The Environmental, Economic and Social Impact of Huxhams Cross Farm 2020

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Contents

Supplementary information available

Soil Analysis Report by FCT
Soil Carbon Report 2020
Farm Carbon Calculator report 2020
Social Impact report by CAWR

Summary of findings

The aim of Huxhams Cross farm is to mitigate climate change, be resilient to climate change, support biodiversity, and produce food whilst being economically viable as a farm business. We designed the farm to achieve these ends, using regenerative agriculture techniques.

We started the farm from a bare field site in 2015 and by 2021 we found the following;

- The farms sequesters almost 5 tonnes of carbon dioxide equivalents per hectare per year over and above what the farm uses. A total of 64 tonnes per year.
- The soil organic matter went up by 25%
- The bird species numbers rose by 50%, the orchid numbers roses by 200%
- The worm count in the soil doubled
- The farm harvest rainwater and is becoming increasingly less dependent on mains water for irrigation.
- In 2020, we harvested a total of 15.4 tonnes of fruit and veg. Almost a 20% increase from 2019. This is in line with the increase in land use area. In addition, we obtained 2.5 tonnes of eggs, 2.4 tonnes of hay (used as animal feed over winter), 6 tonnes of wheat and 2.3 tonnes of straw. This is produced from a cropping area of 5 hectares for the vegetables and fruit, and 2 hectares for the wheat.
- The turnover of the farm was approximately £200,000 in 2020, with £140,000 of this being from our own produce.
- We employ 6 FTE people on the farm with 3 apprentices.
- On average we have over 300 customers per week within a 12 mile radius of the farm (150 deliveries, 150 plus on the market stall)
- 63% of our customers said that our engagement has helped them be more resourceful with their food
- In 2020 we had 1420 visitors on the farm

1. Introduction

1.1 What is the Apricot Centre and Huxhams Cross Farm?

In 2015 the Biodynamic Land Trust bought Huxhams Cross Farm from Dartington Hall Trust, near Totnes South Devon, with 150 shareholders. It is a very small farm of 13 hectares.
The Biodynamic Land Trust's purpose is to secure farms into long-term trusteeship for sustainable food production for farmers and communities. Dartington Hall Trust wanted to implement a 'land partnership' scheme with lots of smaller tenants on its estate practicing different forms of sustainable farming to create a dynamic food culture, as well as a world class learning campus for sustainable agriculture next door to the Schumacher College. Huxhams Cross farm is the biodynamic farm in the mix.

The Apricot centre is the first tenant of Huxhams Cross farm, and as a team we took it on as a bare field site. We are sustainable or regenerative farmers, growing vegetables, fruit, flowers, eggs, and grain. The Apricot centre is also home to a wellbeing service for children and families. We scaled up our business from a 1.5 hectare site in East Anglia to the Huxhams Cross farm in Devon.

One of the initial aims of this partnership was for the Apricot Centre to take baseline measurements on the farm and demonstrate the outcomes and impact of the farming practices we use. This report details our impact on this 13 hectare farm over a 5 year period, in terms of the carbon sequestration and resilience to climate change, biodiversity, food produced, and our economic figures, and the social impact of the food.

1.2 What is the Devon Environment Foundation (DEF)?

This report was funded by the Devon Environment Foundation. The aim of DEF "is *to protect and restore at least 30% of Devon's land and water by 2030. We will implement this vision by supporting grassroots projects that regenerate nature, especially those that can be replicated and scaled across the county".*

They have funded a 3 month post at the Apricot centre to create this report, and to host 2 farm walks to farmers and land managers, and to share our knowledge and information.

1.3 Why 30% Devon for nature by 2030?

Approximately 70% of Devon is farmland, if 30% of Devon is to be for "nature" then this needs to include farmland, as well as conservation projects and pockets of land.
The issue of biodiversity loss has to go hand in hand with mitigation and adaptation to climate change, as one is not possible without the other. Farms by their very nature also produce food and are businesses. The question for us when creating Huxhams cross farm was "how can we mitigate and adapt to climate change, support biodiversity, produce food, and be economically viable at the same time ?"

2. The story of Huxhams Cross Farm

2.1 Background

Huxhams Cross farm was part of Old Parsonage Farm, a part of the Dartington Hall Trust. It is 13 hectares of clay soil, 80 meters at the highest point, and 30 meters at the lowest. It has one spring. In reality this was little more than a collection of six degraded fields with no farm buildings. It had been farmed conventionally for the last 40-50 years by the main tenant of Dartington Hall, a dairy farmer, with 3 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 damaged it was just a giant muddy puddle that could barely grow grass. The contractor called it ‘a miserable bit of land’.

2.2 Aims and objectives of the Apricot Centre

The aims and objectives of the Apricot Centre are to;

- Produce good quality food - vegetables, fruit, egg and small scale grain
- Carry out conservation grazing on the wetland meadows
- Support biodiversity
- Offer training
- Offer access to the farm for children and community
- Offer a wellbeing service
- Be a demonstration farm
- Carry out research on the farm
- Be economically viable
- Be beautiful

2.3 Business model

Huxhams Cross farm is 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.

We aim to sell as much of our produce as possible directly to the customer so maintaining the highest economic gain from our produce. This includes milling our wheat into flour. We sell via an online shop with deliveries in a 20-mile radius of the farm, and Totnes Market every week. We sell the remainder as wholesale to local shops and restaurants. We run a wellbeing service for children on the farm and this provides extra income to share the overheads of the farm.

3. Climate change: the challenges

There are three challenges facing farming that need to be addressed across the UK, as well as Devon. They are outlined below. In addition, farms need to produce high quality, nutritious food.

3.2 Mitigation and adaptation

Current conventional food production systems are responsible for 30% of carbon emissions. The International Panel on Climate Change (IPCC) set target carbon emission reductions at the Paris COP in 2015. The current aim is to reduce emissions by 100 percent by 2050, in order to keep the global temperature increase to a sustainable level set at two degrees celsius (4). Some countries are now aiming for 100 percent emission reduction by 2030 because of the recently declared climate change emergency. The IPCC has suggested that the world community has until 2030 to start to address climate change and to start effectively reducing emissions or we will be into runaway climate change. In the UK the National Farmers Union (NFU) has set a target for net zero carbon emissions for the Farming sector by 2040. As these transitions take time, the time to start them is now.

Farms uniquely have the ability to sequester carbon into their soils and trees, they are able to not only decarbonise themselves but also soak up carbon produced from other sectors. There are four main greenhouse gases (GHG), carbon dioxide, methane, nitrous oxide and fluorinated gases. In farming the main focus is on the first three GHGs.

1. Carbon dioxide is emitted from burning fossil fuels. Farms use fossil fuels to power tractors and machinery, and use electricity for cold stores,drying and processing equipment. Fossil fuels are used for long distance transport of food around the world called ‘food miles’ and out of season food produced in glasshouses. Embedded energy is used in the production of plastics that wraps food, and in the production of nitrate fertilizers and pesticides.

2. Nitrous oxide is emitted from the manufacturing of nitrogen fertilisers. It is a GHG three hundred times more powerful than carbon dioxide. On their own, nitrogen based fertilisers are thought to contribute 6 % percent to worldwide carbon emissions.

3. Methane is produced by cattle and ruminant livestock. As a GHG, it is four times as powerful as carbon dioxide. Most cattle in Devon are fed on pasture and pasture fed cattle produce less methane. However when they are fed grain or soya that is potentially shipped from all over the world and produced using large scale tractors, pesticides and fertilisers, the carbon footprint of the cattle feed goes up and when fed grain cows emit higher methane emissions.

Climate change produces erratic weather and farms need to adapt to these changing weather conditions. Predictions for changes in weather suggest more extreme weather events such as storms, high rainfall, high wind, rain at the wrong time of the year, drought, late frosts and warm spells in winter. Climate change is now experienced in real time and is no longer something to be projected into the future. Farming by its very nature relies on predictable weather patterns, one late frost can wipe out a fruit or vegetable harvest. A drought in summer can cause crop failures, storms devastate glasshouses and polytunnels. Wet autumns make autumn cereals difficult to sow and harvest.

Farms can sequester many more times carbon than they produce, and they can be resilient to climate change. Farms can also provide flood protections in heavy rain storms and regenerate water systems with careful planning.

3.3 Biodiversity loss

Worldwide biodiversity loss is currently estimated to be at 1000-10,000 times the background rate of extinction by the United Nations Environment Programme (UNEP). The term biodiversity in this context means the number of species in a habitat, the number of habitats or ecosystems present in a region or farm, and the genetic diversity within each species. Biodiversity increases the ability of ecosystems to adapt to climate change. The loss of biodiversity applies to wild plants, animals and microorganisms in the soil (6)(8).

Agro-biodiversity is the number of crop plants, crop plant varieties and animal breeds used in food production. The diversity of all of these is in decline with the loss of "agro-biodiversity" placed at 75-90 percent over the last 100 years. This has made diets less diverse and cropping systems less resilient.

The causes of these losses are wide ranging but one of the main drivers is the loss of habitat to agriculture. This includes the loss of forest, hedgerow, small woodlands, the draining of wetland meadows, filling in of ponds and ploughing of marginal lands to mechanise food production. The use of fertilisers and pesticides causes the loss of soil micro-flora and fauna and organic matter in the agricultural soils. These are the basis for the higher food chain. If there are fewer fungi and bacteria, there will be fewer worms, insects, small mammals and birds. The subsequent fragmentation and loss of wildlife corridors in the remaining habitat means that it becomes too small to support a self sustaining population. Pollution further degrades habitats putting the population under stress. Climate change will exacerbate this problem as species need to migrate to find suitable breeding conditions. Due to the lack of wildlife corridors this becomes extremely difficult.

Since the introduction of industrial farming systems began after World War II, biodiversity levels have plummeted. Agricultural soils are so degraded in the UK that DEFRA have suggested that there are only 40 years of harvests in some places (9) (19).

The concept of ‘Land sparing’ suggests that if some land is farmed more intensely than other land then some can be “spared for nature”. However this does not address the systemic problems in the long term. Firstly, it does not address the problem of habitat fragmentation, one of the main issues of biodiversity loss as many species need to migrate to cooler climates with climate change. The soils that would be used continually for industrial food production will continue to decline, and will only last for another 40 -60 years without regeneration. Therefore ‘land sparing’ only postpones the problem, rather than solving it. Using more pesticides and fertilisers will only exacerbate climate change and the loss of biodiversity.

In Devon where farmland occupies 70 per cent or more of the land mass, it is crucial that farming systems support biodiversity at all levels. Ideally farmland would become “porous” to biodiversity, biodiversity will be able to move from farm to farm via wildlife corridors. Currently single use plastic packaging is used to wrap food, especially supermarket bought food. Very few plastics are recycled, the majority are thrown away. These end up in landfill, incinerators, or find their way into rivers and the sea. Fish and animals become entangled in them. Plastics contain bio accumulative toxins that move up through the food chain to people (10). Plastics are also made from fossil fuels.

3.4 Produce food

Farms need to produce healthy food. It is estimated that food production needs to increase by 60 percent over the next 30 years, although it is estimated that a third of all food in the world is wasted. Land that has been used for food production in the past is now under utilised because it has been degraded, or because it is no longer an economically viable way to earn a living.

The Eat- Lancet report suggests that a shift to a healthier more plant based diet is not only better for our health but is necessary as a shift towards long term planetary sustainable food production systems. This diet would consist of “half a plate of fruits, vegetables and nuts. The other half consists of primarily whole grains, plant proteins (beans, lentils, pulses), unsaturated plant oils, modest amounts of meat and dairy, and some added sugars and starchy vegetables”(15). Eating meat is still healthy but the emphasis is on pasture fed livestock.

3.5 What is regen ag?

Farming differently can meet these challenges in a multifunctional way, by switching their type of farming from “conventional farming” to “regenerative farming” practice. Farms can sequester carbon, be more resilient to climate change, support biodiversity and produce food at the same time. Regenerative practice is “*farming and grazing practices that, among other benefits, reverse climate change by rebuilding soil organic matter and restoring degraded soil biodiversity; resulting in both carbon draw-down from the atmosphere and improving the water cycle. It also aims to be resilient to climate change, and produce higher yields of healthy or nutrient dense food”*.

Regenerative farming uses a number of tools or practices to achieve these aims whilst producing food and earning a living, these practices reduce inputs and the produce usually demands higher prices, so the economic viability is also increased.

The tools we used at Huxhams cross farm are Permaculture design in the initial stage to design for these outcomes. When we took the farm on we put it done to deep rooting green manures, and planted agroforestry rows. We use “key line ploughing” or subsoiling across the contour to allow for soil organic matter improvements deep into the soil. We have reduced our tillage to a minimum to reduce soil disturbance. We introduced the soil biome back into the soil, using the Biodynamic system, but compost teas, manures of composts can also be used. We are a very small farm, but on a larger scale with livestock we would use mob grazing techniques.

3.6 ELMS
Farming has received subsidy from the government in the form of Basic Payment Scheme (BPS) at the rate of £250 per hectare land farmed, Farmers can also apply for the Countryside stewardship (CSS) at mid tier or Higher tier for extra payments based on environmental benefits. This is now being phased out and farmers will be paid for provision of "public goods" under the new Environmental Land Management (ELMS)

There are 6 public goods;

1. Managing land or water in a way that protects or improves the environment;
2. Public engagement - supporting public access to and enjoyment of the countryside, farmland or woodland and better understanding of the environment and managing land or water in a way that maintains, restores or enhances cultural or natural heritage;
3. Managing land, water or livestock in a way that mitigates or adapts to climate change;protecting or improving the quality of soil.
4. Managing land or water in a way that prevents, reduces, or protects from environmental hazards;
5. Conserving biodiversity; native livestock, native equines or genetic resources relating to any such animal;protecting or improving the health of plants;conserving plants grown or used in carrying on an agricultural, horticultural or forestry activity, their wild relatives or genetic resources relating to any such plant;protecting or improving the health or welfare of livestock;
6. Clean air

Many of the details for what ELM might look like is still unknown, but it will financially support a transition to a regenerative or sustainable form of farming. There are three levels of payment support;

1. Sustainable Farming Incentive (SFI) will pay for environmentally sustainable land management actions that all farmers can do. It will be designed to be the most accessible route to funding. The government will publish details of the scheme, what it will pay for and how to get involved by June 2021.

2. Local Nature Recovery will pay farmers and land managers for actions that support local nature recovery and deliver local environmental priorities. The Government is still trying to identify the best method to do this, but, in principle, the idea is that this funding stream will help to target actions within a specific area to address a key concern.

3. Landscape Recovery will involve bespoke agreements to support long-term, land-use change projects. Rewilding might be considered under this stream. Pilots for Landscape Recovery projects will begin between 2022 and 2024, and the Government plan to make the full scheme available from 2024.

Collaboration and integration. Farmers and land managers will be encouraged to come together and work collectively on solutions. The idea, particularly with the Landscape Recovery and the Local Nature Recovery streams, is that if farmers work together to fix a problem, there will be a higher chance of success.

In 2021; the government will start the transition away from BPS and CSS across the next 7 years, the Government will begin to reduce Direct Payments, beginning with a 5% reduction. This money will be ring fenced for schemes, grants and other types of support for farmers to manage land and their businesses more sustainably. In 2021 the Government will also provide funding through the Protected Landscapes bodies to support farmers, particularly upland farmers (75% of whom live and work in Protected Landscapes), to make improvements to the natural environment, cultural heritage, and public access.

2022 to 2023 targets; will continue to reduce total spend on Direct Payments by around 15% in both 2022 and 2023. In 2022 they will start rolling out some core elements of ELM. The Sustainable Farming Incentive will support sustainable approaches to farm husbandry to deliver for the environment, such as actions to improve soil health, enhance hedgerows and promote integrated pest management. During 2022 and 2023, more funding will be made available within the legacy Countryside Stewardship scheme, which is currently open. The administration of the scheme will be simplified further and will seek to increase participation rates so that more people and land areas can benefit from being part of the scheme.

2024 to 2028 targets; The full roll-out of the three components of ELM will be in late 2024. By the end of 2024 the Government anticipates that BPS will have reduced by about 50%. In 2024, following formal consultation, the government plans to de-link Direct Payments from the land. They will offer lump-sum exit payments to farmers who may wish to leave the sector. They will then phase the residual payments out, with the last payments made in 2027. All new Countryside Stewardship agreements starting after 2024 will be managed through the new ELM scheme.

4. Research findings

The results regarding carbon sequestration, resilience to climate change, biodiversity changes, production of food, economic figures, and the social impact are detailed below.

4.1 Farm Carbon Toolkit results

4.1.1 What is the Farm Carbon Toolkit ? (The following is taken from the FCT website). The Farm Carbon Toolkit (FCT) was set up in 2009 because there was no farmer-led organisation to provide practical support for farmers in neither this area nor providing a clear farmer informed platform on the importance and urgency to tackle climate change. It was started, has been developed, and is run by farmers and aims to encourage the awareness of climate change within the UK farming community and support farmers who understand the importance of taking action to reduce GHG emissions from their farming operations.

The ethics and philosophy underpinning FCT's vision are:

1. Reducing GHG emissions
2. Energy resilience and renewable energy generation
3. Farmer to farmer, making change possible

4.1.2 What is carbon sequestration?

Carbon sequestration is the process of capturing and storing atmospheric carbon dioxide[1]. Reservoirs that retain carbon for a certain period of time are called **carbon sinks.** The main natural sinks are plants, the soil and the ocean. Soil carbon is captured in the **carbon cycle** during photosynthesis. Carbon is pulled in from the atmosphere and turned into carbohydrates and sugars. The sugars are pumped down through roots to feed microorganisms in the soil (Fig.1).

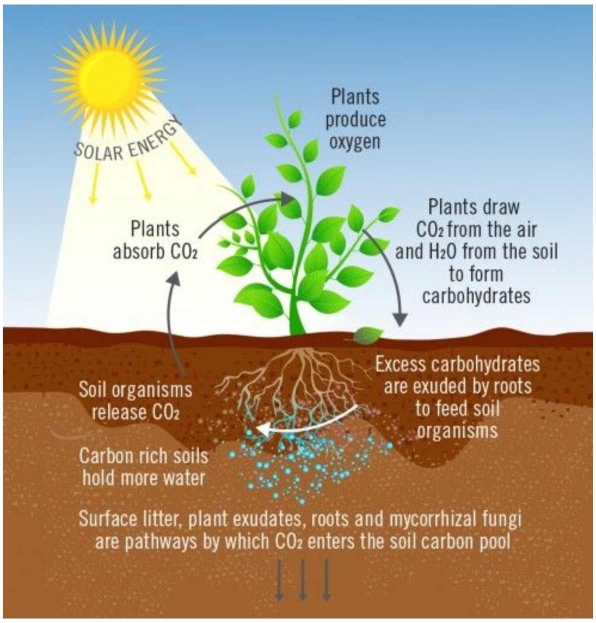

Figure 1. *The Carbon Cycle. Source: Fibershed*

[1] Prof. Cortrufo; Simple biophysics of soil carbon sequestration (7:20) - youtube

4.1.3 Soil carbon

Building up soil carbon can help cut GHG concentrations in the atmosphere, as well as improving soil quality in a number of ways; gives soil structure, stores water and mediates nutrients cycling. Carbon in the soil combines with oxygen, hydrogen, nitrogen, and other compounds, forming what scientists collectively call soil organic matter (SOM). This material is amazingly complex, made of thousands of different chemical compounds that remain from the decomposition and transformation of plants, animals and microorganisms.

Adding to the complexity, carbon can be found in different physical states within soil. It can be dissolved in water, present as larger chunks or “particulates,” enveloped by soil particles or bonded to minerals. These various forms all behave differently, and ultimately have very different impacts on plant growth, soil structure and carbon sequestration.

The challenge is how to conceptually divide up all of these different forms without getting completely lost in the muck. The soil science community has been studying this question for decades. One key distinction can provide an underlying framework for soil carbon management: particulate organic matter (POM) versus mineral-associated organic matter (MAOM)[2] (fig 4).

POM and MAOM are created by different processes and respond differently to management practices. In addition they have different potentials to sequester carbon. MAOM saturates, which depends on the amount and type of mineral in the soil, while POM does not. Most soils are below saturation so there is a high potential for sequestration[3].

Contrary to previous thought, it’s not the recalcitrant plant material that persists and creates long term soil carbon stores, instead it’s the microbes who process this plant matter that are most responsible for soil carbon sequestration[4]. A systematic review of over 50 international studies found nearly 60% more biomass from soil microorganisms in organically managed farm systems versus conventional[5]. The soil life in the organic systems were also over 80% more active than in conventional systems.Furthermore, soils with a high fungi to bacteria ratio perform well at carbon sequestration and water holding capacity. This is because of the Mycorrhiza that live symbiotically with plants absorbing carbon exudates from their roots and supplying them with up to 80 per cent of their nitrate and phosphate requirements. They secrete glomulin that helps form soil aggregates that sequester carbon for the very long term. Mycorrhiza thrive in soils rich with perennials, deep rooting plants and a wide diversity of plants. They can be added to the soil in the form of amendments as prescribed by the Soil Food Web practitioners, compost, and very possibly biodynamic preparations[6]. Biodynamic and agroforestry soils are particularly high in fungal life, as they are fundamentally designed to increase biodiversity and support soil health.

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[2] Lavelle *et al.* (2019) Conceptualizing soil organic matter into particulate and mineral-associated forms to address global change in the 21st century. *Global Change Biology*

[3] Prof. Cortrufo; Simple biophysics of soil carbon sequestration (7:40) youtube

[4] Rodale Institute, 2020 *Regenerative Agriculture and The Soil Carbon Solution*

[5] Lori M, *et al.* (2017) *Organic farming enhances soil microbial abundance and activity—A meta-analysis and meta-regression*. PLoS ONE 12(7)

[6] Rodale Institute, 2020 *Regenerative Agriculture and The Soil Carbon Solution*

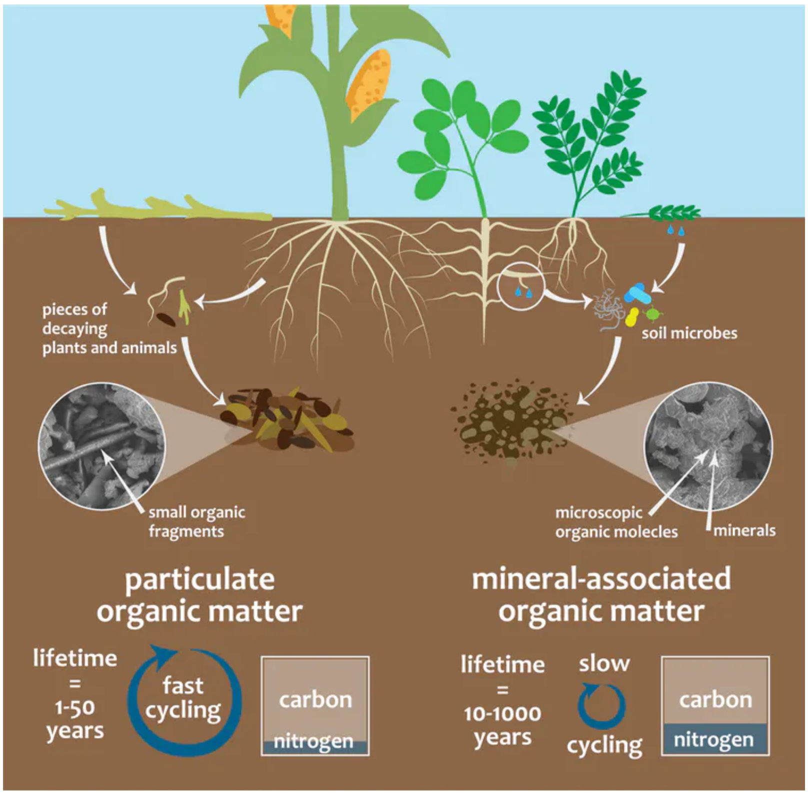

Figure 4. *Particulate organic matter (POM) vs. Mineral-associated organic matter (MAOM)*

Box. 2. Different forms of soil organic matter.

Particulate organic matter (POM)
Contains partially decomposed organic fragments e.g. tiny bits of leaves or roots. POM is freely available to microorganisms so it gets broken down much faster. It's also vulnerable to agricultural practices such as tillage that disturb the soil. Although it contains less nitrogen per unit of carbon, the nitrogen is more readily available. POM is more readily available but its usefulness or quality for decomposers varies.

Mineral-associated organic matter (MAOM)
Consists mostly of microscopic coatings on soil particles, derived from bodies and byproducts of microorganisms and plant compounds. Because it is stuck to soil particles, it tends to stay there for a long time. MAOM contains more nitrogen per unit of carbon than POM.

Managing SOM stocks to effectively address global change challenges requires deep understanding of SOM formation, persistence, and function. Since POM and MAOM form, persist, and function in different ways, conceptually separating them is key to crafting effective global change mitigation strategies that involve SOM sequestration and functioning.

4.1.4 FCT results - summary

We completed FCT's Farm Carbon Calculator (FCC) for the 2020 calendar year. The key findings are in box 1.

Box. 1. Key findings from the Farm Carbon Calculator (FCC) for 2020.

Key statistics

Total annual carbon emissions	53.16 tonnes CO_2e
Total annual carbon sequestration	117.70 tonnes CO_2e
Total carbon balance	-64.82 tonnes CO_2e
Carbon balance per hectare	-4.78 tonnes CO_2e
Carbon balance per tonne of product	-2.69 tonnes CO_2e

Note: CO_2 stands for carbon dioxide equivalence – i.e. other greenhouse gases are included, but converted to a standard unit to represent the global warming impact of carbon dioxide

The main source of **emissions** came from Fuels (31.6%), and Livestock (28.9%) (fig.2). Together, these account for almost 60% of farm CO_2e emissions. Capital items are similarly responsible for a high percentage of emissions, due to the embodied carbon in materials, however this will reduce over time.

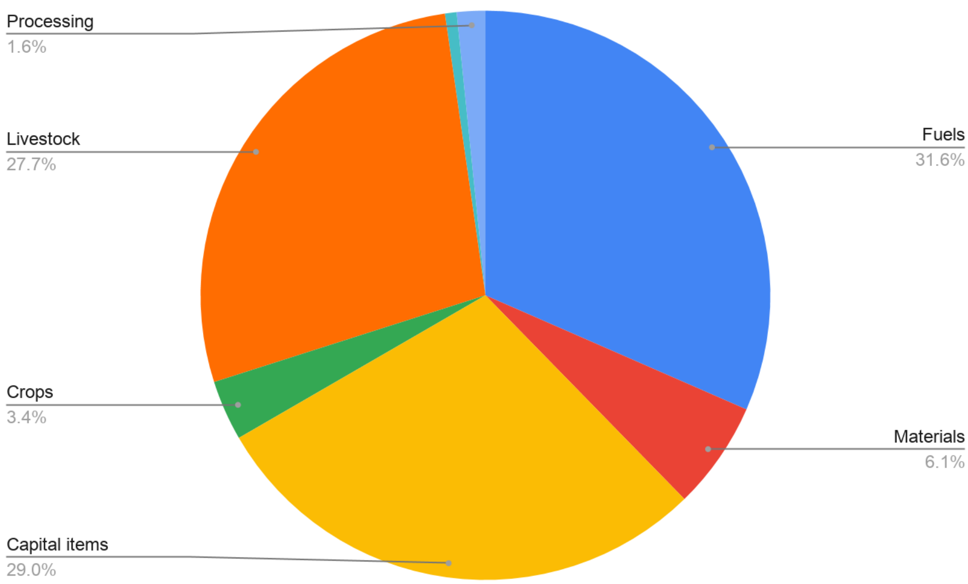

***Figure 2**. CO_2e emissions of the farm of Huxhams Cross farm 2020*

A total of 91.60 tonnes of total carbon sequestration can be attributed to building Soil Organic Matter (SOM) (fig. 3). Without sufficient organic matter, soil cannot support microbial life or plant life without vast amounts of imported inputs.

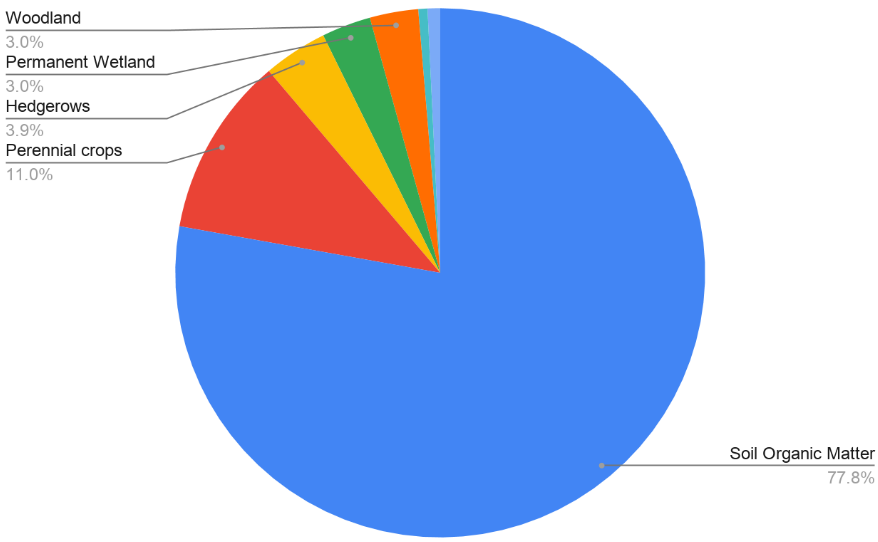

***Figure 3**. Total CO_2e sequestration on Huxhams Cross farm 2020*

For full results and analysis, see our Carbon Report 2020 available separately.

4.1.5 Soil analysis report

At the beginning of the farm in 2015, we collected baseline samples of the soil quality for 3 fields; higher week (HW), billany (B) and the grove (G). More recently the FCT has analysed the soil (soil analysis report attached) in all 5 fields and included a number of additional tests that relate to soil structure and soil health. Soil Organic Matter (SOM) content has been analysed by Plymouth University using the Loss on Ignition (LOI) method. Samples were taken from 3 depths; 0-10cm, 10-30cm and 30-50cm.

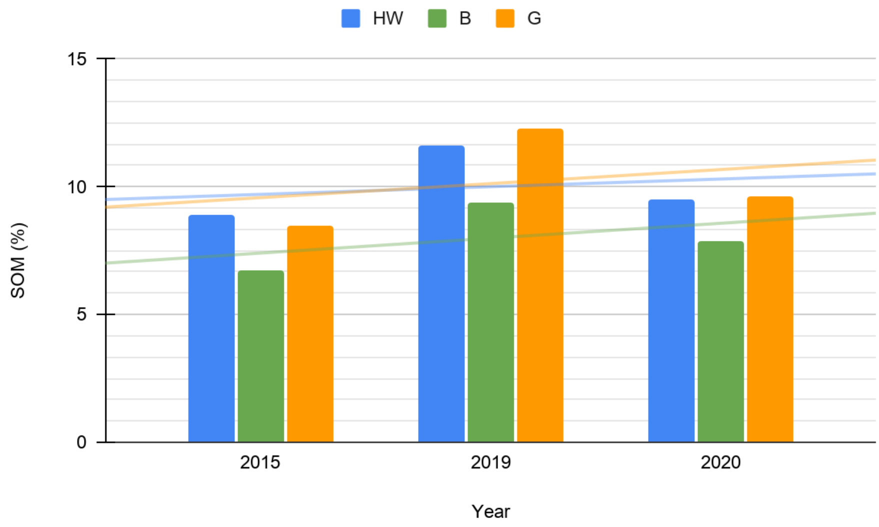

***Figure 5**. Soil Organic Matter (SOM) percentage in 3 fields from 2015 to 2020. HW = Higher Week, B = Billany, G = Grove.*

The 2019 and 2020 results from FCT appeared to show a lot of variation (fig. 5). According to FCT, this could be due to the following;

- high organic matter content fields have more in-field variation in OM; despite returning to GPS logged points, there may be some differences in sample points that lead to overestimation in 2019 and under-estimation in 2020
- bulked samples not being mixed well enough before bagging up and analysis
- differences in lab humidity affecting sample weighings

In light of the above, we took an average across the 2 years and compared it to the 2015 results. The results suggest that we have increased SOM content by 25% since 2015. This can be attributed to the regenerative farming practices which are known to increase SOM[7]. Further experiments are needed to analyse the SOM in full and across the whole farm.

At each depth, the FCT analysed the following;

1. Soil organic matter (%)
2. Soil bulk density (g/cm^3)
3. Soil carbon yield (tonnes per ha)

The average results of 2019 and 2020 are presented in the graphs below. Full breakdown is available in the soil analysis report.

[7] https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_053260.pdf

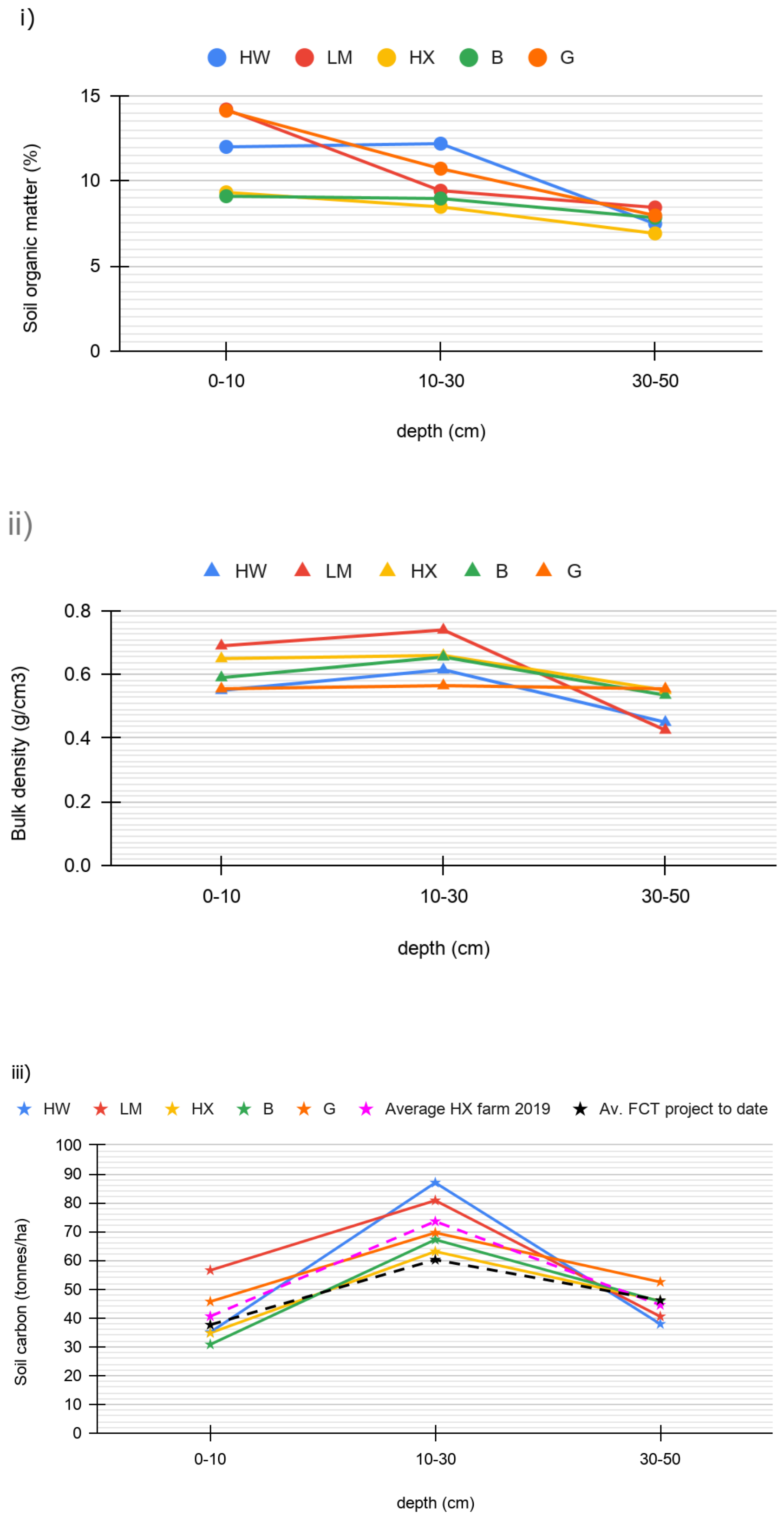

Figure 6. *Farm Carbon Toolkit average results of 2019 and 2020 for i) Soil Organic Matter (%) ii) Soil bulk density (g/cm^3) and iii) Soil carbon yield (tonnes/ha). Samples were taken at 3 different depths in each of the 5 fields. HW = Higher Week, LM = Long Meadow, HX = Huxhams Cross, B = Billany, G = Grove.*

Soil Organic Matter (SOM) percentage was measured using the Loss on Ignition (LOI) method. The data shows that the SOM % decreases with depth in all 5 fields (fig. 6.i). The highest levels of SOM are in the uncultivated fields (HW, LM, G). Higher week (HW) and the Grove (G) show an almost 50% decrease in SOM from the top 10cm to the bottom, 30-50cm. The cultivated fields, Billany and Huxhams Cross, show the least amount of change as the depth increases.

Soil bulk density (g/cm^3) is the weight of soil in a given volume. It can be used as an indicator of soil compaction and will normally increase with soil depth (low = less compact). It affects infiltration, rooting depth/restrictions, available water capacity, soil porosity, plant nutrient availability, and soil microorganism activity, which influence key soil processes and productivity. For clay soils, ideal bulk density is < 1.10g/cm^3 and root function is impaired at levels >1.5g/cm^3.[8]

All fields had bulk density less than 0.75g/cm^3. A similar trend was visible in all 5 fields (fig. 6.ii). The lowest bulk density value across the 3 different depths was at 30-50cm, decreasing to 0.54g/cm^3. Generally, loose, well aggregated, porous soils and those rich in organic matter have lower bulk density.[9] Compared to the SOM percentage (fig. 6), the lowest bulk density at 30-50cm had the least amount of SOM. Low bulk density may also be due to subsoiling which aerates the soil at depth. Subsoiling has been recommended to disrupt compacted soil layers and create a reasonable soil structure for crop development.[10][11]

Soil carbon (tonnes/ha) within the fields was calculated by multiplying 1ha by the depth of soil (0-10cm, 10-30cm or 30-50cm), the bulk density and the soil organic carbon percentage. Soil organic carbon percentage is calculated as organic matter percentage divided by a correction factor of 1.72.

The farm average soil carbon is above the average soil carbon for the overall FCT project to date (fig. 6.iii). The soil carbon levels follow a similar trend in all 5 fields, increasing at 10-30cm and then decreasing again. The greatest variation with depth is in higher week (HW) and long meadow (LM). As with soil bulk density, this could be due to different management practices. According to Fidelity Weston (ORFC talk), 50% of UK soil carbon is held in the top 30cm of soil.

4.1.6 Additional soil tests

The FCT collected additional data that relate to soil structure and soil health. Three points in each field were selected to look at the following indicators;

a) **VESS score** – Visual Evaluation of Soil Structure is a scoring system which rates the soil in terms of its structural condition from 1 (friable and good structure) to 5 (very compact and impacting on plant root growth and function). The VESS scores are

[8] https://www.sdsoilhealthcoalition.org/technical-resources/physical-properties/bulk-density/
[9] https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_053260.pdf
[10] https://www.sciencedirect.com/science/article/pii/S209531191962681X
[11] https://acsess.onlinelibrary.wiley.com/doi/abs/10.2136/sssaj2003.1213

divided up into top and bottom as the topsoil and subsoil were looked at and rated in terms of their structure.

b) **Worms** - were counted from 3 soil pits that were 20cm x 20cm x 30cm deep. All the worms present in the soil sample were counted and an average number of worms per pit was calculated. From this we have estimated the number of worms per hectare for each field.

c) **Ag** – This stands for aggregate stability and is thought to be a good indicator of organic matter levels in soil. A handful of soil from each pit was taken away and air dried for 4 days. Once dry, three lumps of soil are submerged in water and assessed for how well they hold together after 5 minutes and then again after two hours. The lumps of soil are scored using a scale of 0-4 with 0 being good and the lump remaining intact and 4 the score when the lump breaks down. (If there is no bar in the graph, your soil scored 0).

d) **Infiltration** – The amount of time in minutes (and seconds) that it took a set volume of water to soak into the soil was recorded. This is an indication of how well structured the soil is as if there is lots of air and pore space and the soil is well structured the soil will hold more water. The shorter the time – the better the infiltration.

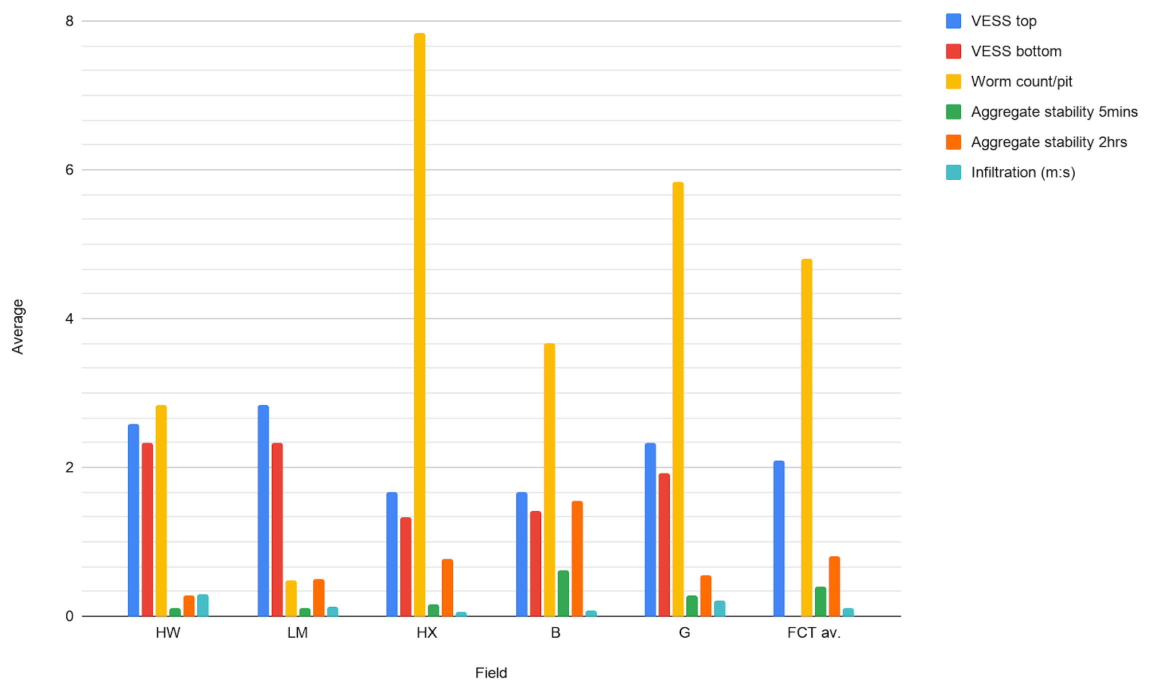

Figure 7*. Additional soil health indicators by FCT. The graph shows the averages for 5 fields in a) VESS score; b) Worm count; c)i) Aggregate stability 5mins; c)ii) Aggregate stability 2hrs; d) Infiltration (m:s). HW = Higher Week, LM = Long Meadow, HX = Huxhams Cross, B = Billany, G = Grove. FCT av. = project average to date*

Compared to the overall FCT project average, the only poor result for the soil health indicators measured was the worm count in long meadow (LM).

The VESS top results were average for the fields under more permanent pasture - HX, G and LM. Whereas they were good in both B and HX which are cultivated more frequently. In all fields the VESS bottom score fell below the VESS top score. This suggests the subsoil is more compact and less friable compared to the top soil.

Worm counts were good for all fields apart from Long Meadow (LM). They were particularly high in Huxhams Cross (HX) which is under a 2-year chicory and clover mix.

Aggregate stability results were good in all fields after both 5mins and 2hrs. In particular they were above average in Billany (B) which is down to veg production.

Huxhams cross (HX) and billany (B) had a shorter infiltration time than the FCT project average. The grove (G) and long meadow (LM) had higher rates however they are wetland meadows and measurements were recorded in November so this is not surprising. Higher week had the longest infiltration time.

4.2 Climate change adaptation

4.2.1 Summary of extreme weather events
Over the last 10 years, the number and frequency of extreme weather events has increased.[12] There have been dramatic changes in rainfall and temperature.

- 2012: wettest summer 100 years
- 2013: coldest spring 50 years
- 2013/14: wettest winter on record
- 2014/15 warmest year on record
- 2016: monthly extremes
- 2017: 5th warmest year
- 2018: Beast from East followed by summer drought
- 2019: warmer, wetter and sunnier than average
- Feb 2020: storms Ciara and Dennis - heavy rainfall and flooding

Extended periods of flooding can cause widespread damage to soil structure, exacerbates soil erosion leading to greater flood risk and pollution of the surrounding area. Furthermore, nutrients and carbon are lost from the soil. This creates very challenging conditions for farms, as by its very nature, farming relies on predictable weather patterns; one late frost can wipe out a fruit or vegetable harvest; a drought in summer can cause crop failures; storms devastate glasshouses and polytunnels; wet autumns make autumn cereals difficult to sow and harvest.

Projected milder, wetter winters and hotter, drier summers by the end of the century will change the frequency, persistence, or severity of each of these risks.[13] With this in mind, it is important to grow a diversity of crops that help to build resilience and adapt to the unpredictable changes.

Below are few examples of how the farm has coped in the last 5 years with changing circumstances, including both predictable and unpredictable shocks and stresses.

1. **Rainwater harvesting**

A simple rainwater harvesting system is used for crop irrigation and livestock drinking water throughout the year. A tank with 20,000 litre capacity, collects rainwater water off the barn roof. An overflow pond can hold a further 100,000 litres. In addition, we pump water from an underground spring. Despite unpredictable weather patterns and some particularly dry spells, over the last 5 years we have used less and less mains water for irrigation, reducing the impact of water-related risk e.g. dry summers.

2. **Diversity of cropping**

We grow approximately 100 different crops; 80 vegetables and 20 fruits. Within that there are many different varieties which may vary in terms of seasonality, or resistance to pests and disease. The agro-biodiversity also provides resilience in the face of crop failure, and is

[12] F. Crotty; Life Under Soil Pasture ORFC (35:30) youtube
[13] Hess *et al.* (2020) Resilience of Primary Food Production to a Changing Climate: On-Farm Responses to Water-Related Risks

strengthened by the use of good crop rotations. Variation within and between crops also expands our market and may allow us to exploit profitable niche markets e.g. kalettes, or simply supply locally grown products that would otherwise be imported e.g. beans and pulses. New market supply chains offer farmers new opportunities to produce more value and retain more of that value on the farm.

Ecosystems with greater diversity are usually more stable: they withstand disturbances and can recover better than less diverse systems. The more diverse the plants, animals and soil-borne organisms that inhabit a farming system, the more diverse the populations of pest-fighting beneficial organisms a farm can support. For example, healthy soils enriched and revitalized by rotation and cover crops promote root development and water infiltration, thus are less prone to disease.

3. **Crop varieties**

Crop yields are often referenced as a reason why we cannot scale up organic and regenerative systems, but evidence does not support this claim, particularly when addressing resilience and adaptation to climate change. A long-running trial by the Rodale Institute has found that during drought years, yields are 30% to 100% higher in the organic systems compared to conventional methods[14]. This not only reduces uncertainty but also has economic benefits.

On our farm, we have seen crop resilience in our wheat variety. Every year the farm grows a 2 hectare field of YQ population wheat from saved seed. The initial 500kg of seed was kindly given to us by Martin Wolfe of Waklyns farm. Martin bred this wheat by crossing 20 modern varieties of wheat, chosen for their yield and quality hence the name “YQ”. This is genetically diverse, resistant to diseases and stress caused by drought and heavy rains. It gives consistent yields, although they are rather low at 2.5 tonnes per hectare. It has great taste and is naturally low in gluten. As the wheat is a “population” wheat it will naturally adapt to its local conditions. In year 1 and 2 of growing our YQ wheat we have very low yields, but by year 3 as our solid improved and the YQ adapted to the Devon conditions the yields went up to 2.5 tonnes per hectare. Even in 2020 when across the UK the grain yield went down by 30% because of adverse weather conditions, our YQ yields remained the same.

[14] Rodale Institute, 2020 *Regenerative Agriculture and The Soil Carbon Solution*

4.3 Biodiversity

By working within nature's cycles and practicing environmentally sustainable land management, organic systems are designed to benefit wildlife and the natural world[15]. Biodiversity provides a huge number of benefits to the farm ecosystem. Ideally farmland would become “porous” to biodiversity, biodiversity will be able to move from farm to farm via wildlife corridors.

Baseline studies were taken in 2015 at the start of the farm. Over the last 5 years, the farm has flourished and although many of the results are anecdotal, it is clear that there has been a huge increase in biodiversity both above and below ground. A record is available of all the different species of birds, plants and small mammals sighted on the farm.

4.3.1 Soil

Earthworms are an indicator of soil health and can improve crop yields by 25%. They have been identified as ecosystem engineers. Of the 27 species of earthworm in the UK, 12 are common and thought to be widespread. They have different characteristics and are found at different depths within the soil structure; some feed on surface leaf litter, some are vertical burrowers which draw leaf litter down below the topsoil. It is important to consider the time of year that samples are taken, as well as the differences in management practices.

We used the OPAL Soil and Earthworm survey by Imperial College London[16] to identify the number of mature and immature earthworms. We dug 20x20cm pits and compared the figures to our 2015 results. In our main veg cropping field (billany), the highest number of worms were found in the plots with overwintering green manures and soil appeared more friable. On average the number of worms since 2015 has almost doubled.

4.3.2 Plants

Aboveground biodiversity is also important in restoring soil health. In 2015 we identified the different plant species using quadrats along a transect. We recorded the number of species present and percentage of bareground. This was repeated in 2021. For a full plant list, see appendix. The most significant difference was the percentage of bareground in our cropping areas which has greatly reduced in all fields since 2015. Cover crops are vital for regenerating degraded soils, as bare soil - lack of living roots - disables photosynthesis and encourages erosion.[17] *“It’s becoming very clear that in order to regenerate soils, we have to have continuous and diverse inputs, and that mostly comes from living roots*.” — (Cotrufo Interview)

Long meadow is home to the southern marsh orchid. In 2020, there were approximately 260 orchids identified. This is a 4-fold increase since 2015.

4.3.3 Hedgerows

The hedgerows on the farm are allowed to grow tall and wide. They not only provide habitat for species but also important food sources for many species and contributes to wildlife

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[15] https://www.soilassociation.org/organic-living/why-organic/better-for-wildlife/
[16] https://www.imperial.ac.uk/opal/surveys/soilsurvey/
[17] Rodale Institute, 2020 *Regenerative Agriculture and The Soil Carbon Solution*

corridors across the farm[18]. Other benefits include preventing water runoff and soil erosion, as well as carbon storage (see Carbon report).

We have a total of 1,600m of hedgerow which are all 3-4m wide. They predominantly consist of alder, ash, blackthorn, hawthorn, oak, and willow. Spindleberry, dog rose and guelder rose were also identified. The full list of tree species can be found in the appendix. In addition we have planted agroforestry rows across billany with 3,000 hazel trees, and have a small woodland area which is approximately 0.4ha in size (see map in appendix). Since mycorrhizal fungi need root-partners to survive, farming strategies that include perennial plantings and trees on edges benefit the long-term stabilisation of soil carbon[19]

4.3.4 Birds

Bird species were recorded in 2015 by the RSPB. In 2020, we identified the birds on the farm and compared the results. Numbers have increased by about 50% over the last 5 years. See appendix for a full list of bird species.

4.3.5 Other wildlife: mammals, reptiles and invertebrates

We have identified various other wildlife on the farm, including deer, fox, weasel, voles, slow worm, lesser horseshoebats, poplar hawkmoth, and many insects. See appendix for a full list of species. The diversity of wildlife on the farm shows that we are supporting biodiversity by creating habitat, providing food sources and shelter. This is in contrast to the impact of many conventional farms which have been identified as key drivers of global biodiversity collapse due to habitat loss. Increasing farmland biodiversity can provide a number of ecosystem services, e.g. pollination and pest and disease control, and may be a vital part of the food chain. Restoring these natural cycles can help reduce the use of pesticides and herbicides on farmland.

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18 https://www.soilassociation.org/causes-campaigns/fixing-nitrogen-the-challenge-for-climate-nature-and-health/why-are-hedgerows-so-important/

19 https://rodaleinstitute.org/wp-content/uploads/Rodale-Soil-Carbon-White-Paper_v11-compressed.pdf

4.4 Food produced

4.4.1 Land area

The farm is 13.5ha in total (see map - appendix). The area of cultivated land for veg and fruit production is approximately 5ha, and 2ha used for wheat production. The amount of land under green manure at any one time varies from year to year (greater in winter, less in summer), as well as from season to season, germination success, and method of cultivation (e.g. undersowing). An estimate of 60% of the total veg area has been applied to 2020. The chickens are kept in mobile coops and are regularly moved around the farm onto areas with green manure. This provides them with forage, whilst adding fertiliser in the form of chicken manure to the land.

We use different methods of cultivation for different areas. The 'intensive area' is under minimum tillage (min till) and is used for high value crops e.g. salad and herbs that have a quick turn around, allowing successional planting. In winter it is put down to green manure. The polytunnels are under no-dig and in the winter are predominantly used for brassica salads.

The field scale crops undergo some tractor cultivation. Green manure mixes are used and undersowing is practiced with certain crops. Occasionally areas are left fallow in attempt to eradicate weeds from a seed bed.

The non-cropping areas are the field margins and wetland meadows that are grazed by the 2 cows. We also have a small woodland area.

In 2020 we increased our use of green manures and also expanded the veg cropping area into huxhams cross field in response to the Covid-19 pandemic.

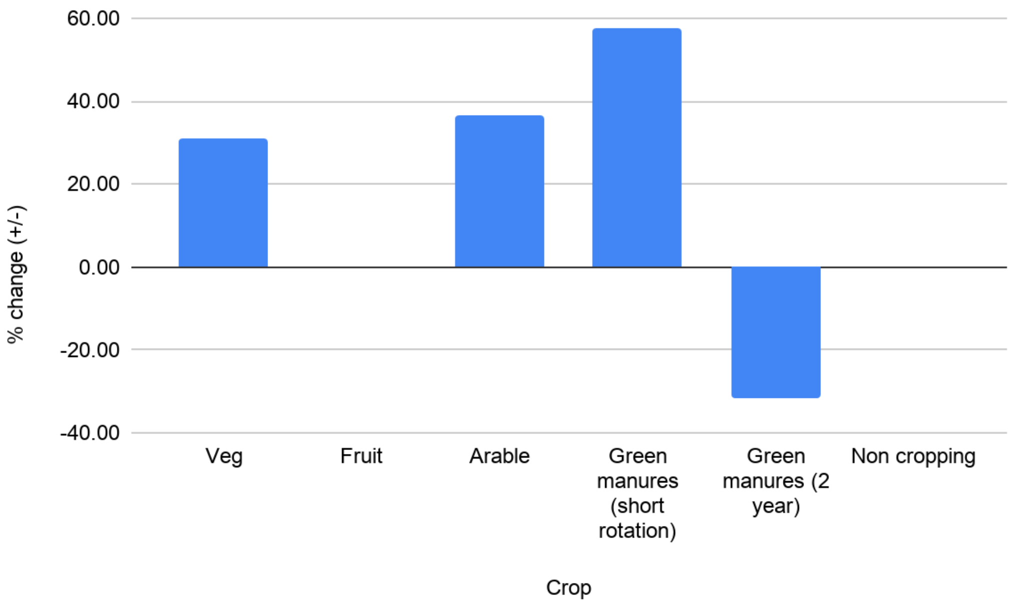

Figure 8. *The percentage change in land use area (ha) of crop type from 2019 to 2020*

4.4.2 Yields

In 2020, we harvested a total of 15.4 tonnes of fruit and veg. Almost a 20% increase from 2019. This is in line with the increase in land use area. In addition, we obtained 2.5 tonnes of eggs, 2.4 tonnes of hay (used as animal feed over winter), 6 tonnes of wheat and 2.3 tonnes of straw. The fruit and veg is mostly sold directly to the consumer, via our online shop and weekly market. Less than 10% was sold as wholesale to local restaurants and small shops in 2020. Surplus produce is used for processing and sold as jams, chutneys and juices, or is donated to local food banks e.g. Food in the Community. A small amount of waste is composted on site, or fed to the chickens.

We are growing a range of 100 different crops and varieties; 82 veg crops/varities and 18 fruit. We make about 30 different products using our preserving equipment and process the wheat to sell as flour (wholemeal and white), wheat berries, and use waste products as chicken feed. Straw and hay is used as animal feed, mulching crops, animal bedding, and some is sold to customers.

We keep a stable flock of approximately 150 white leg-horn chickens. Egg numbers vary through the year. In 2020, we collected a total of 38,500 eggs — 6,410 boxes, worth a total of £16,000.

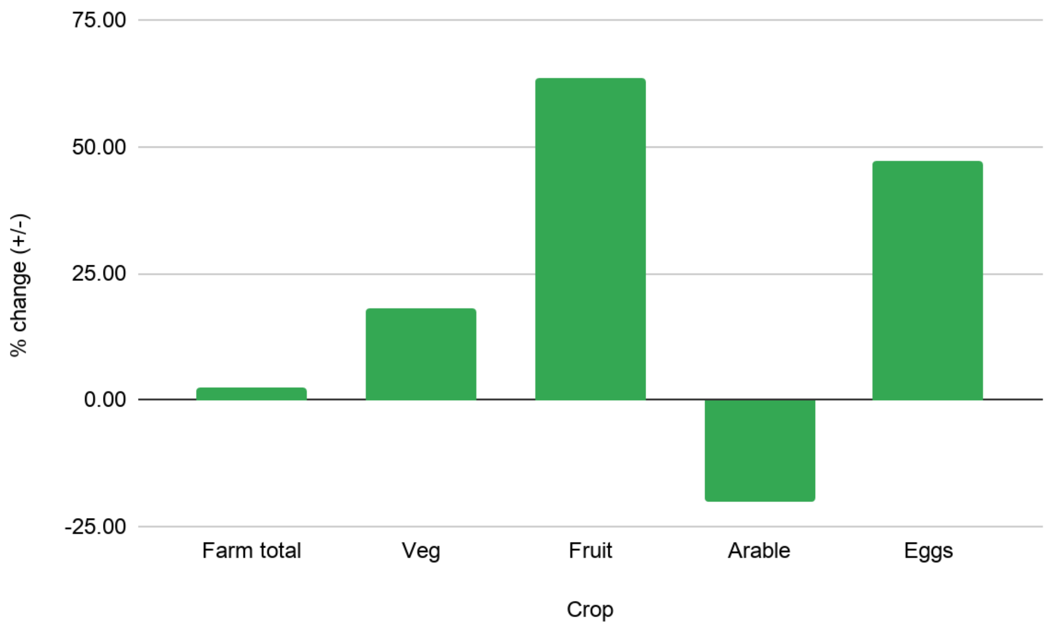

Figure 9*. The percentage change in yields (tonnes) of crop type from 2019 to 2020*

4.4.3 Sales

All our produce is sold within a 12-mile radius of the farm. The majority is sold direct to the consumer. In 2020, approximately 75% of sales occurred via the online shop, 18% via the market, and 7% was sold as wholesale. Due to Covid-19 there was a 350% increase in sales on the online shop. The market was closed for 2 months. However, despite 2 months of no sales, total market sales for the year increased by 4% compared to 2019. When the market re-opened (June 2020), our sales more than doubled.

In 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% increase. The number of customers also increased two-fold since 2019 on both the online shop and market. In total were selling to about 250-280 families per week within the local area.

We also buy organic produce to supplement our own. This is as local as possible, but we do import from further a field including Spain, Italy and Dominacan Republic (for bananas). In 2020, this accounted for one third of our total sales.

Although our overall yield only increased by 2.6% in 2020, the value of our produce increased 116.2%. This is because in 2020, we increased our salad and herb production which are high value crops. This is reflected in the average value per kg of produce, which increased from £4.47/kg to £7.85/kg.

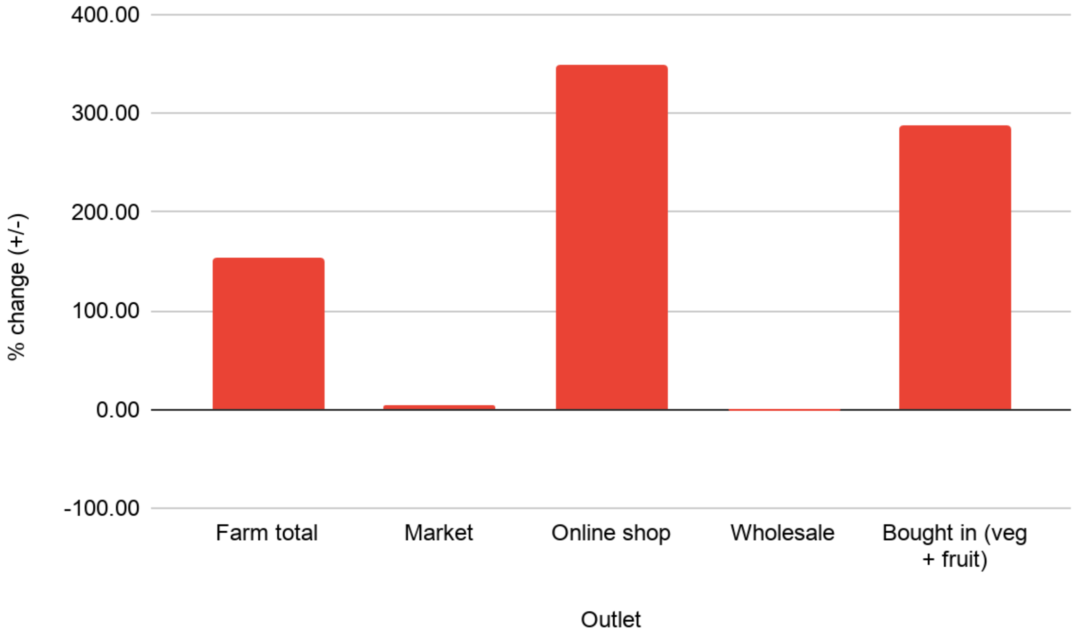

Figure 10*. The percentage change in sales (%) at different outlets from 2019 to 2020*

4.5 Economic viability

Turnover/costs 2015 - 2020

Our approximate turnover for 2020 was £200,000 for the farm, not including the wellbeing service.

Number of people employed

We currently employ 5 full time staff, a further 4-7 part-time people (depending on season) and take on 3 trainees per year, for the farm, not including the wellbeing service.

Crop value

The individual crops vary in terms of the value per square metre; from red cabbages at £1.94/m^2 in 2019, to cucumbers at £235/m^2 in 2020. Yield depends on a number of factors including variety; growing conditions e.g. weather, location i.e., polytunnel, field scale or intensive; growing method e.g. bare-root transplants vs plug plants; and pest damage. Value depends on the customer e.g. wholesale vs consumer, and input e.g. time and resources required. In 2020, our highest yielding crops per square metre were cucumber and tomato, followed by french beans and watercress. This varies from year-to-year. Although focussing on high value crops may seem preferable in terms of economic yield, growing a range of crops is important to be resilient in the face of climate change, increase biodiversity, and to provide a reliable food source throughout the year.

4.6 Social impact

4.6.1 No. of visitors per year

We run various activities/events on the farm including volunteer days, school visits and training courses. Due to Covid-19 many of these were cancelled in 2020, however we still had a total of 1420 visitors over the course of the year.

In 2020 our Social Media had 1803 followers on facebook, engagement has risen 80% since December 2019, 1346 followers on Instagram with a 96.2% increased engagement since December 2019.

We hope to be able to run community events again when Covid-19 allows including a makers market, plant sales, farm tours and Open Farm Sunday again in 2021.

EVENTS	**2018**	**2019**	**2020**
School visits/ Farm Club/Mud Tots	20	6 schools 172 children	12 at farm club x 16 sessions =192 visits 20 at mud tots x36 sessions = 720
Root and Rise			10 x 2 sessions =24 people
Volunteer day	58	126	Veterans 12 visits =50 4 visits x 6 = 24 2 onlines x 6 = 12 people
Training Courses	29	281	10x 2 = 20 agroforestry 10 x 12 = 120 pdc
Paid Educational visits	78	155	5
Events	304	147	0
Farm Visits	38	73	25
Total	**507**	**951**	**1420**

4.6.2 Social impact survey

A social impact survey was co-developed by the Centre for Agroecology, Water and Resilience (CAWR), the Real Farming Trust and the Apricot Centre. The survey addressed the themes of motivations, changing in food practice and behaviour, health and well-being, training and skills and community. These themes are considered to be integral parts of social impact in the context of community food businesses in the UK.

In 2020, an initial report was published which serves as the first year (of three) report of Apricot Centre's Loans for Enlightened Agriculture Programme (LEAP) journey. The full report is available separately.

Some key findings are as follows;

- 88 people responded to the survey, the majority (96%) were online veg box customers
- 63% of respondents affirmed that since becoming engaged in The Apricot Centre, being resourceful with food has improved.
- Rather than catalyse wholesale behaviour changes or ways of feeling, the Apricot Centre provides a vibrant space for customers to practice their worldviews and to sustain their sense of connectedness to a range of social and ecological issues.
- Drawing on the Life Satisfaction Survey, respondents strongly indicated that being involved in some capacity with The Apricot Centre is considered to be very worthwhile. This is due to the mutual value systems and ethics of care that both community members and the organisation have.

The main reasons for engaging with Apricot Centre were associated with environmental and ecological issues (i.e. to reduce carbon dioxide emissions and access food with less packaging). A further reason was to support local jobs and business whose values aligned with the ethical values of the respondents.

These motivations correspond to the main benefits of being involved with The Apricot Centre, as indicated by the categories of a reduced carbon footprint and supporting local jobs. Moreover, respondents felt that improved diet as well as reliable access to food that tastes good were other significant benefits; particularly noteworthy during the covid-19 pandemic whereby food shortages and anxieties about access to food were well reported.

Further in-depth approaches to elicit qualitative data is required to complement and explore some of the points of departure that the data gathered in this report has revealed.

5. Discussion

The production, processing and distribution of food is the world's largest activity. Rather than mitigating the climate crisis, it is a net producer of greenhouse gas emissions both directly through conventional industrial farming practices, and indirectly through land-use change and the greater food system[20]. To meet the IPCC's target and respond to the threat of global warming, the farming sector needs to move from a climate crisis problem, to part of the solution. Farms need to support biodiversity, build soil organic matter, and sequester carbon. However mitigation is not the only issue, farming must also adapt by making itself more resilient in the face of extreme and variable weather. We need to continue to grow a diversity of crops, reduce soil disturbances, plant deep rooting green manures and trees. This will in turn promote a soil rich in mycorrhiza and bacteria, that themselves help to form soil aggregates and store soil water and carbon. At the same time, farms by their very nature also produce food and must be profitable. Food supply chains need to be re-localised and seasonal, with the amount of plastic packaging reduced. Farms can help address food sovereignty and revitalise rural communities.

Two of the major agricultural contributors to climate change is the release of carbon held in the soil and use of fossil fuels[21]. The most significant Greenhouse gas (GHG) emissions from arable cropping in the UK are associated with the use of artificial nitrogen fertilisers (60-70% in conventional systems). The other significant operation is cultivation (frequency, intensity, and depth) and the effect that has on Soil Organic Matter (SOM) and subsequent GHG emissions. This is both because of the effect cultivations have on the soil and also because of the fuel use and wear and tear involved with cultivation. There is a growing body of evidence that demonstrates the fewer the number of passes and the less the disturbance to the soil with each pass, the lower the GHG emissions are from the soil. GHG emissions from the soil occur as carbon dioxide (CO_2) and to a lesser extent methane (CH_4) as well as nitrous oxide (N_2O). This is principally as a result of the oxidation of the soil organic matter (SOM) by microbial activity that is stimulated by available oxygen following a mechanical cultivation[22].

To restore the quality of soil, water, air, ecosystems, animals, and ultimately humanity, farming practices need to move towards Regenerative agriculture. This can be practiced under many names: agroecology, organic, biodynamic, holistic, conservation, permaculture, management intensive grazing, agroforestry and more[23]. There won't be a one-size-fits-all approach for regeneration of degraded farm and rangeland, but the vanguard of regenerative farmers and researchers know enough now to provide guidance for each farm given its specific physical, environmental, social and economic contexts. Farming in ways that sequester carbon is not just possible in many places, it's already happening across the world

[20] Rodale Institute, 2020 *Regenerative Agriculture and The Soil Carbon Solution*
[21] The Carbon Farming Solution book, Toensmeier p.12
[22] Farm Carbon Toolkit https://www.farmcarbontoolkit.org.uk/toolkit/
[23] Rodale Institute, 2020 *Regenerative Agriculture and The Soil Carbon Solution*

6. Conclusion

This report demonstrates some of the benefits of regenerative farming techniques. It details the changes of Huxhams Cross farm over the first 5 years, in terms of the carbon sequestration and resilience to climate change, support for biodiversity, production of food, economic viability and social impact. It is clear that the aims and objectives of the Apricot Centre are being met, and it is possible to address the challenges facing farming today in a multifunctional way.

We are continually addressing the wider sustainability of the activities on the farm. In response to the FCT analysis, we hope to further reduce our carbon footprint by shifting to producing our own chicken food as well as investing in electric vehicles for distribution. We would like to demonstrate how farming the land is a crucial element in the future management of GHG emissions and hence the response to climate change.

If the DEF is to protect and restore at least 30% of Devon's land and water by 2030, it will undoubtedly include farmland. Farming can adopt a "land sharing" model and lock carbon underground, thereby restoring degraded soils, addressing food insecurity, and mitigating the impacts of the climate crisis on food production. Furthermore, the attributes of regenerative farming fall within many of the "public goods" outlined in the government's new Environmental Land Management scheme. This will likely increase the amount of financial support available to farmers in the UK.

7. Next Steps and Further Resources

We will host 2 farm walks in May 2021 (covid-19 dependent). This will be for farmers and land managers, and to share our knowledge and information.

Copies of the following reports are available separately

- Soil test by FCT
- Soil Carbon Report 2020
- Farm Carbon Calculator report 2020
- Social Impact report

ACKNOWLEDGEMENTS

We would like to thank everyone who contributed to this report. In particular the Devon Environment Foundation for their generous financial support and Amanda Keetley for her time and guidance. Thanks to the Farm Carbon Toolkit for their research into soil carbon, and to the supportive team at The Apricot Centre.

Resources: Farming for Nature

Carbon accounting and farming;

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Real Farming Trust www.feanetwork.org/

Rhizoterra www.rhizoterra.com/

Films;

Probably one of the best known films about regenerative agriculture '*Kiss the ground'* available on https://kisstheground.com/ and other platforms.

The incredible Vandana Shiva in her new film, *The Seeds of Vandana Shiva* https://vandanashivamovie.com/

"How is regenerative organic farming better "John Kempf USA YouTube

"From the ground up Regenerative Agriculture" Film of the story of regenerative agriculture in Australia You Tube

"Keyline design explained on a beach" by Darren Doherty. You Tube

Oregon State University Ecampus has on line training in keyline management. There is a whole series where you can see Yeomans farms and yeomans ploughs in action

P. Stamets. *Fantastic Fungi film* https://fantasticfungi.com

Allan Savory TED Talk
https://www.ted.com/talks/allan_savory_how_to_fight_desertification_and_reverse_climate_change?

Films about the soil food web, *Symphony of the soil* available by subscription www.symphonyofthesoil.com and other platforms.

Oxford Real Farming conference - recordings from 2021 conference https://orfc.org.uk/

Groundswell Agriculture - *Farmers are changing the world with Regenerative Agriculture*

Soil Health Institute - *Living Soil film* - youtube

Podcasts;

Investing in Regenerative Agriculture

Farmerama Radio

FarmGate

Agricology

APPENDIX

<u>FARM MAP</u>

BIODIVERSITY

Plant species identified 2020;

primrose	*Primula vulgaris*
ragged robin	*Lychnis flos-cuculi*
red campion	*Silene dioica*
Oxeye daisy	*Leucanthemum vulgare*
Ragwort	*Jacobaea vulgaris*
Meadowsweet	*Filipendula ulmaria*
Foxglove	Digitalis
Salad burnet	*Sanguisorba minor*
Hogweed	*Heracleum sphondylium*
Hemlock, water	*Oenanthe crocata*
Mint, water	*Mentha aquatica*
Celandine, lesser	*Ranunculus ficaria*
Bluebell	*Hyacinthoides non-scripta*
Knapweed, common	*Centaurea nigra*
Cuckoo flower	*Cardamine pratensis*
Trefoil, birdsfoot	*Lotus corniculatus*
Meadow vetchling	*Lathyrus pratensis*
Woundwort, marsh	*Stachys palustris*
Willowherb, great	*Epilobium hirsutum*
Fleabane, common	*Pulicaria dysenterica*
Sneezewort	*Achillea ptarmica*
Clover, white	*Trifolium repens*
Clover, red	*Trifolium pratense*
Pignut	*Conopodium majus*
Speedwell, germander	*Veronica chamaedrys*
Vetch, common	*Vicia sativa*
Buttercup, meadow	*Ranunculus acris*
Orchid, southern marsh	*Dactylorhiza praetermissa*
Dandelion	
Thistle spp.	
Dock spp.	
Daisy	
Grass spp.	

Hedgerows

The following trees were identified in November 2020:

- Alder *Alnus glutinosa*
- Ash *Fraxinus excelsior*
- Blackthorn *Prunus spinosa*
- Elder *Sambucus nigra*
- Elm english *Ulmus procera*
- Guelder rose *Viburnum opulus*
- Hawthorn *Crataegus spp.*
- Hazel *Corylus avellana*
- Holly *Ilex aquifolium*
- Laurel *Laurus spp.*
- Lime small leaf *Tilia cordata*
- Oak *Quercus spp.*
- Dog rose *Rosa canina*
- Spindleberry *Euonymus europaeus*
- Willow crack *Salix fragilis*
- Willow goat *Salix caprea*
- Willow grey *Salix cinerea subsp. Oleifolia*

Birds

he following birds have been recorded on the farm

Common name	***Latin name***	**2015**	**2016**	**2020**
Blackbird	*Turdus merula*	Y	Y	Y
Blackcap	*Sylvia atricapilla*	Y	Y	
Bullfinch				Y
Buzzard	*Buteo buteo*	Y	Y	Y
Chaffinch	*Fringilla coelebs*	Y	Y	Y
Chiffchaff	*Phylloscopus collybita*	Y	Y	
Crow	*Corvus spp.*	Y	Y	Y
Dunnock	*Prunella modularis*	Y	Y	Y
Garden warbler	*Sylvia borin*		Y	
Goldfinch	*Carduelis carduelis*		Y	
Heron				Y
Gull, herring	*Larus argentatus*	Y	Y	Y
Jackdaw	*Corvus monedula*	Y		Y
Jay, eurasian	*Garrulus glandarius*	Y	Y	Y
Kestrel				Y
Kingfisher				Y
Linnet				Y
Magpie	*Pica pica*	Y		Y
Owl, barn				

Owl, tawny				Y
Pheasant	*Phasianus colchicus*	Y	Y	Y
Redstart				Y
Redwing				
Robin	*Erithacus rubecula*	Y	Y	Y
Song thrush	*Turdus philomelos*	Y	Y	
Sparrowhawk	*Accipiter nisus*	Y		
Swallow	*Hirundinidae spp.*		Y	Y
Tit, blue	*Cyanistes caeruleus*	Y		Y
Tit, great	*Parus major*	Y	Y	Y
Tit, long-tailed				Y
Wagtail, pied				Y
Woodcock	*Scolopax rusticola*			Y
Woodpecker, green	*Picus viridis*		Y	Y
Woodpecker, spotted				Y
Woodpigeon	*Columba palumbus*	Y	Y	Y
Wren	*Troglodytidae spp.*	Y	Y	Y

Other wildlife

The following have been seen on the farm

- Roe deer
- Muntjac deer
- Fox
- Weasel
- Stoat
- Vole
- Field mouse
- Slow worm
- Lesser horseshoe bat
- Poplar-hawk moth
- Dragonfly spp.
- Damselfly spp.
- Butterfly species, including meadow brown and little skipper
- Cinnabar moth caterpillar
- Crickets