

## **Low carbon farming - maximising carbon sequestration** **Woodland Valley Farm, Cornwall**

### **Introduction**

Chris Jones farms at Woodland Valley Farm, a 170 acre mixed organic farm. Chris predominantly focuses on beef production as well as having some sheep, pigs and chickens. He has a keen interest in grassland management and the associated carbon sequestration potential and has moved the farm away from rotational cropping in recent years to the grassland farm it is now. The farm has over 20 acres of woodland, as well as streams, and ponds providing some wetland and works to attract and maintain a wide range of wildlife. The Jones family are keen to engage with the wider community and have dedicated 5 acres of the farm to allotments as well as establishing a community nut plantation.

### **Emissions**

Woodland Valley Farm supports a mixed breed beef suckler herd with 28 cows, 24 calves and 11 store cattle. These numbers are gradually increasing. These animals are the main source of greenhouse gas emissions on the farm – emitting approximately 67 tonnes CO<sub>2</sub> eq annually.

Chris has introduced a number of practices to help minimise emissions from the livestock at Woodland Valley Farm. A transition to a 100% grass based system means that the sheep and cattle are outside for the majority of the year, sourcing 100% of their diet from forage based feed – grass production is key in maintaining and increasing carbon levels in the soil. The clover and herb rich grassland provides a good source of protein eliminating the need

for bought in concentrates. This cuts out potential emissions associated with the production of cereals both on and off the farm as well as the emissions occurring from the transport of bought in goods. Grass and herb species have been carefully selected to optimise livestock health and palatability. Ensuring livestock are fit and healthy is very important in minimising the intensity of emissions per kilo of meat produced – healthier animals are more efficient. Rock salt is provided for the cattle to supplement sodium, calcium, magnesium and potassium. This again helps in ensuring optimal health of the cattle and their production efficiency – minimising emissions intensity.



**The beef suckler herd are raised on a grass-based system.**

Manure management is also important in minimising emissions at Woodland Valley Farm. The cattle are housed during the winter and bedded on straw which is bought in locally. Farm yard manure produced is composted to maximise benefit to the soil

and minimise environmental risks. Dung is kept in a purpose built dung store until spreading when it is applied to the grassland on a rotational basis in late winter/early spring. It is inevitable that some nitrous oxide is emitted at this time but FYM applications are timed to ensure that the grass is actively growing and that there is a requirement for the nitrogen so that uptake is rapid and losses are minimised.

Energy and fuel use are the next biggest contributor to Woodland Valley's carbon emissions after the livestock. Weed control of thistles and ragwort is carried out manually which eliminates the requirements for energy use by either mechanised control or emissions associated with chemical applications. The protection and enhancement of biodiversity on the farm has allowed the natural proliferation of the dock beetle which feeds on and controls the dock weeds. This is a significant bio-control mechanism which improves the quality and productivity of the pasture while also removing the need for mechanical control and any associated emissions. Where chicory has been sown there appears to be a great reduction in the number of docks.



**Dock beetle presence acts as a biocontrol mechanism**

The farm tries to minimise the consumption of energy and resources. Fuel is used predominantly for farm vehicles and machinery as well as for heating the farm house and guest accommodation. Solar

heated water is used in one of the guest buildings and a wood burning stove has been installed in the farmhouse to reduce the reliance on oil for heating. Chris has also reintroduced the use of horses on the farm in place of cattle - this is likely to develop as a low carbon management tool to reduce the farm's reliance on fossil fuels to an extent. Electricity is the main energy input onto the farm and this is supplied on a green energy tariff from Scottish Hydro power - Chris is currently installing a 50kW wind turbine to help reduce the farm's reliance on the National Grid.

The farm takes all youngstock through to finishing, producing on average 20 finished animals per year. The outlet for the beef depends on market demand but it tends to be put into a local supply route which helps reduce transportation costs. The farm also has an online farm shop marketing some farm produce direct to the consumer. This significantly reduces the supply chain and associated emissions and overhead costs.

A local abattoir and butcher are used for all meat processing to reduce the emissions associated with transporting livestock and carcasses. The farm achieves growth rates of at least 1kg per day, the annual carbon audit indicates that per kg of beef sold deadweight there is a net sequestration of some 30kg carbon - the grass based production of beef at Woodland Valley Farm is therefore having a positive impact on GHG emissions.

### **Carbon sequestration**

The level of carbon sequestration at Woodland Valley Farm is very important in balancing out the emissions from the livestock. In the past the farm produced cereal crops which were fed to the livestock. The rotational land has now been converted to long term pasture. This conversion has a significant effect on the farms' carbon balance, sequestering in the region of 1600 kg CO<sub>2</sub> eq per hectare per year. This dramatic increase in carbon held in the soil

comes from the increased levels of biomass both above and below the ground and the reduction in the level of soil disturbance which allows the soil processes to slow minimising losses of carbon dioxide.

Chris actively manages his grassland to increase the amount of carbon locked up in the soil, he does this in a number of ways:

**Creating a diverse, species-rich pasture**

– the inclusion of a wide variety of deep rooting grass, legume and herb species within the pasture improves productivity as each species grows within its own niche. The varied nature of a soil's characteristics across a single field can therefore be optimally exploited by the various species, improving production. This increases the level of biomass both above and below the ground, raising the amount of carbon held in the system. Organic matter from grassland is more resistant to decay than residues from cereal crops – it therefore remains in the soil for longer and contributes more to building carbon levels in the soil. Chris includes yarrow chicory and plantain in his sward which are very deep rooting – it therefore has good drought resistance and is able to deposit carbon at deeper levels within the soil profile, turning the soil into a 3 dimensional carbon storage space, as well as making nutrients available from deep within the soil profile

**Increased long term/permanent pasture**

– in letting grassland mature, a dense and deep rooting system is established. Grassland roots provide a source of organic matter via their own biomass when they die off, but also continuously through root exudates, cell shedding and root hair turnover. The dense and deep nature of grassland roots helps with the distribution of carbon throughout the soil profile. Carbon is deposited at depths and within soil aggregates where it's better protected from break down. The presence of a dense root system is key in building soil carbon levels.

**Clover rich swards** – the inclusion of legumes in the sward eliminates the need for artificial nitrogen fertilisers. This reduces the farm's potential to emit nitrous oxide as there is steady supply of nitrogen as opposed to a sudden application. Potential indirect emissions resulting from the production of fertiliser are also removed from the farm's carbon footprint. Leguminous plants within a ley promote productivity through increased availability of nitrogen for both plant growth and in providing a nutrient source for soil microbes – increased productivity → increased biomass → increased source of carbon. Legumes also have a low C:N ratio which means that their residues can be efficiently decomposed by microorganisms without too much carbon dioxide being released by the microorganisms – carbon is therefore retained in the soil.



**Species-rich grassland is a key feature of the farm**

**No till** – the long term and permanent nature of the pasture at Woodland Valley Farm means that no cultivations are required and the soil is left undisturbed. This reduces the risk of both nitrous oxide and carbon dioxide being emitted from the soil which is positive for both the farm's carbon footprint but also its nutrient balance as nitrogen losses are minimised.

**Grazing** - the pastureland is grazed on a rotational basis to ensure that productivity

of the sward is optimised. Grazing intensity and timing is carefully managed to ensure that the plants are not damaged and are allowed to recover. Care is also taken to make sure the soil does not become bare or poached as this can lead to carbon and nitrogen losses. Grazing is an important aspect of pasture management, the use of both cattle and sheep helps optimise management as the two species have different grazing characteristics which promote grassland productivity – increased productivity → higher input of carbon via plant biomass. "Mob-stocking" is being considered at Woodland Valley Farm to aid pasture management. This allows a natural form of management with low carbon input which helps develop the root system of the pasture increasing organic matter in a shorter time-frame.

**Livestock manure** – as a result of passing through the digestive tract, dung from grazing and cattle and FYM contains compounds which are more resistant to decay than the original residue would have been. Livestock manure therefore provides a good source of organic matter, aiding carbon sequestration.

**Sea sand** - the application of locally sourced sea sand maintains the soils in the optimum pH range for grass and clover production ensuring productivity of the pasture is optimised.

The extensive hedgerow and woodland at the farm contributes significantly to the carbon store at Woodland Valley Farm. The diverse and well developed hedgerows and woodland contain mixed deciduous species including alder which is unique as a tree in its ability to fix nitrogen, helping to improve fertility of the soils beneath. Willow is also present which is fast growing offering high and rapid carbon sequestration potential. These are important aspects of on-farm carbon management with the woodland alone contributing approximately 94 tonnes CO<sub>2</sub> eq to the farm's carbon balance per year.



**Trees and hedgerows contribute significantly to sequestering carbon.**

A nut plantation was recently planted at Woodland Valley Farm; this is a community funded venture which engages the locals in sequestering carbon and, in a few years time, will produce sweet chestnuts for a niche market. The plantation makes use of a steep slope that was previously unmanageable grassland because of its topography.

### **Natural resource management**

Water is sourced both from the mains and borehole as well as being collected from the roofs of farm buildings into storage tanks. Collected water is used predominantly for watering the gardens and the livestock. Waste is managed sustainably; cardboards and paper sacks are re-used in cattle bedding on the farm; effluent is processed through a septic tank and then a reed bed to soakaway; food waste is composted - turning waste into organic humus for soils and enhancing carbon capture. Composting is of significant value in building nutrient levels in the soil and in providing a form of organic matter which is highly resistant to decomposition and therefore remains in the soil increasing the level of carbon in the soil.

Sustainably sourced timber has been used where possible on the farm for building - using timber as a building material ensures that the carbon held in the wood is stored for longer than it might be if left standing in the woodland as it would later decompose

releasing carbon dioxide. It is important that timber is source sustainable such that harvesting does not exceed regeneration or planting so that stored carbon levels are maintained.

## **Potential Development**

The greatest strength of Woodland Valley Farm in terms of its carbon impact is the farms move away from cereal production to 100% grass fed livestock and the careful pasture management programme and the subsequent biodiversity that runs with this. The farm's soil is a significant sink and Chris' drive and passion for increasing carbon levels in the soil through grassland management will be key in optimising the carbon balance of the farm into the future. Chris intends to continue developing the management of his pasture, trialling new concepts with a view to maximising carbon sequestration. There are also plan to extend the solar-panelling used on the site

for renewable energy. There is currently a 12 panel solar thermal system on the farm.

Wind power also holds potential as part of future development plans – the location and climatic conditions on the farm mean that a turbine could offer a suitable method of sustainable energy production on the farm. This would mean that the farm would not have to import electricity from the grid and would therefore reduce the emissions further as well as offering an opportunity for a new income stream through the Feed in Tariff for renewable energy production. There is interest from a local renewable energy cooperative in this project which would further improve the social benefits of the farm. As the nut plantation matures and comes into full production in the coming years there is potential for the development of a permaculture scheme. This would provide additional potential for carbon sequestration without requiring significant management.

**Many thanks to Chris Jones for his time and input into the production of this case study**

**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](http://www.soilassociation.org/lowcarbon)**



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