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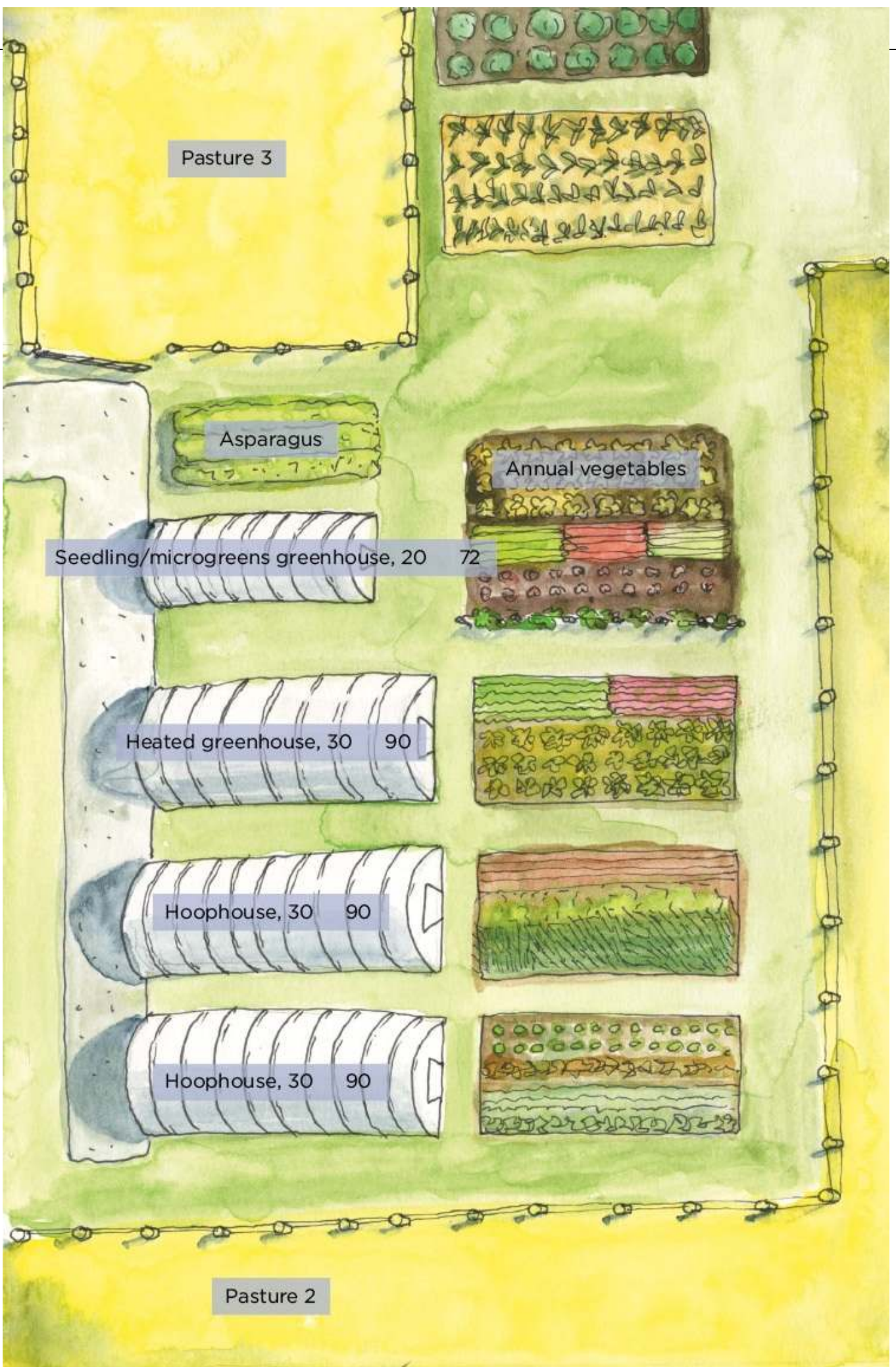
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Acknowledgments

This book would not have been possible without contributions from many people. First, I thank Steve Brenneman, CEO and founder of Aluminum Trailer Company, Nappanee, Indiana, and a Clay Bottom Farm customer, who introduced us to lean concepts and who generously consulted with us for several years as we steadily implemented lean on our farm.

In October 2014 I met in Chicago with Susanne Pejstrup, a lean coach from Denmark who for many years has worked with farmers in Scandinavia, other parts of Europe, and Asia to implement lean systems on their farms. She described to me lean systems in use on these farms and contributed photos that enrich this book. Thank you.

Likewise, I thank the farmers who contributed photos and allowed me to interview them about how they employ lean: Pete Johnson at Pete's Greens, Craftsbury, Vermont; Randy Ewert at Bair Lane Farm, Marcellus, Michigan; and Steve Lecklider at Lehman's Orchard, Niles, Michigan, among others. The diversity and success of their operations is living proof that lean concepts can benefit all types and sizes of farms.

I thank Lynn Byczynski, author and editor/publisher of *Growing for Market* magazine, for her encouragement to publish this book. Her indispensable magazine is a constant drumbeat of improvement ideas, many of which we have implemented on our farm.

Some people claim that the lean production system is the most powerful production system in the world. Fortunately, several scholars have done the careful work of distilling the most basic concepts and putting them into words that everyday managers can use. In particular, this book relies heavily on the work of James P. Womack, president and founder of the Lean Enterprise Institute (Brookline, Massachusetts); Daniel T. Jones, chairman and founder of the Lean Enterprise Academy (Goodricke, UK); and Daniel Roos, Japan Steel Industry Professor of Engineering and founding director of MIT's Engineering Systems Division. Perhaps the most inspirational (and literary) writing on the subject we have found are original works by Taiichi Ohno, the Chinese-born founder of the Toyota Production System, who died in 1990 in Japan. Ohno's short but wise books, now translated into English, contain no-nonsense headings like "If You Are Wrong, Admit It" and "Look Straight at the Reality" and continue to inspire firms—and farms—all over the world to root out waste and think more creatively.

I must also thank the dozens of interns and workers who over the years have contributed to the continuous improvement of our own microfarm. Many, many ideas for doing things more efficiently at Clay Bottom Farm are not my own but theirs. Thanks especially to Emma Gerigscott for contributing illustrations.

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My wife, Rachel, also read this manuscript many times and leaned it up. Editing is a thankless task and this book is as much the work of her insight as it is my writing. It wouldn't be in your hands if it weren't for her work and support. To my life and work partner, thank you.

Introduction

“Take care of the waste on the farm and turn it into useful channels” should be the slogan of every farmer.

—GEORGE WASHINGTON CARVER

All we are doing is looking at the time line from the moment the customer gives us an order to the point when we collect the cash. And we are reducing that time line by removing the non-value-added wastes.

—TAIICHI OHNO, creator of the Toyota Production System

A few years after my wife, Rachel, and I took the leap and started farming full time, one of our customers, Steve Brenneman, a lean coach and the CEO and founder of an aluminum trailer manufacturing company, offered to come to our farm, watch us work, and talk with us about ways to “lean up” our operation.

The basic goal of lean production is to ruthlessly eliminate waste—anything the customer does not value—from your production system; essentially, you seek to create your product with as few interruptions as possible in the flow of work. The concepts behind lean originated in Japan and are now widely used in all types of industries around the world. Toyota in particular is a model of lean.

At first I was skeptical. Lots of well-meaning folks regularly give us farming advice, and we can incorporate every idea that comes our way. Did lean principles really have a place on a farm? Aren't factories and farms very different places? Did I really want to turn our organic vegetable farm into an assembly line? Besides, what does manufacturing a trailer have to do with growing a tomato?

As it turns out, plenty.



Our farm at the time was in a state of flux. As with all new farms, the first few years had been a flurry of high-energy experimentation and construction. We had built greenhouses, a walk-in cooler, and a processing room; dug trenches for drain tiles and water lines; bought a tractor and implements, a skid loader, and a John Deere Gator, along with a slew of hand tools, some of which we found useful and others that we discarded in various corners of the farm.

In just a few growing seasons, we had tested out hundreds of crop varieties and had experimented with growing techniques ranging from cutting-edge greenhouse practices to age-old methods gleaned from our Amish neighbors.

We were making it, but workdays were long, leisure time short. Some days we worked from sunrise to well past sundown and still had supper to prepare. We hadn't been on a vacation in several years, partly because we were reinvesting all profits in the farm and partly because we felt that we couldn't leave. What if the greenhouses overheated? Who would take care of a sick animal while we were gone? We didn't have training systems or standards in place that would allow other people to perform even simple tasks that were needed to keep the farm going in our absence. Our production, on the whole, was erratic: every week we seemed to seesaw between overproducing and underproducing. We had a sense that if our farm was to survive for the long haul, the chaos would need to settle down.

So we decided to give lean a try.



We started with a tour of Brenneman's factory. He showed us that instead of a centralized tool storage area, their workers used human-scaled, customized tool carts on wheels. *No matter the task, the right tool was always within arm's reach.*



Pea shoots sprouting on our farm. Photo by Emma Gerigscott/Clay Bottom Farm.

The tool carts utilized a color-coded two-bin system for parts replacement: when one bin of bolts was empty, the worker placed the empty, labeled bin on top of the cart and kept working from the second, identical bin. Twice a day one person walked around the factory, collected the empty bins, and replaced them with full ones from a room where parts were meticulously labeled and tracked. *Supplies were always ready in the right place, at the right time, in the right amount.*

The workspace was well lit and remarkably clean. It felt *good* to be there. These were not the dirty, grimy environs one pictures on hearing the word "factory." *Organizing and cleaning were part of the workplace culture.*



Lean offers a management system to help farmers analyze their work. Photo by Emma Gerigscott/Clay Bottom Farm.

The workers were skilled and well trained. On the wall next to workstations were clear outlines of worker tasks. The outlines explained each procedure and gave reasons for the task. Brenneman told me that with their training protocols, “even complex tasks can be taught to nearly anyone.” *Jobs were broken down into steps that could be easily learned, and standards were clearly visible.*

After the factory tour Brenneman showed me the office spaces for the accountants, engineers, and executives. I was surprised: for a manufacturing business of this size I expected corner windows, flashy paperweights, and Herman Miller chairs. Instead, the corporate offices, carved into a corner of the factory building, were modestly sized with adequate but certainly not extravagant furnishings. *Even office spaces had a feeling of efficiency and focused production.*

Most important, Brenneman designed his factory with his customers in mind. “A few years ago we were discussing the possibility of new offices. It would have been an expensive project. Then we asked ourselves, from a lean standpoint, *What do our customers want?* We decided our customers didn’t really care what our offices looked like. What they wanted were quality trailers. So that’s where we put our resources.”



We were hooked. What if we could apply the lean principles that worked so well in a factory to our organic farm? Not all principles would translate perfectly, but what would happen if we tried out a few?

Farms and factories are very different places, but in the end our task is the same: to deliver a high quality product to customers who value what we make or produce. We began imagining our tools neatly lined up in tool stations, close to their point of use. What if there was no clutter, no stumbling

over crates? What if every item on the farm was well cared for? What would happen if we really took seriously what our customers valued? How would that change how we washed lettuce or designed our processing area? What if no movement was wasted, and every single seed turned into a product that was sold?

We started to see how lean might give a boost to our small farm without upending our values. We had something to strive for, a new vision, and new energy to meet the challenge.

A Basic Definition of Lean

In its simplest form, Taiichi Ohno, the founder of the Toyota production system, described Toyota's lean method as “looking at the time line from the moment the customer gives us an order to the point when we collect the cash. And we are reducing that time line by removing the non-value-added wastes.”¹

Another way to view lean is by analyzing capacity, the amount of product that can be produced in a given span of time. To Ohno, the capacity equation is simple:

$$\text{“Present capacity} = \text{work} + \text{waste.”}$$

The lean way to increase the capacity is to eliminate the waste. “Work” is anything that adds value for the customer; “waste” is anything that doesn't. The eventual goal is zero waste and 100 percent work.²

This “absolute elimination of waste” became the backbone of the Toyota production system, and catapulted the company in the latter part of the 20th century past its rivals to become the largest automobile manufacturer in the world. It was also the most profitable: by the early 2000s Toyota's net profit margin was 8.3 times higher than the industry average.³ The very simple formula was to find waste, root it out, and turn it into capacity to produce more.



In their book *Lean Thinking*, James P. Womack and Daniel T. Jones define the lean approach as a set of steps, arguing that lean boils down to five principles:⁴

1. Precisely specify what customers *value*.
2. Identify the *value stream* for each product.
3. Make value *flow* without interruptions.
4. Let the customer *pull* value from the producer.
5. Pursue *perfection*.



Here is how these principles apply to a farm:

1. *Precisely specify value*: Dig deep and really listen to your customers. Scratch below the surface. Research what really gets your buyers excited. The precise good or service your customer wants should drive your farming.
2. *Find the value stream*: Once you know what customers value, map out your farm and trace the value—your product—as it's being created. Don't skip steps. Start your map at the beginning with planning and ordering seeds, and finish with depositing cash in the bank.
3. *Create flow*: Now scour your map—your farm—for waste, anything that doesn't add value. Once you find it, plan to root it out. The goal is to make value *flow* without interruption.
4. *Sell through pull*: Instead of growing too many radishes or raising too many chickens and *pushing* the excess, produce exactly what customers want, in the amounts they want, when they want it. Let their *pull* guide your production.
5. *Aim for perfection*: Develop a farm culture of continuous improvement with the goal of achieving perfect flow: zero waste production.



French breakfast radishes.



This book is the story of how we used these ideas on our microfarm to grow and sell more food than we ever thought possible.

Factory versus Farm

In some circles, to pair the terms “factory” and “farm” is sacrilege. Indeed, many of the dire problems facing our environment in the 21st century come from the inappropriate application to the family farm of factory-style production methods and output standards. When yield per acre or gallons per cow is your only standard of success, when living animals are “production units” and produce or grain fields are nothing more than “profit centers,” then the mystery of life is overlooked and the health of the planet suffers.

There are, of course, important differences between factories and farms, and these affect how land should be used on farms. The raw materials of industry are inert and predictable. Steel, aluminum, wood, and copper are molded, shaped, fabricated, and assembled to form objects for sale. In farming, our raw materials—our seeds, plants, and animals—are constantly changing form. Even soil is constantly changing. Researchers at Oregon State University determined that a single teaspoon of garden soil contains up to a billion bacteria, along with “several yards of fungal filaments, seven thousand protozoa, and scores of nematodes.”⁵ These are all *living* soil organisms. Farmers cannot

predict with precision how these organisms will interact with tomato plants or blueberry bushes or potatoes.

Imagine running a factory without a roof and you have a picture of the vulnerable and dynamic nature of a farmer's work. Weather shifts, which can occur several times a day, force farmers to adapt plans repeatedly. Heavy rains, strong winds, and temperature swings will leave a manufacturing facility largely unaffected but can destroy an unprotected crop of lettuce, costing the farmer several months' worth of wages. We head to town on a cloudy morning, confident in the prediction of overcast skies, and watch the clouds roll away. Do we then make the twenty-minute drive back home abandoning our errands, or just stay where we are and hope for the best in the quickly overheating greenhouses?

In his book *Oil and Honey*, author and activist Bill McKibben writes of learning through a beekeeping friend how keeping bees is like playing a game of chess, where with each move—each day of unpredictable weather, each small fluctuation in how things are growing—the entire board is different.⁶ Good farmers are keen observers of nature, adjusting their moves and their strategies every day.

As Wendell Berry says, “The farmer lives and works in the meeting place of nature and the human economy.”⁷ Farm products will always be intimately tied to ecosystem behavior in a way that factory goods are not.



Climate change is an undeniable threat to our farm and our livelihood. In the winter of 2013–2014, we managed to survive multiple polar vortexes, and in fact we continued harvesting carrots, spinach, kale, and other cold-hardy crops through many nights below 15 degrees F (-9 degrees C). I still remember running up to the processing room from our greenhouses with totes of spinach and salad greens in order to keep the crops from freezing en route. We relished every leaf in those extremes, but our yields were low and our income suffered. Is our food system more vulnerable because of climate change? No doubt.

With weather patterns becoming more and more erratic, agricultural climate control becomes increasingly important. Our greenhouses got us through that arctic winter. Irrigation systems in the Midwest, used to combat drought, have spread in the past few years like an octopus's tentacles across the field after field. Animal buildings and greenhouses rely on more and more robust ventilation and heating systems—anything that can provide a buffer between our products and raw nature.

While new technologies for climate control suggest that the worst climate swings can be mitigated, completely shutting farming off from nature—if that were even possible—would not be true farming. Industrial farmers, perched in the cabs of air-conditioned tractors, distance themselves and their work from nature, to the peril of us all. Carbon-heavy, production-at-all-costs agriculture produces greenhouse gases at an alarming rate; it turns fertile ground into wastelands; and it pollutes the water and air we all rely on. It is ultimately self-defeating: it gobbles good topsoil without replenishing the land; it robs from the fossil fuel bank without giving back; and it contributes to erratic weather that will eventually make farming an impossible task. It is a style of farming that cannot endure because it misinterprets the work of farming.

A farmer's work is more like that of a horse trainer than a mechanic, more like that of a healer than a computer repairperson. It is not really accurate to say that farmers grow food or raise animals. Farmers alter environmental conditions in such a way as to maximize a plant's or an animal's innate ability to do its own growing—in the same way that the best horse trainers seek to draw out abilities

already *within* their horses or in the way the best healers know when to stand back and let the patients' bodies do the work. There is mystery in farming. While there is beauty in the craft of shaping inert materials into useful things, it is a different type of work from tending to the living beings of a farm.

Some 12,000 years ago humans entered into a new type of relationship with nature. No longer were we content to glean berries and hunt game. We learned ways to participate even more fully in the cycle of life by altering nature's "raw materials," its flora and fauna, to feed ourselves. While lean methods can make that work more efficient, they should not be used to completely remove nature from farming, even if less nature sometimes means easier, more profitable farming. A lively and dynamic nature is both the core challenge and the core ingredient of farming.

When farmers apply lean with the right intentions—to restore the earth and increase the health of families and local communities—their farms can produce lots of food *and* fall into alignment with nature. The number of production challenges facing manufacturers is surely equal to the number facing farmers. They are just different kinds of challenges. Appreciating the differences will help farmers use lean to its fullest.

Lean down on the Farm

After touring Brenneman's factory, we continued reading about lean principles and soon began applying them on our farm.

We currently farm a 5-acre property, with less than 1 acre in production, including 9,000 square feet (roughly $\frac{1}{5}$ acre) under four greenhouses. My wife and I farm year-round and earn a comfortable income from farming. One part-time staff person helps us throughout the year, and from March to November one or two additional interns join our team. Our microfarm is one of thousands such farms that now dot the landscape. Large farms may dominate US agriculture, but small-scale farming seems to be "happening everywhere, including in cities and suburbs," as Lauren Markham, a writer for public radio's *This American Life*, explains. This new "ubiquity of agriculture" gives consumers access to goods produced on a small and local scale in ways that they didn't have before.⁸ We are a tiny operation compared to many who use lean principles, but we've found that lean works well on our scale.



A greenhouse ready for plants. Lean says to clear out clutter so you can see your work.

We sell roughly equal amounts to three outlets: to five area restaurants and a grocery store; to a farmers' market, where we participate in a collective community-supported agriculture (CSA) program; and to around sixty of our own CSA customers, who pay us at the beginning of the season and receive our food nine months out of the year.

We did not arrive here overnight. For five years, while we were in our twenties, we lived in town, farmed part time on rented land, and worked part time at other jobs as we saved for a down payment on our current farm, where Ben has farmed full time for another six years. For four of those years, Rachel continued working in the public schools. We grew gradually and steadily: our first CSA had only twelve members, then twenty, then thirty-five, and now sixty. We've kept our equipment simple and to a small scale and have focused on increasing our knowledge and improving our process.

Our savings helped us take off quickly when we purchased our current property. A large down payment meant that our monthly costs were reasonable and that we could focus our efforts on farming. Except for a small family loan early on to help put up a greenhouse (which we quickly paid off), we've managed to pay for capital improvements as we've gone along rather than racking up debts and interest payments.

We've had good teachers along the way. We both worked for Kate and James Lind at Sustainable Greens in Three Rivers, Michigan, where we honed our skills. The Linds, along with their son, Matt, were pioneers in supplying fresh greens to fine-dining Chicago restaurants long before the winter greens movement took off. We also owe plenty to creative direct-market pioneers like farmer and author Eliot Coleman and to our Amish and other Plain neighbors, who for decades have been perfecting—and leaning—their craft.

Lean to Keep Farms Small—and Viable

Lean is so effective as a tool that it might be tempting to use it as a means to get big. But lean can be used equally well to increase profits while keeping your farm small.

The dominant business model in the United States assumes a successful business will grow in size every year. But can one also find one's right size and be satisfied with it? Lean principles—which focus on creating more value over simply more quantity—opened up the possibility for us of *not* growing bigger, of thriving even within the constraint of size.

In fact, scaling *back* might sometimes be the right decision for a farm. With lean as a guide, we've steadily shrunk our growing area to less than an acre, and we've increased our profits every year. If you can cut back in the size of your production area and—by eliminating waste and working out process kinks—still net a comfortable salary, why not do so? Through the steady application of lean principles—systematic waste elimination, a focus on crops with high margins, careful planning to harvest crops when they are in highest demand—our farm has stayed small and profitable. Lean for us means doing more and more with less and less.

In the United States, profit-through-growth farming is more common. Huge, industrial-scale agriculture—which serves the interests of investors and agribusinesses, not local communities—dominates the nation's rural landscape. According to a USDA report, farm size has doubled since 1990 “and the trend is likely to continue.”⁹ A recent article from the *Washington Post* states bluntly: “Farms are gigantic now. Even the ‘family-owned’ ones.”¹⁰

The problems with supersizing farms are many. Rural communities are left tattered. Many farms are sterile, uninviting places void of windbreaks, trees, and habitats for snakes, dragonflies, and migratory birds. In 1900 a majority of farms raised chickens, cattle, milk cows, and hogs in addition to a wide range of fruits and vegetables. Now just a tiny percentage can claim that diversity. Farms used to be places that connected us to nature, where children played and learned about the world. Now many megasized farms so little resemble the natural world that children would be lost on them.

Fortunately, it is also true that small-size farms are also on the rise. Lean can help the small producer survive, as I hope this book shows, by cutting costs and harnessing the *advantages* of small. Small-scale farmers who apply lean principles can serve their customers better than do gigantic producers and at the same time produce in sufficient volume to support their farms.

LEAN AS INTUITION VERSUS LEAN AS SYSTEM

Lean habits come naturally to many farmers, especially those who sell directly to customers and who are intimately involved in their farm's production.

One idea that came naturally to us, for example, was the principle of inventory reduction. Lean manufacturers keep inventories low—they assemble cars on order rather than on speculation, for instance—because it costs money to warehouse goods that could become obsolete. On our farm, we've never had the luxury of filling warehouses or parking lots with large inventories of goods for months on end because much of our food will hold its value for about a week before it turns into mushy waste. While many manufacturing firms struggle to lean up by culling bad habits of inventory buildup, we were able to apply this principle quickly to improve our farm.

No farmer likes to see waste. Steve Lecklider, owner of Lehman's Orchard in Niles, Michigan, intuitively implemented many lean techniques on his farm because they made sense for his operation. He organized his 55-acre farm to operate in ways that maximized his efforts. He told me, “You can say this or that is a Japanese theory, but for farmers like us, we live this stuff every day. We're th

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