

Farming to improve self sufficiency and lower emissions **Abbey Home Farm, Gloucestershire**

Introduction

John Newman manages Abbey Home Farm near Cirencester, Gloucestershire. A 650 hectare mixed organic farm on Cotswold brash soils, Abbey Home Farm supports a diverse range of livestock enterprises as well as cereal and forage crops and smaller scale fruit and vegetable production. The farm also has 50ha of woodland and an area identified as an SSSI. John focuses on maintaining a closed production system, minimising imports to create as self sufficient a system as possible. The on-site farm shop markets produce from the farm as well as other organic food and non food goods. The shop provides a sustainable and variable source of food to the local community.

The adoption of organic production on the farm along with other conscious management decisions John makes, have made significant progress in reducing greenhouse gas emissions on the farm as well as increasing the farms potential to sequester carbon. Abbey Home Farm is continually working to improve productivity and sustainability, optimising the system they work with - reducing on farm emissions and increasing the level of carbon sequestration as they go.

Livestock

The farm supports 700 Lleyn ewes; 60 South Devon suckler cows plus their followers; a 25 head Dairy Shorthorn

milking herd; 8 Gloucestershire Old spot and Hampshire sows for meat production; 500 Hubbard cross table birds and 350 Black Rock and Silver Link laying hens.



The Lleyn flock form an important part of grassland management

Ruminant livestock contribute significantly to the farm's carbon footprint. Methane produced through enteric fermentation is the largest source of greenhouse gases at Abbey Home Farm. Optimising production is important in minimising methane production by livestock. Healthier livestock will produce less methane as digestion is more efficient - careful health planning is therefore important. Abbey Home Farm has a detailed animal health plan which is monitored regularly to ensure livestock health is paramount. The diet can also affect the amount of methane produced. Higher quality forage is more digestible and can result in lower methane production - productivity can also be improved which reduces the intensity of emissions - volume of emissions per unit of production. Diet quality is therefore

important to the farm. They ensure that the most productive livestock are fed the higher quality feed to ensure that productivity is optimised and emissions per unit of production are therefore minimised.

The cattle on the farm graze for a significant proportion of the year. The grassland supporting the livestock is a significant carbon sink on the farm. Grazing management is important in soil carbon management – maintaining and encouraging increasing root biomass density which provides a continuous source of organic matter in the soil, both building soil carbon and providing nutrients required to support the microbial population in the soil. Grazing intensity and timing needs to be carefully managed to ensure that plant growth is not adversely affected as this has a knock on effect on both productivity and the level of organic matter (and therefore carbon) in the soil.

The farm tries to minimise imported inputs to improve the sustainability of the system and to minimise transport costs and associated emissions.



Grassland management is key to optimising carbon capture

The majority of the livestock concentrate feeds are grown on site with the exception of a protein balancer fed to the pigs and poultry. The home grown nature of the livestock's diet reduces

indirect emissions that are associated with imported cereals and feedstuffs and also helps preserve the farm's carbon sink through grassland and crop management.

Straw for bedding is bought in to supplement that produced on the farm. Farm yard manure (FYM) from the cattle is composted - windrowed in the field, uncovered and turned over several times. It is applied between March and September when crops are actively growing on the farm and nitrogen demand is high. There are no manure applications between the end of September and beginning of March this ensures that nitrogen losses are minimised over winter. No real quantity of slurry produced so yard scrapings containing straw and waste silage remnants are stored in a midden and then added to the windrows. Composting manure stabilises it, reducing nitrogen losses. It also produces much more stable forms of carbon which are more resistant to decay and therefore promote carbon sequestration within the soil. The addition of FYM provides nutrients for crop growth supports the soil's microbial population which is vital in creating a healthy soil. Farm yard manure also promotes soil aggregation which is key in maintaining good soil structure. Poultry manure produced on the farm is also composted and then used as required as a ready source of on-farm fertiliser on a small-scale.

Pigs and poultry do not play as significant a role in contributing to Abbey Home Farm's greenhouse gas emissions as the ruminant livestock. The main concern in terms of emissions from these animals is the release of nitrous oxide and methane from their manure and so management of this is important. Pig manure either from direct droppings

from their paddocks or straw pads are left on site when the houses are moved, and are incorporated into the field by crude spreading by machine and ploughing. Similarly poultry manure and waste bedding (woodshavings) is composted for 6 -12 months on site and then used as required, contributing to soil organic matter content.

Cropping activities

Approximately half of the farm (275-300 ha) is used for arable production annually, with the remaining area down to temporary and permanent pasture for livestock production. In 2011 the farm had 29 ha red clover leys, 189 ha white clover leys, 48 ha long-term pasture, 13 ha lucerne and 42.5 ha permanent pasture. The diverse choice of species within the grassland has a significant effect on the carbon sequestration potential of the farm due to the variance in over and below ground biomass characteristics – the organic matter supplied by the different species varies in its nature and quantity providing a mixed diet for soil biology as well as a variety of organic matter components with varying resistance to decay – some will breakdown rapidly while other components remain in the soil for longer, locking up carbon.

Grassland's high density, fibrous root system is a key contributor to soil carbon. Roots provide carbon from their own biomass and also through exudates, root hair turnover and root sloughing whereby cells from the root cap are shed. The deep, fibrous nature of grassland roots also helps distribute carbon throughout the soil profile, building carbon at lower levels and protecting it within soil aggregates. The presence of permanent and long term pasture at Abbey Home Farm is particularly helpful in promoting carbon

sequestration on the farm as root networks increase in density as plant mature. Legumes within the grass leys promote productivity through the fixation of nitrogen. This leads to increased organic matter production both above and below the ground, again increasing carbon levels in the soil.



Cereals are grown without any artificial inputs which drastically reduces associated emissions.

A typical rotation on the farm comprises grass clover leys – either white or red clover or lucerne growing for different lengths of time – white clover typically for 4/5 years, grown with a diverse mix of grass varieties and herbs; red clover for 2 years and lucerne for 4 years - followed by wheat, triticale, beans and barley. Varieties are chosen to suit the market and depend upon availability. They tend to be chosen to suit a low input system. The use of legumes to fix nitrogen within the rotation at Abbey Home Farm eliminates the need to use artificial nitrogen fertiliser – this automatically cuts the farm's potential nitrous oxide emissions significantly as the emissions associated with artificial fertilisers are zero. Carbon emissions are also cut due to the reduced use of farm machinery when compared to conventional cultivation techniques.

The release of nitrous oxide from the soil when it's cultivated still poses a risk, albeit lower than if artificial fertilisers were being used, because soil

disturbance increases the rate of nitrification of which nitrous oxide is a by product. John minimises nitrogen losses by employing minimum tillage techniques such as shallow discing or tined cultivating in the first instance. In minimising soil disturbance, oxidation and nitrification processes within the soil are not disturbed and don't increase – carbon dioxide and nitrous oxide losses are therefore minimised. Shallow ploughing is still used, particularly when breaking the ley and if weed populations are high.

After the appropriate primary cultivation, secondary passes are usually tines/levelling rolls depending on weed pressures. Drilling is usually by a Horsch drill combination using tines and press wheels. If conditions are difficult in late Autumn then plough followed by power harrow combination may be used. John also ensures that any manure applications are timed to ensure that a crop is present to take up available nitrogen to reduce the risk of losses through volatilisation and leaching/run off.

A biological approach to pest and weed control is taken at Abbey Home Farm. Predatory insects are used on farm to control pests in both horticultural and arable crops, targeting pests such as ladybirds and aphids. Buckwheat is grown to help control weed pressure through allelopathic action – it naturally produces biochemicals which affect the growth of other plants. This is grown at the end of a rotation before returning to a grass/clover ley and controls dock and couch. This is a sustainable biological approach to crop protection and removes the need for chemical inputs and emissions associated with fuel use and machinery used for their application as well as those produced during their manufacture.

The farm also has 17 hectares of fruit and vegetable crops a small area of these are protected. All of these fruits and vegetables are sold through the farm shop including both salad and root crops. Approximately 200 different vegetable crops are grown - a huge diversity with a mosaic of fertility building legumes, crops and access paths. Some livestock are incorporated into the vegetable area – chickens and occasional grazing with sheep or cattle. There are also plans to grow fruit trees, adding to the portfolio of produce available.



Growing crops in polytunnels extends the productive season for some crops.

Abbey Home Farm has approximately 4,500 m of hedgerow which has been established since 1998. Hedges are maintained at a minimum height using controlled cutting on a rotational basis. One third of the farms hedgerows are cut each year with some cut under enhanced hedgerow management in a stewardship agreement in which only one side is cut in any one year. The hedgerows are an important carbon sink on the farm and help enhance and maintain biodiversity as well. The woodland on the farm is extensively managed. Firewood is cut and sold using coppice techniques charcoal is also made and sold. Brash is left on site to break down and some fallen timber is also left to decompose on site ensuring that the woodland ecosystem is maintained on

the farm. The 50 hectares of woodland are thought to sequester in the region of 730 tonnes CO₂ eq annually (estimated using the CALM calculator). This level of sequestration contributes significantly to balancing out other emissions from the farm.

The farm has a bore-hole which is used for the irrigation of horticultural crops through sprinklers, trickle and boom and reel irrigation methods. It also provides drinking water for all the livestock and properties on the farm including the farm shop and on-farm processing units (dairy, chicken abattoir and butchery) The use of the bore hole demonstrates a more sustainable approach to water use than using mains. This significantly reduces the farm's water footprint and carbon emissions associated with mains water.

Market

100% of Abbey Home Farm's dairy, pork, chicken and eggs, 90% of the lamb, and 80% of the beef is sold through the farm shop. The farm has an on-site butchery and also uses a local cutting unit for meat products. The shop sells lamb, pork, bacon and chicken. Processed products, sausages, burgers, bacon, gammon and ham are also made on site. Meat which is not sold directly from the farm is sold into co-operatives and onto retailers. 60,000 litres of milk are produced annually, some is sold as liquid milk, and the rest is made into cheese, yoghurt and cream on the farm. This means that excess milk does not have to be sold off the farm and helps reduce waste and associated environmental costs. Retaining sales and processing within the farm boundary eliminates emissions associated with transportation and distribution and helps maintain a sustainable system.



Dairy products are processed on site.

Energy use

Abbey Home Farm is dedicated to maintaining a sustainable and productive system, doing as much as possible within the farm boundary. This helps minimise the farm's indirect carbon emissions by concentrating the production and processing of farm products within the farm gate. Direct emissions from transportation and distribution are also minimised by retaining activities within the farm boundary. The majority of the fuel used by the farm is utilised for the farm vehicles and machinery. Electricity is used for grain drying when required to achieve correct moisture levels post-harvest; on-farm processing of dairy products; refrigeration units storing meat and milk. The farm uses electricity from the National Grid.

Farm materials are recycled on farm where possible – this includes plastics, glass, and paper. Other materials are collected by specialist collectors. Landfill and the associated environmental costs are therefore avoided wherever possible.

The farm has guest accommodation which was built from green oak, sustainably sourced on the farm. The

use of wood as a building material is a good method of locking up carbon in the long term. The guest rooms have low energy lighting and a wood-burning stove which use wood from the farm for heating.

Potential Development

Abbey Home Farm is already actively working to optimise its practices to improve sustainability, productivity and to minimise its impact on both the environment and wider society. There are a number of areas that the farm intends to develop in the future:

Water management – this is next on the farm’s agenda in the future. There are plans to install ponds for water storage

and to collect water from the farm building roofs. This will provide an alternative source of water which won’t require pumping and therefore has lower energy requirements than current water sources.

Solar panels are currently used to a small extent on the farm to power electric fences. Solar energy could be utilised to a greater extent in the near future. This would have the advantage of reducing the reliance on power from the National Grid and associated emissions from its production as well as generating excess electricity that could be sold back to the Grid on the feed-in tariff. John is also exploring the possibility of having a wind turbine on the farm to provide an alternative source of electricity.

Many thanks to John Newman for his time and input into this case study and to Abbey Home Farm for the photos included in this document.

For more information on low carbon farming and how you can reduce greenhouse gas emissions and increase carbon sequestration on your farm visit www.soilassociation.org/lowcarbon



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