designing regenerative food systems

and why we need them now

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Hawthorn Press

Glossary of terms

Many of the terms used in this book are interchangeable with other ones. I have defined my usage of these terms below. Not everyone will agree with my definitions, but for the sake of clarity, and until the terms settle into common usage, this is how they are used in this book.

Industrial farming is the form of farming generally thought of as 'conventional farming', in references to the fact that it is mainstream in the global north. However, it is a relatively new form of farming; only three generations of farmers have used these industrialised methods. Sociologists call this the 'industrial production paradigm'

Sustainable food systems is a collective name for all of the food systems described in this book, sometimes called 'biological', 'ecological' or 'alternative' farming systems. Sometimes 'agroecology' or 'regenerative' is used as an umbrella term for all of them. I have not used these two terms in this way, since each is presented in this book as a food system in its own right. The sociologists call this the 'ecologically integrated paradigm'.

Regenerative agriculture implies something more than sustainable agriculture – a system that repairs and rehabilitates the badly damaged soil and water systems.

Pesticide is used as a collective term for insecticides, fungicides and herbicides.

Farmers are people who produce food, whether on a large or a small scale. They're sometimes described as 'growers'. Many farmers are women, people of colour and/or indigenous people.

The agricultural revolution, which happened first in England, was the move from subsistence farming on common land, to enclosed, privatised food production that was carried out as a business for money. This started in the 14th century in England and is still happening today in many parts of the world.

The industrial farming revolution started in the global north in the early 20th century. It introduced nitrate fertilisers, pesticides, tractors, new varieties of crops, artificial insemination and battery farming. The focus was on yields.

The green revolution refers to the rolling out of industrial processes in farming across the global south from the 1960s onwards.

The sustainable farming revolution refers to the changes needed to transform the current food systems into practices that regenerate the soil, watersheds, food quality and economies, allow biodiversity to flourish and mitigate climate change. ■

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Acknowledgements

I would like to thank my very lovely husband Mark for supporting me on the journey of creating this book – the farm walks, the endless discussions, the lack of company for very many weeks and days while I tried to capture in words what I know from the fields. I would also like to thank my beautiful daughters Ruby and Lily-mei who have joined us on many farm walks, listened politely to so many discussions, enjoyed the food at the table and share my love of a good farmers' market.

Thank you to Gabriel Kaye and Martin Large, who as the Biodynamic Land Trust's directors gave their trust to and encouraged the embryonic Apricot Centre team and helped shape Huxhams Cross Farm into what it is today. Thank you to Anne Phillips and Wendy Cook who were key in bringing Huxhams Cross and the Apricot Centre together. And thank you to the 150 shareholders who invested in the farm. Martin Large also encouraged me to write this book so that some of the knowledge we gained can be shared with others.

The late Professor Martin and Ann Wolfe of Wakelyns Farm laid the foundations for the very core of the premise behind this book. I would like to thank them for all the farm walks, talks, dinners, laughter, thoughts, challenges, the occasional raised eyebrow and the very many flapjacks – but also the encouragement over 20 years to keep going with this work.

Thank you to all of the farmers and growers who gave me permission to use them in case studies to showcase different aspects of the food systems. Most of them use multiple methods but I have generally illustrated just one aspect of their work. They include the farmers at Winter Green Farm, Oregon; Christine Arlt at Sekem, Egypt; Tamarisk Farm; Sarah Green of Mark Farm; the Organic Lea team, London; la Ferme du Bec Hellouin, France; Mark Lea of Green Acres Farm, Shropshire; Emmanuel Baya of Margarini Children's Centre and Organic Demonstration Farm, Kenya; David Wolfe, the late Martin and Ann Wolfe of Wakelyns Farm, Suffolk; Martin Crawford of the Agroforestry Research Trust, Devon; Jon and Lynne Perkin of Parsonage Farm, Dartington: Josiah Meldrum of Hodmedods; Jon Perkin, Dan Mifsud and Bob

Mehew of Dartington Mill; and Julie Brown and Kerry Rankine of Growing Communities, London.

Thank you to those who took the time to contribute to the book: Julia Wright and Luke Owen of the Centre for Agroecology and Water Resources at Coventry University, Philip Franses and Mini Jain of the Flow Partnership, Rachel Bohlen of the Apricot Centre, Christian Kay for his wonderful photos, Ben Raskin for his agroforestry photos, Sophy Banks for insight into ecopsychology, and Christopher Upton of Zerodig at Oakbrook Community Farm.

Thank you to the Hawthorn Press team, Anthony Nanson for the huge amount of editing required and Amanda Cuthbert, my neighbour, who helped me structure my thoughts early on in the process.

Thank you to the Devon Environmental Foundation for its generous support of our research, together with its impact assessments and its encouragement to bring these messages into the world.

Last but not least, thank you to my wonderful colleagues at the Apricot Centre. It has been a huge team effort in which everyone has brought their strengths and good humour to make Huxhams Cross Farm work so well, including now to offer it as a demonstration farm for others wanting to make the regenerative transition. They include our directors, in particular Matt Harvey, who has kept us laughing no matter what, and Rhodri Samuel and Liliene Uwimame; our Friends of the Apricot Centre, who have guided us and taken time to input into its development – Wendy Cook, Anne Phillips, Anne Marie Mayer and George Sobel; the operational team – Mark O'Connell, Rachel Phillips, Bob Mehew, Dave Wright, Caspar Meridith, Ross Perret, Rachel Bohlen, Amy Worth, Richard Andrewes and Keren Kossow; the whole well-being team of therapists and mentors doing incredible work in and around the farm; apprentices past and present; all the volunteers who help us; and, of course, our customers who enjoy our food.

I would like also to offer gratitude to the tiny piece of land that we call Huxhams Cross Farm, for its bounty and the joy that it gives us all. ■

Foreword

When you come home from the daring journey, the demons slain and the elixir cradled in your palm, what do you find? The old world is still indifferent. It still does not know it needs your magic. Now the work begins. That was the old way, now we must do this thing. 'To make an end is to make a beginning', wrote T. S. Eliot in *The Four Quartets*. 'The end is where we start from.'

And what a place to start from, at the Earth's great interlocking crises. The loss of biodiversity and species, the crushing of the climate, the rise of inequality, the loss of contentment, the relentless pursuit of material consumption. In the modern world of affluence, many things have been getting better, but some suddenly became much worse. Once upon a time, we knew what a good agriculture and food system could look like, and yet somehow it slipped from our grasp. We might well ask, again, how might greener, low-carbon and healthier options emerge?

When you enter the forest at its darkest point, wrote Joseph Campbell, there is no path. If you find one, it is probably someone else's. The idea is to make your own way. It's over there, the start line. We just need to get in the game, to gather up a staff and enough food and possessions. And start walking.

Well, Mary Oliver had a marvellous answer in her wonder-poem called *Sometimes*:

> *Instructions for Living a Life:*
> *Pay attention.*
> *Be astonished.*
> *Tell about it.*

And this brings us to Huxhams Cross Farm, called a few short years ago by a local rural contractor 'a miserable bit of land'. The world needs transforming; it needs leadership. Someone needs to walk the path over each piece of such land. And this, we see, is what Marina O'Connell has done with glory in this powerful and personal book about transforming the land for the better. Marina O'Connell weaves inspirational stories of redesign and transformation, showing how regenerative methods for agriculture and food have come to life. In half a decade, she created a productive, diverse, profitable and regenerative farm from depleted soil, and has said, 'Over here is a path, now we can walk it'.

The concern for sustainability in agroecosystems centres on the fundamental importance of both agricultural and non-

agricultural ecosystems and their links with farmers and consumers. Agriculture is unique as an economic sector as it directly affects many of the very natural and social assets on which it relies for success. These influences can be both good and bad. Industrialised and high-input agricultural systems rely for their productivity on simplifying agroecosystems, bringing in external inputs to augment or substitute for natural ecosystem functions, and externalising costs and impacts. Pests tend to be dealt with by the application of synthetic and fossil-fuel-derived compounds, wastes flow out of farms to water supplies, and nutrients leach to the soil and groundwater. As a result, there has been widespread and increasing cost to natural ecosystems and human health.

By contrast, regenerative approaches to agriculture seek to use ecosystem services without significantly trading off desired productivity. When successful, the resulting agroecosystems have a positive impact on natural, social and human capital, while unsustainable ones continue to deplete these capital assets. A wide range of different terms for more sustainable agriculture have come into use: regenerative agriculture, a doubly green revolution, alternative agriculture, an evergreen revolution, agroecological intensification, green food systems, save and grow agriculture, and sustainable intensification. Many of these draw on earlier traditions and innovations in permaculture, natural farming, the one-straw revolution, and forms of biodynamic and organic agriculture.

We now know that the concept of sustainability should be open, emphasising values and outcomes rather than means, applying to any size of enterprise, and not predetermining technologies, production type, or particular design components. Central to the concept of all types of regenerative systems is an acceptance that there will be no perfect end point due to the multi-objective nature of sustainability. Thus, no system is expected to succeed forever, with no package of practices fitting the shifting ecological and social dynamics of every location. In the 1980s, Stuart Hill proposed three non-linear stages in these transitions towards sustainability: i) efficiency; ii) substitution; and iii) redesign. While both efficiency and substitution are valuable stages towards system sustainability, they rarely achieve the greatest co-production of both favourable agricultural and environmental outcomes at regional and continental scales.

In the first stage, **efficiency** focuses on making better use of on-farm and imported resources within existing system configurations. In the second stage, **substitution** focuses on the

replacement of technologies and practices. The third stage incorporates agroecological processes to achieve impact at scale; **redesign** centres on the composition and structure of agroecosystems to deliver sustainability across all dimensions to facilitate food, fibre and fuel production at increased rates. Redesign harnesses predation, parasitism, allelopathy, herbivory, nitrogen fixation, pollination, trophic dependencies and other agroecological processes to develop components that deliver beneficial services for the production of crops and livestock. A prime aim is to influence the impacts of agroecosystem management on externalities (negative and positive), such as greenhouse gas emissions, clean water, carbon sequestration, biodiversity, and dispersal of pests, pathogens and weeds. While efficiency and substitution tend to be additive and incremental within current production systems, redesign brings the most transformative changes across systems.

But for redesigned agricultural and landscape systems to have a transformative impact on whole landscapes, this requires cooperation, or at least individual actions that collectively result in additive or synergistic benefits. For farmers to be able to adapt their agroecosystems in the face of stresses, they will need to have the confidence to innovate. As ecological, climatic and economic conditions change, and as knowledge evolves, so must the capacity of farmers and communities to allow them to drive transitions through processes of collective social learning. This suggests redesigned systems have the valued property of intrinsic adaptability, whereby interventions that can be adapted by users to evolve with changing environmental, economic and social conditions are likely to be more sustainable than those requiring a rigid set of conditions to function. Every example of successful redesign at scale has involved the prior building of social capital, in which emphasis is placed on relations of trust, reciprocity and exchange, common rules, norms and sanctions, and connectedness in groups. As social capital lowers the costs of working together, it facilitates cooperation, and people have the confidence to invest in collective activities, knowing that others will do so too.

All things are connected. And this is why land and agricultural transformations such as these described in this timely book on designing regenerative food systems are so important. Can we do better, if we think differently? The answer is a resounding yes. The next question then centres on what could happen next. Regenerative agriculture approaches have been shown to increase productivity, raise system diversity, reduce farmer costs, reduce negative externalities, and improve ecosystem

services. There are thus a range of potential motivations for farmers to adopt agroecological approaches on farms, and for policy support to be provided by national government, third sector and international organisations. But these transitions still require investments to build natural, social and human capital: redesign is not costless.

There are important arguments that suggest the world would not need to increase agricultural production if less food were wasted, and less energetically-inefficient meat was consumed by the affluent. These changes would help, but there is no magic wand of redistribution. Most if not all farmers need to raise yields while improving environmental services. And now we know, these changes are happening worldwide. Two groups of 40 authors have recently undertaken global assessments of the spread of these sustainable practices: 160 million farms, 450 million hectares and 240 million people organised into social groups to take action at the landscape level.

It was the questions from visitors about the transformation of Huxhams Cross Farm's depleted soil and bare land that sparked this book. They wanted to understand what they saw so that they could go back and redesign their own farms and communities. This evidence shows that redesign of agro-ecosystems around agroecological and regenerative approaches to sustainability can achieve yield increases. The evidence on farms of redesign and regenerative transformations offers scope for optimism. The concept and practice embodied in the application of agroecology will be a process of adaptation and redesign, driven by a wide range of actors cooperating in new agricultural knowledge commons and economies.

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Introduction

In order to create the sustainable farms now urgently needed for the 21st century it is useful to have available a 'toolkit' of methods by which to radically transform a piece of land, or at least to nudge food production in a more sustainable direction. All the methods described in this book can be used in a pure form by themselves. Each system appeals to individuals and communities in different ways. However, in my experience and from a farming perspective, these various methods weave together to create resilient, low-carbon and productive biodiverse farming systems. They contribute to what I have called 'the sustainable agricultural revolution'.

Visitors and students on courses at Huxhams Cross Farm have asked me how we created a productive, beautiful, profitable and regenerative farm from depleted soil on former land of Dartington Estate. The contractor who had previously worked this land had called it 'a miserable bit of land'. The short answer to the question is that we drew on the methods described in this book to create a sustainable farm from industrially farmed land. We observed that many visitors understood one sustainable farming system but rarely grasped the variety of approaches and how to weave them together. The methods are culturally different, but from a farmer's perspective they complement each other very well, each bringing different strengths.

Relatively few people fully understand what biodynamic farming, organic farming, permaculture, agroforestry, agroecology and regenerative agriculture are, how they relate to each other and how they compare with current industrial farming models. This book aims to give an overview and insight into these systems from a practitioner's perspective. It does not provide an in-depth academic study of any of these systems. At the end of each chapter are signposts to further sources of information to explore these systems – books, websites, films, academic papers, and real or virtual farm visits. Each system is illustrated by an existing case study of a farm working in the ways described. The case study of Huxhams Cross Farm showcases how the systems can be brought together to transform land in a short period of time.

Although each chapter can stand alone, the structure of the book reflects how food systems and farming require an integrated holistic systems approach, rather than a fragmented reductionist approach. There are many overlaps between the chapters, just as there are many overlaps between farming and food systems. What is good for the soil biome is good for plant nutrition, is good for biodiversity, is good for human health and is good for the economic health of a farm. Each farming system described here brings a different quality to a

comprehensive holistic systems approach to sustainable farming and food systems.

My farming story

I have been professionally involved in sustainable farming and growing since the 1980s. I started with a degree in horticulture from the University of Bath, where I was trained in the industrial methods of the day. I came across my first biodynamic farms in Ireland and Brazil by accident during my work experience placements and was amazed by the quality of the food, the physical beauty of the farms, and the pleasant nature of the work in comparison with working in industrial farming systems. On leaving university, my first job was at the Horticultural Training Workshop at Dartington Hall Trust, South Devon, training young people to become gardeners or nursery workers. I was privileged to attend one of the first permaculture design courses in the UK, and I attended weekly study groups for biodynamic farming at the same time. One of my first 'aha!' moments was at a talk by Peter Procter, one of the world's great biodynamic trainers, at the local Steiner school. He drew a picture of a biodynamic farm that was identical to the permaculture notion of a 'zoned' farm. It was then that I realised that there are more similarities between the two systems than most people thought.

I hung out with pioneering organic and biodynamic growers and farmers in the area, often volunteering to help out at the weekends. I attended sustainability conferences. When Schumacher College opened in 1991, I went to evening talks by some of the leading thinkers in the field of sustainability. I have wonderful memories of delivering piles of fresh herbs, vegetables and fruit into the college kitchen where Julia Ponsonby cooked them up into delicious food, and of Thursday evening fireside talks by the likes of Satish Kumar, Wendell Berry and Vandana Shiva. My ways of thinking about growing food changed from how I had been taught in university to new ways that were and still are evolving through practice. Such learning by doing is an example of what is sometimes called 'action learning'.

I first used permaculture design methods on a large scale to develop the Organic Market Garden at Dartington Hall between 1989 and 1991. This evolved over the next 30 years into the successful School Farm CSA (community-supported agriculture) that it is today. My partner, Mark, was studying psychotherapy at this time and we were both reading the same books, which intrigued me. What was the crossover between sustainable land practice and healing people from trauma? It is only now, 30 years later, that we have finally been able to bring these two disciplines together fully in practice and understand how they interweave.

We moved to East Anglia, where I worked at Otley College of Agriculture, lecturing in permaculture, biodynamic horticulture and organic farming, and offering continuing professional development (CPD) to help existing farmers change their practice. The need for this very enlightened programme was not fully recognised at the time and so the funding for it was removed. During this time I also managed to squeeze in a master's degree at the University of Essex. This transdisciplinary degree in environment and society offered modules in

environmental politics and sociology, giving me further insight into how sustainable systems of food production did and did not work. The degree course was led by Jules Pretty, one of the leading lights in sustainable agriculture. We met Martin and Ann Wolfe at Wakelyns Farm in 1996 and took groups of students and farmers to visit the new agroforestry farm. Over the years, I observed how the agroforestry system developed into what it is today. We met up regularly with Ann and Martin to discuss the more holistic thinking that was generating and integrating the new sustainable food systems practices.

Leaving the college work, Mark and I managed to buy a 1.5-hectare field with a home. We used permaculture design methods to create a beautiful orchard, combined it with agroforestry throughout the site and applied biodynamic preparations regularly on the depleted soil. We employed a wonderful farm worker called Wayne for two days a week. When we left, the farm was turning over £25,000 per year. The holding was registered organic. We brought up our children there and built the first Apricot Centre out of recycled shipping containers. We sold the produce at the renowned Growing Communities Farmers' Market in Stoke Newington, part of a network of sustainable food producers in and around London.

We both worked elsewhere as well to make ends meet. Mark worked for the National Health Service (NHS) as a child psychotherapist, in particular with children either adopted or in the care system, having suffered some trauma in their lives. I worked as a creative practitioner in and around schools in deprived areas of Essex, collaborating with the teachers to create outdoor classrooms and deliver the curriculum in a kinesthetic learning environment, using the activities of growing, cooking and eating food to teach the children maths, science and English. We were also a part of the Transition Towns movement in East Anglia, attempting to create local food systems in the region. I delivered some Transition Town training in London and East Anglia.

What I've described in a few sentences encompasses 16 years of work. As I observed and worked the small farm, and it matured from an ordinary flat oblong of depleted pasture, something magical happened. It became very abundant. The food tasted delicious. The place was and still is full of wildlife. We had sparrowhawks, turtle doves, grass snakes, owls, foxes and elephant hawkmoths – the dawn chorus was a racket. It was then that I really knew how well these farming systems work.

In 2014, Martin Large, founding director of the Biodynamic Land Trust, asked us to submit a business plan for leasing their new 13-hectare bare field site on the edge of Dartington Hall Estate. The Biodynamic Land Trust intended to buy the piece of land and needed a farmer and team to transform it into a financially independent biodynamic farm. Bob Mehew joined us as a director with skills in project management and financial planning. The farm was bought in 2015 and is now a fully operational biodynamic farm designed using the permaculture design process. Agroforestry is woven through the site, which is home to a thriving well-being service for young people and families.

Rachel Phillips joined the well-being team to undertake the complex task of bridging the well-being work and the farm; she created a plethora

Figures 0.1 and 0.2: Transformation of the soil at Huxhams Cross Farm – left: before and after.

of nature-based activities for young people. Dave Wright joined the farm team to manage the market garden, which now yields delicious vegetables, chickens, eggs and wheat. The soil has been transformed after five years of sustainable farming practices following 40 years of industrial barley crops. From a standing start, the annual turnover after five years is £200,000+ for the farm and another £400,000 for the well-being service. We employ six people on the farm, with three apprentices per year, and another five people in the well-being team, as well as a number of part-time psychotherapists and psychologists. The farm is now sequestering ten tonnes of carbon dioxide equivalent per year – twice as much as the farm uses. The biodiversity is up, people who eat our food say it's delicious and most of them say they eat more fruit and vegetables because of it. We deliver almost 4,000 hours of therapy per year in total, including 500 hours on the farm. Over 1,000 people per year attend training or well-being activities such as 'mud tots', a parent and toddler group in the forest garden area. The farm attracts cohorts of young people as apprentices who are keen to learn about sustainable forms of food production and bring their own skills and knowledge to the the farm, the business or the Apricot Centre. All of this has come about from the transformation of the soil (Figures 0.1 and 0.2).

I am descended from seven generations of nurserymen from the small village of Boskoop in the Netherlands. Famous for its fruit tree 'Belle of Boskoop', Boskoop is central to the nursery stock production of trees in Europe. My generation is the first generation of my family in which women too have worked professionally in horticulture. During my career I have found

myself surrounded by more and more wonderful women pioneering the shift to sustainable food production and relocalised food systems.

I grew up listening to my mother's stories about the Winter of Hunger in the Netherlands. She was 18 in 1944 and she suffered from malnutrition at this time. She told me how she gleaned the fields with her brother for potatoes and peas, and of her relatives walking for hours to share some of this food. She spoke of seeing people starving to death in the streets. My English father told me stories of his childhood during the Great Depression, in 1935, when he was ten, there was no food in the cupboard when he came home from school. When I reflect on all this it seems no surprise that my whole career has revolved around growing food.

I would like to acknowledge the late Martin and Ann Wolfe, who have had a huge influence on my thoughts and the approach presented in this book. Their thinking about sustainable food production systems has resonated with me since we met: the need to go back to the point of divergence of the industrial and the sustainable models of food production and to devise modern sustainable systems rather than small adjustments to the current industrial farming system. I have had the privilege to visit Wakelyns Farm from 1996 until the present day and have observed it develop – and eaten many of Ann's delicious flapjacks in the process.

Overview of the book

Part 1 of this book's three parts establishes the context. Chapter 1 outlines the extent of the challenges facing food systems in the 21st century. Chapter 2 tells the story of how we got to this point and explains the structure of the book. Since the advent of industrial food systems, there has been a parallel development of diverse sustainable food systems. These have been quietly developing their practice and principles, often underrated, misunderstood or simply ignored.

Part 2 comprises six chapters, one on each of the sustainable food systems that have arisen sequentially from that point of divergence between industrial and sustainable food systems. These are the biodynamic, organic, permaculture, agroforestry, agroecology and regenerative food systems. Each chapter explains what the respective system is, where it started, its principles and practices, why it works, what it looks like in terms of one or two case studies, and where training is available.

Part 3 looks at how these sustainable food systems can be used as a toolkit to revolutionise the food systems of the 21st century. Chapter 9 highlights the characteristics that will be required of sustainable farms if we are to meet the challenges of climate change, biodiversity loss and producing enough food. The chapter then illustrates, with the use of research findings and practices arising from our six sustainable methodologies, how these food systems have pioneered holistic solutions to these challenges.

Chapter 10's case study of Huxhams Cross Farm illustrates how, in a few short years, the weaving together of diverse sustainable farming practices transformed a barren piece of land into the thriving healthy farm that it is today. Chapter 11 explores the next steps in the transition to sustainable food systems and how everyone can choose to be part of the sustainable agricultural revolution. ■

Chapter 10

Designing the world we want

Buy land, they're not making it anymore.[1]
Mark Twain

Introduction to a case study: the Apricot Centre @ Huxhams Cross Farm

The Apricot Centre team in partnership with the Biodynamic Land Trust came up with an answer to 'designing the world we want',[2] and this has been the creation of Huxhams Cross Farm. This is the story of the creation of this farm.

In 2015 the Biodynamic Land Trust bought Huxhams Cross Farm in Dartington, near Totnes, in Devon, with investment from 150 shareholders. In reality the farm was little more than a collection of six degraded fields of 13 hectares with no farm buildings. It had been farmed industrially for the last 40–50 years by the main tenant of Dartington Hall, a dairy farmer, with three arable fields of continuous barley, two wet meadows that had been abandoned and one field that had been put into set-aside and sprayed with glyphosate for many years. The soil structure was so damaged the land was just a giant muddy puddle that could barely grow grass. The contractor called it 'a miserable bit of land'.

The story of this small farm reflects the journey of many farms throughout the UK and the world. In the 1800s it was owned by Henry Champernowne, the owner of Dartington Hall. It was rented out to three tenants, and the old maps show that they grew vegetables, fruit in an orchard, and arable crops, with some livestock on the meadows. The barn on the farm was unusual for Devon, in that it comprised a threshing barn upstairs, for processing the wheat crops, and a cow shed downstairs; it was built next to the springs. There was a 'great meadow' for grazing draft animals. The apple barn was next door, and the cider press just around the corner. The parcel of land that we now call Huxhams Cross Farm was sold off to small-scale farmers at the turn of the 20th century, the time of the farming depression, and farmed on a small scale with arable crops until it was sold back to Dartington Hall Trust in the 1930s.

When Dorothy and Leonard Elmhurst bought Dartington Hall Estate in 1920, the 14th-century Dartington Hall was derelict and the farm run down. Dorothy, an American, was one of the richest women in the world. She and her English husband regenerated the estate as a place to live and work and experiment with progressive arts and farming. Dartington Hall became a progressive centre for arts, crafts, education, architecture and thinkers. It was here

that the concept of the NHS was born. However, when it came to farming, the 'progressive of the day' was the new industrial model of farming. Leonard Elmhurst had studied agriculture at Cornell University, and so Dartington Hall Trust pioneered industrial agriculture on the estate. Huxhams Cross Farm was bought to enlarge the scale of the dairy farm. A farmer was brought over from Denmark to modernise the dairy farm. He pulled out old hedgerows and Devon banks[3] and introduced tractors, fertilisers and pesticides. The estate experimented with artificial insemination of cattle and battery farming of chickens. This continued with the subsequent tenants and the estate farmed industrially right up until 2015.

Over the years, Dartington Hall was home for a while to some of the founders of the organic movement. Eve Balfour visited. John Seymour visited in the 1970s and made recomendations for the whole of Dartington Hall Estate to be converted into an organic farm. Lawrence Woodward, the founder of the Organic Research Centre, was educated at the progressive school on the estate. Schumacher College started on the estate in 1991, and many of the most prominent environmental thinkers visited and taught on the estate. I personally set up what is now School Farm, an organic market garden, in 1989, at the suggestion of David Cadman and in response to a conference held by Wendell Berry on the estate. School Farm CSA and the Schumacher College gardens were the only organic food producers on the estate until 2020, when Old Parsonage Farm went into registered organic conversion, This farm run by Jon and Lynne Perkin practises agroforestry, grows a mix of population wheat and landrace wheat, hemp and other ancient grains, raises pasture-fed cattle and is a partner in the Dartington Mill CIC (community interest company).

Huxhams Cross Farm, although part of the dairy farm, was sown with continuous barley as a commodity crop; its stubble fields were left bare every winter, the wetland meadows were abandoned and the great meadow was sprayed off with glyphosate to kill the 'weeds' and grass. This was subsidised as a form of 'set-aside', the removal of farm land from food production in Europe in the late 20th century because of the overproduction of food. One of the farm workers commited suicide in the barn and it was subsequently abandoned and then sold off to be a holiday home when the farm was sold to the Biodynamic Land Trust.

This tiny farm's story is like that of many, and yet it occupies a unique position; it is part of a thriving local culture of small- and large-scale organic, biodynamic, permaculture, agroecology and agroforestry farms and holdings and rewilding projects in and around Totnes. Huxhams Cross Farm is now registered biodynamic, has been designed using permaculture methodology and weaves in agroforestry methods throughout. We used the toolkit of different farming systems to create a regenerative farm.

The Biodynamic Land Trust's mission is to secure farms into long-term trusteeship for sustainable food production for the sake of farmers and communities.[4] Dartington Hall Trust wanted to implement a 'land partnership' scheme with many smaller tenants on its estate who would practise different forms of sustainable farming to create a dynamic

food culture, as well as establish a world class learning campus for sustainable agriculture next door to Schumacher College. Huxhams Cross Farm was the biodynamic farm in the mix.

Farmland in the UK more than doubled in price between 2010 and 2015, fetching £19,000 to £30,000 a hectare and putting the price of the average small-sized farm with a farmhouse and buildings out of reach of most people. The capital required to buy a farm does not make financial sense, since the mortgage payments that need to be met will far outstrip any income that can be generated from farming, especially with the long-term investment and time required to build sustainable systems of food production. The Biodynamic Land Trust's solution to this is to buy 10- to 20-hectare plots made up of five to seven fields, costing somewhere between £200,000 and £370,000. In order to make a living on this size of farm, there has to be a mix of high-value horticultural crops, small-scale agriculture producing high-value produce such as organic eggs and grass-fed meat, and value-added products. All these then need to be sold direct to the end customer, and appropriate non-food diversification may also be required in order to make a viable enterprise. Such diversification can sometimes account for up to 70–90 per cent of farm income.

The Biodynamic Land Trust has pioneered the 'farm community buyout' method using a layered cake of 'community shares', gifts and loans. It is a 'community benefit society' and has charitable status. To buy a farm, the Biodynamic Land Trust offers withdrawable shares to individuals, both in the farm's local area and nationally.

According to the warmth of local support and fundraising effort, the Biodynamic Land Trust has managed to raise between 30 and 75 per cent of the sums required to fund three small farm purchases, the rest of the money coming from interest-free loans and from an endowment. Shares deliver no financial reward, only the knowledge that you are a 'trustee', or shareholder, of a farm that brings environmental and social benefits to the locality. Initially, it was thought that mainly local people would invest in local farms, but it turns out that national and international investors like the idea of owning a bit of a farm somewhere in the UK if the vision is clear enough. The strapline of the Biodynamic Land Trust is 'Changing the world one farm at a time'.[5]

The permaculture design of the farm

Survey process

Once Huxhams Cross Farm had been bought, the team needed to make friends with the land and get to know it. So we walked, poked around the corners, took soil samples and tested them for phosphate, potassium, the pH and organic matter. We sat in the wind, watched the sun's movements, followed water down the slopes and as it popped out on the keylines. We measured altitudes and slopes and did contour mapping. We looked at old maps, and gazed at hedges, admired views and stood in howling gales in the rain to see where the wind came from. We followed deer tracks and talked to the dog walkers and neighbours to find out what was and what had been possible on the site. We spoke to the previous contractors and farmers who had worked the soil. We also sat down for some quiet observation time, to get a 'sense of place', or of

the dreaming of the place, the *genius loci*.

We spoke to the stakeholders: the neighbours, the biodynamic community, the permaculture community, the science-based sustainable agriculture community, the people interested in local, good-quality food. We spoke to Dartington Hall Trust, who were selling the land, and to other local food producers to find out how we could collaborate. We spoke to many people who didn't like what we were doing. We spoke to the national leadership of the Permaculture Association and the Biodynamic Association and asked them what they would like to see happen on the farm. We spoke at length to the Biodynamic Land Trust about their wishes for the farm. The Apricot Centre team spent time deciding what our vision and skills were and how far we were going to stretch them, how much money we needed to earn to support ourselves and how much money and time we could invest in the development phase. We used online survey monkeys, paper-based surveys, conversation and dialogue to engage with a wide range of people in this consultation process.

Analysis and design process

The Biodynamic Land Trust suggested that we do the core of the design work for Huxhams Cross Farm in a workshop format so that other people could see how it was done. So we organised two weekends where we analysed all of the information and designed first the pattern and then the detail of the emerging new farm. Both were wonderful events, involving small numbers of people who worked incredibly hard to grapple with, play with and create the concept of what is now Huxhams Cross Farm.

Function and element analysis

From the results of the survey work we created a list of the functions that this particular farm should fulfil:

- produce good quality food – vegetables, fruit, eggs and some grain
- support biodiversity
- sequester carbon
- resilience to climate change
- offer access to children and community
- offer a wellbeing service
- be a demonstration farm
- carry out research ansd training
- be economically viable
- be beautiful.

From this we also had a list of the 'things', or

Figure 10.1: Function element analysis for the permaculture design at Huxhams.

in permaculture jargon 'elements', that the farm would contain in order to fulfil the above functions, such as polytunnels, orchards, chicken houses, forest school area, farm trail, training room, barn, toilets, seats to enjoy the view, and so on. It was a very long list and we have not included it here.

We then carried out function and element analysis, that is, making sure that each function is supported by more than one element and each element supports more than one function in order to sustain resilient systems (Figure 10.1).

Zone and sector analysis

On large-scale maps of the site we mapped out on overlays the direction of the wind, the flow of the water, the sunny and shady spots (Figure 10.2). On another overlay we mapped out the flow of people on the farm: where we would have a cup of tea, what areas we would go to most often and why, and where the paths would be.

Designing

We made a huge scale map of the farm using a large sheet and gaffer tape, put it on the floor and then got out toys, plasticine and twigs, cardboard and scissors. The design group then spent a wonderful few hours modelling what the new farm might look like. We placed the elements in the right zone and in the right sector to make the most of the farm workers' time and energy. The vegetable-growing area was placed in or around where the barn and training centre would be. The orchards and arable or pasture fields were placed furthest from the training centre, since they needed to be visited less regularly. The site had some constraints.

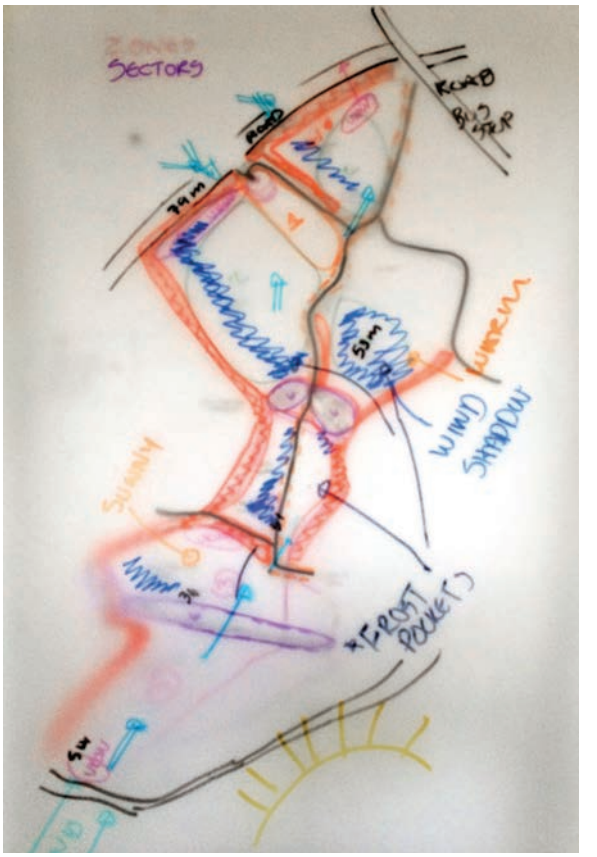

Figure 5.4: Sector analysis.

There was only one place where the farm could be accessed by car, so the buildings, that is, the barn and the training centre, had to go next to that entrance, since the cost of long tracks through the farm was prohibitive. The centre of the farm is one of two wetland meadows of huge conservation and local value, with an ancient droving track running through it, still used by many walkers. This meadow is full of orchids, insects, owls and bats. Its use cannot be changed and so we decided to improve the biodiversity here and on the second wetland meadow. To this end, two Shetland cattle were put in the meadows as conservation grazers. These cattle

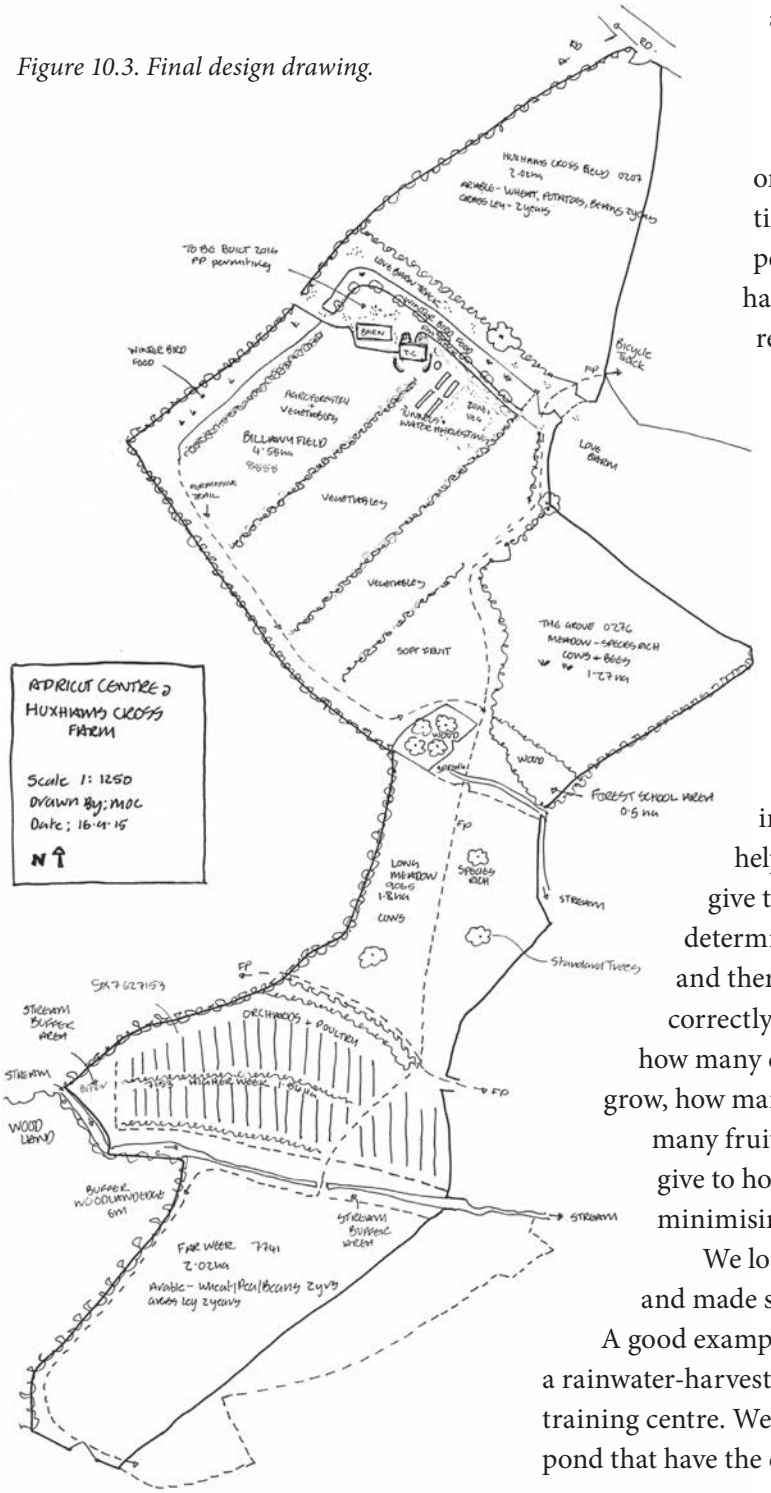

Figure 10.3. Final design drawing.

are therefore right where they should be on a biodynamic farm – in the centre of it.

Once we had placed the elements on our giant floor map, we spent some time imagining the flow of work and people on the emerging new farm. We had prepared lots of figures beforehand relating to the inputs required. For instance our two-hectare field that was planned for small-scale grain production would produce, we estimated, approximately five tonnes of YQ population wheat per year and would feed approximately 100 chickens with some extra protein input. Five tonnes of wheat require 10m^3 of barn storage space.

The research we had done in the input–output analysis described above helped us decide how much land to give to each element in the farm, and to determine the carrying capacity of the land, and therefore helped us scale everything correctly. This guided our decisions as to how many chickens to have, how much grain to grow, how many cows the farm could support, how many fruit trees to plant and how much area to give to horticultural crops – all with the aim of minimising our bought-in inputs.

We looked at the outputs from the system and made sure they would be used on the site. A good example of this was the installation of a rainwater-harvesting system next to the barn and training centre. We planned to install a tank and a pond that have the capacity to hold 125,000 litres of

water. These would collect water from the roof of the two buildings, which would then be fed through irrigation pipes to the polytunnels and vegetable beds. We thought that if the stored rainwater ran short (as it has in two out of the three summers we have been on the farm so far), then we could top up the tank and pond from the springs on the farm, or as a last resort from mains water. This arrangement would give resilience to the water system. We planned to slow down the rate of runoff of the rain falling on to the vegetable field through the inclusion of agroforestry rows running across the contours, which would enable the water to penetrate down through the subsoil to replenish the aquifers and the springs. These rows of trees would also slow down the wind, thereby slowing down the loss of water by evapotranspiration from the plants and evaporation from the soil. We planned to build up the organic matter content of the soil over the years with the use of green manures; this would also increase the capacity of the soil to hold on to water and reduce the need for irrigation in the longer term. Elements of the model were shuffled around until it worked and flowed.

We repeated the whole process a few weeks later, drilling down into the details. For instance, where we had just written 'orchard' on the original design we now planned out the direction of the rows, the sequential cropping of fruit, the positioning of windbreaks. This work in turn led to the creation of a detailed business plan and implementation timetable outside the workshop.

Working as a group brought unexpected and wonderful creativity, pushing the boundaries of us as a team, and making the design richer and more playful. Working as a team also brought up conflict-rich hotspots. Particular hotspots concerned the need for biodiversity on the new farm versus the need to grow food. This conflict was a microcosm of the conflict that arises in relation to biodiversity around the world in general, so the way that Huxhams Cross Farm planned to address this issue is and was key. Once carefully unpacked, such conflicts can lead to rich and creative solutions to the need to grow food but not at the price of decimating the wildlife. At Huxhams Cross Farm we left one field for a year of observation, carefully mapping out the beautiful orchids and other wild flowers on the site.

We subsequently planted extensive orchards where these flowers were not present and managed the rest as a wild flower meadow with conservation grazing with Shetland cows. The cows have also been fenced out of the area where the spring water rises, in order to cut down the contamination of one of the headwaters of the river Dart. The permaculture principle of 'small and slow solutions' was especially useful for these hotspots of problem-solving. Figure 10.3 shows the final design.

Implementation

The implementation of the design began in the autumn of 2015. We 'sculpted' the design on paper into the actual landscape of Huxhams Cross Farm and tweaked it as the farm developed. The very first thing we did, even before we had signed a lease on the farm, was to plough and harrow the arable fields and put them down to a very rich mixture of deep-

Figure 10.4: Putting on the biodynamic preparations.

rooting green manures to start to recondition the soil and bring it back to life. The green manures were designed specifically for the soils at Huxhams Cross Farm.

In the first winter we planted 2,000 trees, mostly on the contour in agroforestry rows; we planted a further 2,000 soft fruit plants and fruit trees and built the barn. In year two we contracted the use of a keyline plough to ease compaction in some of the fields, put a flock of hens on the farm to bring in some much needed cash and hired a contractor to put in our first population YQ wheat crop and put up the barn. In year three we planted our first vegetable crops in between the agroforestry rows, picked the first crops of strawberries and harvested our first YQ wheat crop. We also installed the rainwater-harvesting systems, including the tank and pond that enabled us to store 125,000 litres of water at any given time – or would have done if it had not stopped raining the moment we installed them! We had to wait until the following year to have collected enough water for our polytunnels. We put up six second-hand polytunnels, which gave us 600m^2 of covered growing space. Our training centre was also built in 2018, allowing us to start to deliver our well-being programme of therapy for children on the farm. We brought the farm into full production in the fourth year after signing the lease, although the fruit crops will take five to seven years to come into full cropping.

The toolkit we used was the permaculture design methodology. What we have created is a biodynamic farm incorporating agroforestry and regenerative agriculture and welcoming people back to the land.

The biodynamic conversion process

Bringing the soil back to life: the day we signed the lease for the farm tenancy we applied for the farm to go into the biodynamic conversion process. We compiled a 'conversion plan' for the farm explaining how we were planning to convert it to a biodynamic system over the next

three years. How were we going to bring the soil back to life? The first stage was putting the arable fields down to deep-rooting green manures and applying the horn manure preparation to reintroduce microorganisms into the soil (Figure 10.4); it was this that brought the first group of 25 people to the fields – probably more people than these fields had seen in a long time.

Bringing people back to the farm in this way, to quote Steiner, is 'giving the farm its soul'. A good place to begin the new farm journey.

In the summer months we put on the horn silica preparation and made our first compost heap and put the compost preparations into it. The second autumn, we started making the biodynamic preparations on the farm, the local biodynamic group leading the way. We filled cow horns and buried them and made some of the compost preparations. We continued to put the horn manure on once or twice per autumn and recently we have added to that the 'cowpat pit' preparation. The latter contains all of the compost preparations, so by adding it to the horn manure mix we can apply the compost preparations to all of the arable fields, since we haven't had enough compost to put on them. We use the biodynamic calendar to aid in the choice of day to apply the preparations, aiming for a root day for the horn manure. We apply horn silica to the crops in the summer months. We have just invested in a flow form to stir larger amounts of preparations and apply them with a sprayer on the back of our small tractor.

Figure 10.5: The author at Huxhams Cross Farm.

Our food does have a distinctive taste, or 'terroir'. It is highly regarded by our customers. It is delicious and has great keeping qualities. Our soil went from being the worst soil on the Dartington Hall Estate to the best-performing soil in three short years.

Creating the farm organism is a slow process. We have been around the full rotation only once in five years.

Designing and implementing the agroforestry systems

Our main vegetable cropping field is called Billany and is four hectares. It has the best soil on the farm and faces south. The plan was and is to grow vegetables with polytunnels and some soft fruit in this part of the farm. It is lovely and sunny but exposed to the wind. The soil is clay over shillet, basically a free-draining clay, but most of the top soil is at the bottom of the hill after years of soil erosion.

We chose hazel coppice as our agroforestry tree species because of the exposure and our presumption that we would need wood to heat our training centre. As it turned out, the

Photo: Christian Kay

Figure 10.6: Drone picture of Huxhams Cross Farm 2016.

new training centre was built with such good insulation that a wood-burning stove would have made it too hot. Instead we will use the coppice to make ramial wood chips to improve the soil carbon content. Our next decision was which way to plant the alley rows: on a north–south axis up and down the slope or on the east–west axis on the contour? This was an agonising decision, since each solution had its merits, but we knew that once we had planted the trees it would be difficult to change their arrangement.

We used a permaculture design tool called 'Strengths, weakness, opportunities and challenges' (SWOC) to help us make our decision. Because we had done so much work to clarify the functions, aims and objectives of the farm, the choice was quite simple in the end. We decided to plant the trees on the contour running across the field with 28m spacing between them. Planting east to west means that we do give some shade to our crops, but because the farm is on a slope this is minimal. In order not to shade our crops out we kept the spacing very wide at 28m, so we could at a later date add another row in the middle, which would make the rows 14m apart. The fact the trees run across the slope slows the movement of water and topsoil down the slope, helping water to percolate down into the subsoil and aquifer below. The trees break the prevailing wind and

this in turn reduces evapotranspiration from the crops in hot windy weather. The agroforestry rows create a human-scale farm in which to work; we can see right into all of the cropping areas. The agroforestry alleyways are three metres wide, are full of long grass and are a perfect home for our functional biodiversity predators as well as many linnets. They bring a lot of 'edge' into the cropping areas. The way they break up the space makes it easier to plan our rotations in the alleyways; we made them the right size to fit the standard sizes of crop covers and the length of pipe our irrigation would run.

Because the agroforestry rows have been planted on the contour, the tractor work is carried out on the camber – on a slight slope. Most tractor implements work better on the flat, so most farmers carry out cultivations up and down a slope, even though this causes problems with soil erosion. We have found that all but one of our cultivations can be done adequately across the slope; the exception is mechanical weeding. To compensate for the latter we have invested in pedestrian wheel hoes that are fast and efficient to use by hand. Had the slope been steeper, we would have made a different decision. After four years of cultivation two of our agroforestry alleyways have become home to no dig intensive beds that run up and down the slope (see Figures 10.6 and 10.7).

In our meadows we planted standard perry pear trees to add a potential crop in 20 years' time and to add more biodiversity and bee fodder to our wetland meadow. In the fullness of time they will offer shade to our two cows grazing in this meadow.

Figure 10.7: Drone picture of Huxhams Cross Farm 2021.

Photo: Christian Kay

We are partners in Broadlears Agroforestry Field on the Dartington Hall Estate. This is a 20-hectare field with agroforestry rows 20m apart. We have planted a third of these rows with 800 fruit trees. Luscombe have planted elderflower on a third of the rows for their elderflower cordial, and the London Peppercorn Company have planted a third with Sichuan peppers. The arable cropping space in between is farmed by Jon and Lynne Perkin of Old Parsonage Farm; they grow wheat, hemp and oats there. The wheat is the genetically diverse wheat produced for Dartington Mill: the YQ population wheat, Cornovii, a new wheat created by Fred Price of Gothelney Farm in Somerset. Some of the oats are sold to the Lush cosmetics company as fresh oats for their hand cream. The field is registered organic. All the partners pay rent for their allocated areas and have signed a lease that reflects the shared values underpinning the way the crops are managed in the field.

Dartington Mill

A few years after we took on the lease for Huxhams Cross Farm it became clear that it was not economically viable to grow two hectares of YQ wheat. At the same time, Old Parsonage Farm at Dartington Hall and the Almond Thief bakery, close by, were keen to add value to their grain and to access local flour for baking. Together the three companies formed Dartington Mill, out of the Grown in Totnes not-for-profit organisation. Old Parsonage Farm has 120 hectares of arable land (out of 180 hectares in total), on which the Perkins grow a wide range of grains. Dan Mifsud at the Almond Thief bakes artisan sourdough loaves and shares a building with the New Lion Brewery. Together we bought a new mill from the US which mills the grain slowly without overheating it, preserving its taste and nutritional value. The Apricot Centre sells its grain to the mill; the mill processes it and then sells it on to the bakery, occasionally to the brewery, or the Apricot Centre buys it back. The Apricot Centre puts the flour in bags and retails it. Dartington Mill trades under the name of 'Reclaim the Grain', since our aim is to shorten the supply chain and decommodify and relocalise our grain production.

What has the farm achieved after five years?

After five years of hard work to bring the farm into being we have achieved a great deal. We are working towards a closed loop farming system, growing many of the resources we need on the farm and putting back any waste products in the form of compost. We are delivering 500 hours per year of individual therapy to children and run an after school farm club and school visits. We welcome approximately 1,000 people to the farm each year on visits and tours. We train approximately 40–50 people per year in permaculture, biodynamic farming and growing and agroforestry. We are about to scale up our apprenticeship scheme so we can train 20–30 people per year. They will be placed in farms across Devon and trained at levels three and four in regenerative food systems, encompassing the systems outlined in this book.

We are financially self-sufficient and employ six people on the farm, have three apprentices and employ five full-time-equivalent in the well-being service and one person in business

Farming as the key to net zero carbon emissions by Philip Franses

Philip Franses works for Flow Partnership, an NGO that partners with other organisations around the world to reinstate and restore watersheds and the small water cycle.

Many people have the idea that we somehow passively own carbon in a reserve of fossil fuels and have expended this resource in the burning of coal and oil. For instance, common arguments around the ambition to reach net zero carbon emissions by 2030 often refer to the heating of buildings, changing to natural energy sources, and methods of transport – without even mentioning the land. How we farm the land will be a crucial element in the future management of carbon emissions and hence the response to climate change.

Carbon, it is believed, is made in the hot centres of stars, through a chain of unlikely reactions known as the triple alpha process. In 1953 the renowned astronomer Sir Fred Hoyle predicted a then unknown excited state of carbon must act as a stepping stone for the production of stable carbon. This required a number of different chemical constants to be exactly aligned. Were this not so, then the earth would have no carbon to provide the basis for organic life. Carbon naturally cycles between organic life, sediments, soils, the atmosphere and the ocean; photosynthesis and respiration are part of this cycle.

We participate in the carbon cycle and without it we would not exist. The climate is changing because this cycle has become impoverished. When we restore the cycling of carbon in the way we manage a farm with healthy, porous, nutrient-rich soils full of organic life, the carbon picture changes dramatically.

Impact assessments carried out by the Apricot Centre team after five years of farming at Huxhams Cross Farm, using the farm carbon toolkit, have measured that 63 tonnes of carbon per year, over and above what the farm has used, are sequestered from the atmosphere into the farm's 13 hectares of soil. To put this in perspective, agricultural land is by far the biggest sector of the earth's land surface, covering around 5 billion hectares. The rate of carbon sequestration achieved by this farm would translate worldwide into a cycling of 25 billion tonnes of carbon per year.

In burning fossil fuels to fuel industry and changing land use (deforestation etc.), we are emitting about 40 billion tonnes of carbon into the atmosphere per year. So the lack of capacity to hold carbon in the land in the way we farm is just over 50 per cent of the total net emissions of carbon into the atmosphere which are driving global warming.

Such results are similar to findings about potential carbon sequestration in wetlands, another key player in a healthy carbon cycle. Natural England estimates carbon sequestration in wetlands as amounting to up to 14.5 tonnes per hectare per year. By impairing the carbon cycle through removing wetlands and through monocrop farming we are inadvertently taking carbon away from its natural use in the soil food web.

The IPCC goals are to reduce carbon emissions by 2030 to 25–30 billion tonnes and to reach net zero emissions by 2050. Regenerative agriculture over large swathes of land could play a huge role in restoring the natural carbon cycle so that it will have the capacity to sequester these amounts of carbon. It was a welcome surprise to me that innovative farming practices offer a proven method of carbon sequestration.[8]

activities such as accounts and administration. That is twelve full-time-equivalent people. The farm also looks very beautiful and the produce tastes divine. So how has our farm in its short life met the four challenges it was designed to meet?

Climate change mitigation

We have planted 2,000 hazel trees and 1,300 fruit trees. We have converted the land to a fully biodynamic farming system and piled organic matter into the soil via green manures. We have installed a five kW array of PV panels on the roof of the barn. All of our deliveries are carried out within a 30 km radius and we have reduced our plastic use to reusable bags only and we use them for salads and pre-packed greens only. We do buy in extra supplies, but our policy is that we source locally wherever possible from within the UK and then from Europe if necessary, but never shipped by air.

We have worked with the farm carbon toolkit[6] and found that we sequester 62 tonnes of carbon dioxide more per year than the farm puts out. That is, the farm sequesters twice as much carbon as it uses, or almost five tonnes per hectare per year. To put this in context, the average person in the UK expends 5.3 tonnes of carbon dioxide per year. At Huxhams Cross Farm we are still paying the carbon debt for our barns and training rooms. Use of the farm carbon toolkit has highlighted where we can reduce our carbon the most (see Figure 10.8), and that is in the organic chicken feed that we buy in – we still need to supplement 50 per cent of our chicken feed with bought-in layers pellets – and in the fuel for our delivery vehicle. Our next step will be to switch to an electric delivery vehicle and to source locally produced high-protein chicken feed. What have been most effective in terms of carbon sequestration are our deep-rooting green manures (see Figure 10.9).

One research project carried out on the estate has highlighted how Huxhams Cross Farm's soil has formed the highest amount of soil aggregates among all the farms on the Dartington Hall Estate. These are what sequester carbon on a stable long-term basis; biodynamic farms are particularly good at forming them, as demonstrated by research at FiBL.[7] These soil aggregates are formed by the relatively high levels of bacteria and fungi in the soil.

Climate change adaptation

Since we took on the farm in 2015, the weather events the farm team have had to deal with have been as follows:

- 2015: warmest year on record
- 2016: monthly extremes
- 2017: fifth warmest year on record
- 2018: the 'Beast from the East' followed by summer drought
- 2019: warmer, wetter and sunnier than average; hottest day ever recorded in the UK in July
- 2020: Storms Ciara and Dennis, producing heavy rainfall and flooding; driest May on record
- 2021: frostiest April on record; wettest and coldest May on record.

At the start of our cropping season in 2017 we had such extreme weather that I found myself ranting that we were not yet ready for climate change. However, the farm has become resilient

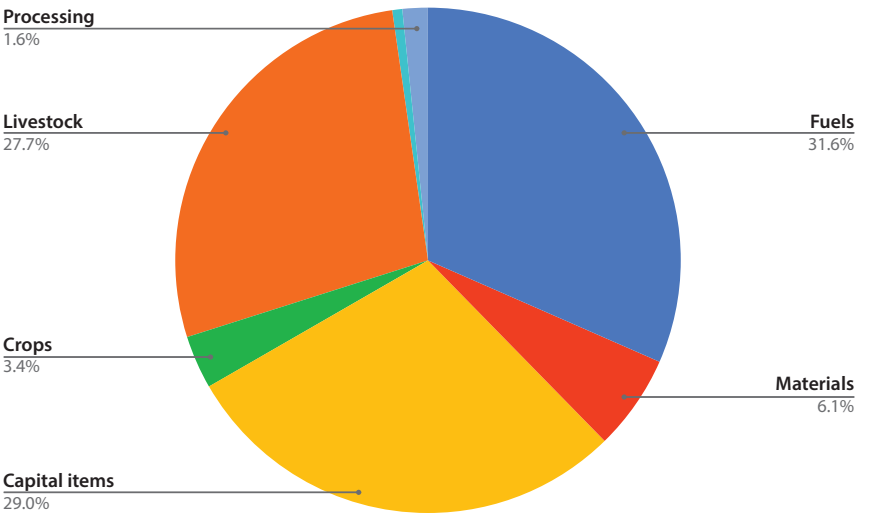

Figure 10.8.
Pie chart of carbon use. CO_2e emissions from the farm. Fuels, livestock and capital items are the biggest contributors of GHG emissions.

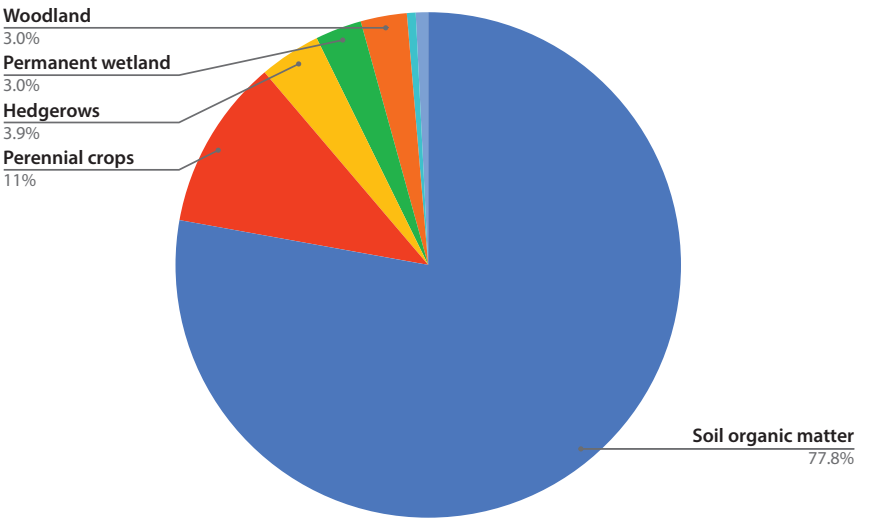

Figure 10.9.
Pie chart of carbon sequestration. Total CO_2e sequestration on farm.

to such weather events and we have managed to cope. We have managed to continue producing high quantities of good-quality fruit, vegetables and eggs. In 2020, when wheat yields in the UK went down by 30 per cent, our grain yield was the same as in the previous years. We installed the tank and ponds with capacity to store 125,000 litres of rainwater; in the first few years the water ran out every summer and we had to resort to mains water for a few weeks. By the summer of 2020 we were managing totally on the stored water. The amount of mains water we use each year will vary according to the year's rainfall distribution. Our soil has increased its organic matter by a huge 25 per cent and is covered most of the year with mulch and green manures, which makes it more resilient to heavy rainfall.

Offsetting biodiversity loss

With careful grazing and hedgerow management, we have restored three hectares of wetland meadows that had been neglected for the last 30 years and that in most farms would have been drained. The orchid count has gone up by a factor of eight, as have the insect, worm and bird populations. When you walk through the meadows in the evenings they are alive with bats and owls, and the summer of 2020 saw an explosion of crickets and meadow brown butterflies.

On the cropping areas of the farm, as the soil has recovered it has acquired a better structure and is also now full of worms. The worm count on the farm has gone up by 50–400 per cent in most fields. Worms are an indicator of soil health and were noticeably absent when we took on the farm in 2015. The worms turned up as soon as they had something to eat; they are near the bottom of the food chain, so they themselves in turn become food. The agroforestry rows are now full of linnets as well as the voles and mice that the cats bring in.

Figure 10.10: Huxhams Cross Farm wellbeing pod and intensive beds.

The RSPB did bird surveys in 2015, when 19 species were noted, and in 2020, when 28 species were noted – approximately a 30 per cent increase. Our green manures of clover and buckwheat are alive with bees when they are in flower. Predatory insects turn up to feed on our pests with welcome regularity.

Producing enough food for everyone

The farm is productive: at Huxhams Cross Farm we are producing enough food for approximately 250 families per week in terms of vegetables, fruit and eggs, plus approximately five to six tonnes of wheat per year (one tonne per acre), some of which goes to feed the chickens and most of which is milled into flour and sold either to a bakery or direct to customers.

The yields and economic performance of the farm in 2020 were as follows. We harvested a total of 15.4 tonnes of fruit and veg – almost a 20 per cent increase from 2019. In addition, we collected a total of 38,500 eggs (or 6,410 boxes), 2.4 tonnes of hay (used as animal feed over winter), six tonnes of wheat and 2.3 tonnes of

straw. The fruit and veg are mostly sold directly to the consumer, via our online shop and weekly market. Less than 10 per cent was sold wholesale to local restaurants and small shops in 2020. Surplus produce was processed and sold as jams, chutneys and juices, or donated to the local food bank. Our local food bank is called Food in the Community and provides fresh food to those in need. A small amount of waste was composted on site or fed to the chickens.

We grew a range of 100 different crops and varieties; 82 vegetable crops and varieties and 18 different fruits. We made about 30 different products using our preserving equipment and processed the wheat to sell as flour (wholemeal and white), flaked wheat and wheat berries (whole grain used as a rice substitute). Of the waste products from Dartington Mill, the bran is sold to local mushroom producers, who use it as a substrate on which to grow mushrooms, and anything left is used as chicken feed. Straw and hay were used as animal feed, mulch and animal bedding, and some was sold to customers. We have a stable flock of approximately 150 White Leghorn chickens providing fertility, pest control and a total of £16,000 of income per annum.

Figure 10.11: Infographic from CAWR at Coventry University.

All our produce is sold within a 30 km radius of the farm. The majority is sold directly

to the consumer. In 2020, approximately 75 per cent of sales occurred via the online shop, 18 per cent via the local market and seven per cent was sold wholesale. Owing to COVID-19, there was a 350 per cent increase in sales on the online shop. The local market was closed for two months. However, despite two months of no sales there, total market sales for the year increased by four per cent compared with 2019. When the market reopened (June 2020), our sales more than doubled.

By autumn 2020 our sales had stabilised, with less variation from month to month.

The total income from the online shop and market sales had increased from £6,500 per month in 2019 to £17,500 per month in 2020. This is a 260 per cent increase. The number of customers also doubled from 2019 on both the online shop and the market.

We also buy organic produce to supplement our own. This is as local as possible, but we do import from further afield, mainly for fruit in the winter months, including from Spain, Italy and the Dominican Republic (for bananas). In 2020, bought-in produce accounted for a third of our total sales.

The value of our crops increased in 2020 because we increased our salad and herb production, these being high-value crops. The average value of produce increased from £4.47/kg to £7.85/kg.

We have carried out a social impact study of our food in partnership with the Centre of Agroecology (CAWR) at Coventry University (Figure 10.11). They found out that our customers wasted less food (63 per cent), felt more connected to the origin of their food (72 per cent) and ate more than the national daily average of fresh fruit and vegetables (91 per cent). One lovely quote: 'As a family we try more veg. My six-year-old son now finds that he likes beetroot. I have figured out how to cook fennel so I like it. My husband now snacks on the green leaves rather than junk food and has lost weight.' ■

1 Attributed to Mark Twain.

2 Quotation from D. Holmgren, *Permaculture*: *Principles and Pathways Beyond Sustainability*, Permanent, East Meon, UK, 2002.

3 'Devon banks' are a particular form of ancient hedgerow found in Devon. The soil is mounded up to a height of one metre and lined either side with stone facing, using stones from the fields. The tops of the banks are planted with trees that are regularly coppiced. These ancient hedgerows are full of biodiversity and up to 800 years old.

4 M. Large and S. Briault (eds), *Free, Equal and Mutual: Rebalancing Society for the Common Good*, Hawthorn Press, Stroud, 2018.

5 https://www.biodynamiclandtrust.org.uk

6 https://www.farmcarbontoolkit.org.uk/

7 P. Mader, A. Fliessbach, D. Dubois, L. Gunst, P. Fried and U. Niggli, 'Soil Fertility and Biodiversity in Organic Farming', *Science* 296, 2002, pp. 1694–1697.

8 C. Harvey and N. Gronewold, 'CO_2 Emissions Will Break Another Record in 2019', *Scientific American*, 4 December 2019; Natural England, 'Carbon Storage by Habitat: Review of the Evidence of the Impacts of Management Decisions and Condition of Carbon Stores and Sources', NERR043, 2012; J. Rogelj et al., 'Mitigation Pathways Compatible with 1.5°C in the Context of Sustainable Development', in *Global Warming of 1.5°C*, ed. V. Masson-Delmotte et al., World Meteorological Organization, Geneva, 2018.