Source: Tim Scrivener/WTML

Regenerative Agriculture Technical Note

The term 'regenerative agriculture' has experienced a sharp rise from niche practice to widespread concept, gaining popularity as a common solution to address net zero and long-term farm productivity.

Whilst cultivating land for crops and food production has always been dynamic, the agricultural landscape is quickly evolving in line with changing demands. The UK food and farming system is coming under greater scrutiny as both a driver and solution to the climate crisis. Regenerative agriculture, when implemented well, can offer management strategies to balance the inputs and outputs of UK agriculture, which is attracting greater attention as reductions to agricultural emission contributions are sought.

Farming activity covers some 17.4 million hectares (43 million acres) occupying around 71% of the UK landmass. By this nature, it constitutes a vital part of the UK's rural, agri-food and bioresource economies, and is a key part of the food and drink sector, which contributed £127 billion to the UK economy in 2019[1]. The scale and breadth of UK agriculture offers farmers and landowners of the nation's 216,000 agricultural holdings the opportunity to be significant drivers of both emission mitigation and carbon sequestration.

Regenerative agriculture looks to address this opportunity by finding a balance between food production and restoring, preserving and protecting the land and soils. Placing soil health at the centre of the system, regenerative agriculture is defined by a group of principles that balance productivity, with the restoration, preservation and protection of the land and soils. It is a holistic approach to farming which encourages resilience and innovation.

Carbon has become central in discussions within food production in recent years, including both emissions and opportunities for storage and sequestration. Farming with the purpose of boosting soil organic carbon levels offers significant but uncertain emissions mitigation potential, delivering co-benefits to farmers and society. Farmers can apply the principles of regenerative agriculture and can contribute to the net zero journey by both limiting emissions and enhancing carbon storage and sequestration in both above- and below-ground biomass. Above-ground carbon can be harvested and sold as a food source to consumers, or accumulated within the wood of hedges and trees, whilst below ground carbon is sequestered as humus (long-term) or cycled in the soil microbial biomass as an energy source. As farming has become significantly more productive in the last century, there has been a trade-off with the levels of below-ground carbon. Carbon that was sequestered and stored over centuries has been released into the atmosphere with the rising productivity of agriculture through more intensive farming practices and cultivations leading to arable soils losing 40–60% of their organic carbon[2]. Regenerative agriculture looks to redress this balance and increase soil organic carbon back to previous levels.

AMC The Agricultural Mortgage Corporation

What is Regenerative Agriculture?

Regenerative agriculture is a growing topic within the global food supply chain, with significant application across North America leading to enhanced discussion within UK agriculture in the past decade. The term adopts many definitions and obtains several different 'core principles', with no widely accepted definition adopted for common use[3]. Regenerative agriculture has evolved from its origins in the early 1980s, after being used by the US-based Rodale Institute in its research and publications. Generally, regenerative agriculture is a holistic approach to farming that encourages continuous innovation and improvement in social, environmental, and economic measures. Regenerative agriculture may even have net positive impacts on all three of these pillars. Regenerative farming is an approach seeking to work with natural systems to restore and enhance soil fertility, biodiversity and ecosystem services. Regenerative systems focus on adding to the system rather than extracting from it to achieve market returns[4].

Regenerative agriculture bridges the gap between the traditional, organic and conventional farming practices. With the various pressures on cultivating crops, whether it be the rising fertiliser prices, threats of climate change or the more extreme weather, farming practices are transitioning towards less conventional methods. A key difference between regenerative agriculture and organic agriculture is that regenerative focuses on principles rather than practices, which includes restoring natural biological processes within the soil and agricultural land. The open definition surrounding regenerative agriculture leaves it open to interpretation to the farmer and how they view it on their own individual system, making it a much more appealing, and less restrictive method to apply to different soil types, farming systems and weather patterns.

Key principles of regenerative agriculture

The five key principles of regenerative agriculture encompass all areas on farm, within each of these are the practices that can be adopted in order to transition towards more sustainable agriculture. The five principles are minimise soil disturbance, maximise crop diversity, keep soils covered, maintains living roots year round and integrating livestock.

Source: Geopard, 2022

Minimal physical, mechanical and chemical disturbance of soils

A large proportion of regenerative agriculture focuses on the key principle underpinning a healthy ecosystem, the soil. Soil is the foundation of the ecosystem and without it, plants cannot grow, and animals cannot be sustained. Minimising soil disturbance, and ultimately soil degradation, can be achieved through reduced tillage agriculture, which lessens the amount of carbon released from the disturbed soil, and allowing for the regeneration of organic matter below the topsoil.

The connectivity of the agroecosystem is affected by soil disturbance and tillage. Consistent soil disturbance affects water infiltration as well as the movement of gases, nutrients and water within the soil and roots through soil pore networks. Soils with poor structure limit the interaction between organisms within the soil and fungal networks, all contributing to healthy functioning soils[5]. Under regenerative models, as soils increase in fertility their water holding capacity also increases, thereby increasing the natural, biological productivity of the land and encouraging species growth.

Allowing for the soil to regenerate, with minimal disturbance from conventional cultivations, facilitates the organic matter in the soil to contribute towards the growth of crops on the surface. This enables a reduced reliance on artificial fertilisers to improve the fertility of the soil and leads to an overall improvement in the condition of the land[5].

Encourage crop diversity

Establishing and maintaining as much plant diversity as possible creates a good environment within the soil for maximisation of the microbial population. In the absence of diversity, through continuous cultivation of the same crop species, imbalance develops within the soil leading to reliance on artificial fertilisers to provide specific nutrients. This leads to reduce soil organic matter, degradation of soil structure and soil biology. A greater diversity in crops creates greater root depth diversity within the soil, allowing for more organic matter to be left in the soil once these plants die off.

Companion cropping and intercropping, as well as diverse main-crop rotations, are methods to increase diversity within an arable crop during rotations, delivering benefits including pest reduction, weed suppression and increased nutrient accessibility and uptake of nitrogen and phosphate. As a result, improvements in crop yield and crop resilience will lead to long term benefits to overall soil health and less reliance on artificial fertilisers[5].

Keeping the soil covered

There are a number of benefits to covering the soils with cover crops, cash crops or with a mulch of crop residue. These practices protect the soils beneath to a variety of threats; wind and water erosion, compaction and weed growth whilst maintaining evaporation rates and soil temperatures. Exposed soil is at risk from water and wind erosion, therefore keeping it covered all year round minimises the risk of damaging the soil. The estimated annual costs of soil degradation in England and Wales total between £0.9–1.4 billion[6].

Cover cropping can be both short-term and long-term options for the soil, acting as a shield and covering the soil surface. The extended period of growing is also often described as 'solar-powered soil building' due to the physical, chemical and biological benefits derived from the crop capitalising on the sun's energy through photosynthesis. Short-term cover crop mixes include faster growing species, such as radish, mustard, buckwheat and linseed. Over-winter mixes are longer term options which include winter rye, spring oats and stubble turnips as some examples. Mulching can be achieved with natural or synthetic materials but natural materials on farm are most common. Leaves, plant residues, grass clippings, hay and straw are examples of mulch, acting as a source of carbon and nitrogen as they breakdown on the surface[7].

Maintaining living roots in the soil

The presence of plants and active roots within the soil is key to optimal soil health and structure, as they provide the energy for the biological processes within the soil. The absence of plants causes carbon to be released, as carbon dioxide, via respiration due to the soil biota metabolising the soil organic matter. This would have otherwise been used as energy for the root and plant growth. Plant and soil biology share a close relationship, centred around plant roots where a host of organic substances are excreted by the plants. Mycorrhizae are a particular type of fungi connecting plant roots, growing in smaller soil pores enabling them to acquire and pass on nutrients, particularly phosphorus, at a quicker diffusion rate through the soil.

Considering integrating cover crops is one way to ensure active roots are kept within the soils. This is when the soils would otherwise be left bare for over four weeks and as a result beneficial microbial populations start to decline rapidly. Living roots provide the constant energy source for nutrient cycling, soil fertility and maintenance of soil structure. Cover crops also increase access of nutrients to micropores which most arable crops are unable to reach, increasing the availability of 'free' nutrients within the soil. This contributes to increased nutrient cycling within the soil and nutrients in crop-available form.

The presence of living roots in the soil also helps reduce the risk of leaching, particularly during winter months. Residual nutrients, particularly nitrogen, are held in the soil before being made available to the next crop in the ground.

Maintaining ground cover and retaining living roots in the soil using plant species with vigorous and active rooting systems enables farmers to manage soil structure using biological systems, particularly with cover crops that can use complimentary but different rooting properties. Using this as a primary form of management then enables application of mechanical amendments to the soil structure only when necessary.

Integrating livestock

One strategy to compliment regenerative principles is to integrate livestock onto farms. Some arable farms have not had livestock for many years, resulting in a loss of organic manures and reduction in the range of perennial crop species. This form of land management through the introduction of grass leys and pastures, gives the land longer rest periods in order to regenerate and recover whilst building soil fertility and improving the microbial diversity of the soils through grazing and organic manure application. This acts as a cornerstone for the other four principles in providing cover and living roots through a diverse species of plants whilst limiting mechanisation and inputs. Integrating livestock also offers greater resilience to businesses by spreading financial risks over different enterprises.

Rotational and mob grazing has seen a number of benefits to soil health, grass growth and diversity of plant species[8]. Mob grazing highlights the importance of rest periods for the grass, allowing the soil more time to recover. As a result, soil health improved, cattle were healthier and there was a reduced need for inputs. The system also allows for a reduction in the time animals are housed which contributes to reduced costs. The greater rest periods also allow for plants to grow taller, leading to a larger and more complex root system leaving more organic matter when the plants die off.

The rise of regenerative agriculture in the UK

Implementing a combination of the main principles behind regenerative agriculture can offer significant benefits to land and farm management. If implemented well, these practices can be economically and environmentally viable, offering a sustainable future in food production. The growth of interest in regenerative agriculture continues to expand, with more and more awareness of the benefits of this type of farming practice. The annual Groundswell Regenerative Farming Festival, celebrating all things regenerative agriculture, went from hosting 450 people to 5,500 in just six years[9].

Whilst the numbers of farmers considered regenerative in the UK are limited many regenerative processes are practised to varying degrees. A recent survey suggests that three-quarters of farmers are already looking to use some regenerative techniques on their farms[10]. This survey also identified the most significant barriers to farm uptake of regenerative practices as knowledge and yield perceptions. As the understanding of practical applications of regenerative agricultural across different farming systems and geographies proliferates, this will inform enhanced Government support and improved guidance to boost farmer knowledge and confidence to make the transition to regenerative practices. AHDB has turned its focus to greater knowledge exchange in this area with increasing demonstration days, events and videos.

Farmer perception of reduced yield is understood to be the second most significant barrier to adoption of regenerative practices, which ultimately comes down to the financial impact of regenerative farming. A 2021 study by The Food, Farming and Countryside Commission found that the yield potential of regenerative arable systems was 27% less than those with conventional systems, on a tonne per hectare basis[11]. Further studies show more mixed yield effects across a number of different farming systems[12]. But while yield has traditionally served as the metric of farmers, a decrease in yield does not necessarily result in a decrease in profit. A US study comparing conventional and regenerative corn production emphasised this with regenerative fields having 78% higher profits than the conventional fields despite 29% lower grain production (Figure 1)[13]. The profits were largely driven by input savings (fertiliser, pesticides and fuel), whilst profit was also positively associated with the particulate organic matter of the soil. The importance of maximising the efficiency of inputs is growing with turbulence to the cost and availability of feed, fuel and fertiliser.

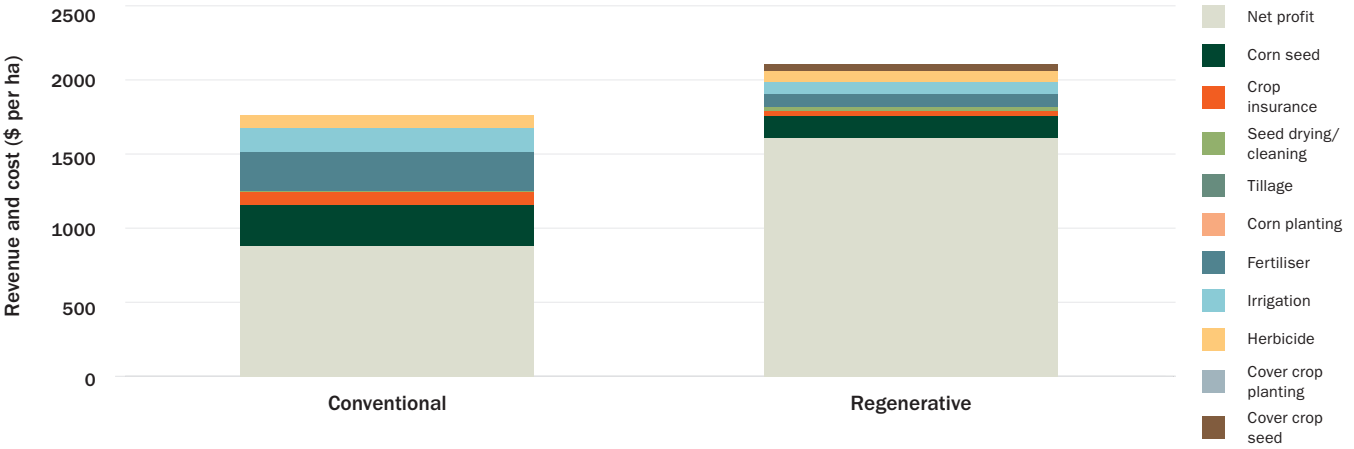


Figure 1. Revenue and costs for 'conventional' and 'regenerative' US corn production[13]

Regenerative agriculture is accessible for all farming systems as well as new entrants, as it has a lack of reliance on high inputs and machinery. There are a number of support groups in the UK for regenerative agriculture, such as **Farming for a Better Climate**, bringing social benefits as well as environmental and economical. The uptake of regenerative agricultural practices looks set to continue its rise over the next decade and beyond. As the evidence base grows, and confidence in application of the practices and principles increase, so too will the number of farmers who invest in regenerative agriculture.

Regenerative agriculture and policy

Regenerative agriculture has grown to be a central focus of UK farming; the holistic approach provided by regenerative agriculture allows farmers to run successful, sustainable businesses through the reduction of greenhouse gases, increased carbon sequestration and increased soil health, which ultimately helps mitigate against climate change and encourage biodiversity. Developments to agricultural policy following Brexit, and their impact across the devolved nations, provide opportunities to support farmers and growers on their journey towards a future of regenerative agriculture through funding and incentives. These currently incentivise the application of individual regenerative practices, with a scheme encompassing regenerative farming as a whole not yet developed due to the flexibility in the interpretation of regenerative agriculture.

Post-Brexit subsidy regime

As a result of Brexit and the UK leaving the European Union (EU), it is the first time since 1973 that the UK agriculture policy was able to be established domestically. In 2018, Defra announced the intention to implement a principle of 'public money for public goods'[14]; this principle meant that farmers and landowners would be paid directly for the environmental benefits they contribute to, rather than the area of land they farm. This is a significant step in the right direction for funding available to farmers when it comes to changes made on farm specifically for the environment and sustainable practices.

In 2020, the Agriculture Act was passed, containing a framework to set out to define a list of 'public goods' that subsidies would be applied. This was reviewed in a plan by Defra which set-out *The Path to Sustainable Farming: An Agricultural Transition Plan 2021 to 2024*[15]. This plan outlined a range of actions that farmers could take in order to qualify for subsidies and included a commitment to continued design of a scheme that includes a breadth of regenerative practices to increase biodiversity and improve soil quality. This included the introduction of the Environmental Land Management scheme as a means to incentivise the actions farmers could take to farm more sustainably, enhance local nature recovery, and restore landscapes.

Environmental Land Management (ELMs)

The Environmental Land Management Scheme (ELMs) was established in 2021, which aims to reward the actions of farmers contributing to the restoration of the environment through environmental land management practices. Farmers will be rewarded for effectively managing their lands to produce cleaner air, clean water, increased health and biodiversity of flora and fauna, ecosystem resilience, protection against environmental hazards, mitigation of climate change and support towards meeting net zero targets. ELMs consists of three schemes: Sustainable Farming Incentive, Local Nature Recovery and Landscape Recovery. These schemes are proposed as part of a 25 Year Environment Plan and a goal to support rural economies in the journey to net zero emissions by 2050[16]. All 3 schemes will pilot the schemes between 2021–2022 and by 2024, the schemes will be fully launched.

Sustainable Farming Incentive (SFI): The SFI scheme will pay farmers to manage their lands in an environmentally sustainable way. The farmers are able to choose from a range of standards that are most suited to the land- farmers will then be paid for implementing these standards. The idea behind the SFI is to support approaches to farm husbandry that deliver for the environment, such as actions to improve soil health, hedgerows and integrated pest management.

Countryside Stewardship Plus will encourage farmers to work together to improve their local environment through actions such as managing and restoring natural habitats, peat or wetland areas, and hedgerows. Actions that farmers take to enhance local nature recovery and environmental priorities will be paid for. The options under this scheme cover a number of regenerative practices, such as increased diversity and minimising soil disturbance.

Landscape Recovery: The landscape recovery scheme will support farmers that are actively supporting landscape and recovery projects[17]. The North East Cotswold Farmer Cluster of 44 farmers and landowners, covering 23,000 ha, has been selected by Defra with their plan to design, create and restore over 3,000 ha of interconnected habitat along the valley[18]. Farms within the cluster share a common approach of implementing regenerative techniques and aim to implement rewilding, wetland creation and woodland restoration.

Countryside Stewardship Scheme

The current Countryside Stewardship Scheme provides financial incentives for farmers and landowners to improve their local environment. Actions include conserving and restoring wildlife habitats, flood risk management, woodland creation and management, reducing widespread water pollution from agriculture, keeping the character of the countryside, preserving historical features in the landscape and encouraging educational access. The various schemes within Countryside Stewardship encompass all five of the principles of regenerative agriculture, linking back to the central point of soils and soil health.

What does the future hold for regenerative agriculture?

With the rising population and climate crisis, agriculture has had no choice but to alter its course. Regenerative agriculture is quickly becoming the answer to this problem as farmers question their conventional methods. As more case studies emerge showcasing the success of regenerative farming practices both environmentally and economically, the more attractive the transition becomes. Support within the industry, whether that be through grants, Government bodies or organisations offering advice, are all creating a positive future outlook for transitioning to a way of farming that helps restore nature's balances.

Findings from a survey conducted by the National Farmers Union of England and Wales found that 69% of farmers plan to improve soil health or carbon content with 51% planning to plant trees[19]. These figures signal the huge transition towards regenerative farming in the UK and the recognition by farmers of how important this transition is towards sustainable food production.

Industry insight – How the LEAF Marque captures the spirit of regenerative agriculture

LEAF is a leading organisation within the industry on a mission to deliver more sustainable food and farming. Naturally, they have heavy links to regenerative principles and practices within the work they do. They are currently paving the way in bridging the gap between consumers and farmers with their 'Open Farm Sunday' events across the UK.

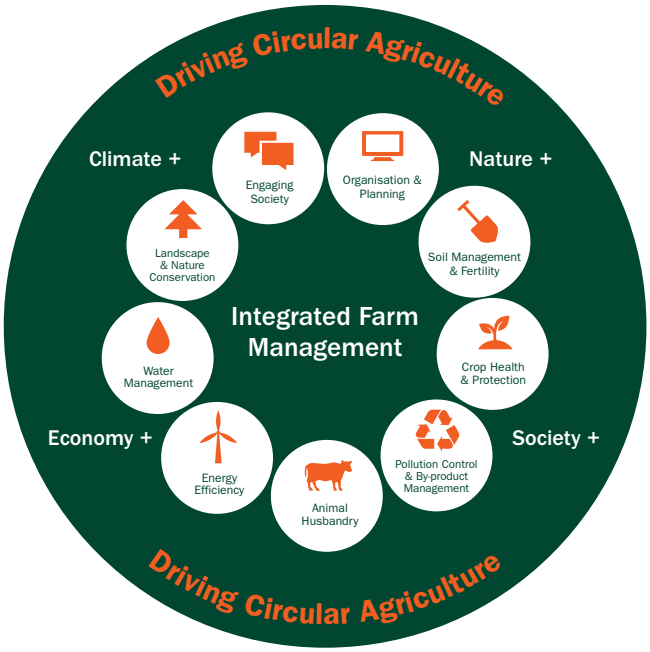
As part of LEAF membership, farmers can certify their products with the 'LEAF Marque', which accredits the products as being produced using the 9 principles of Integrated Farm Management (IFM). Farmers have to prove to third party auditors that they not only follow the principles, but that their farm business is actively increasing and improving in each aspect. LEAF have supported IFM as a successful regeneration approach, with five of their principles linking directly to regenerative practices: soil management and fertility, crop health and protection, animal husbandry, landscape and nature conservation and organisation and planning.

We spoke to Clare Mike, Business Development Director at LEAF, who shared their Integrated Farm Management model with us which includes the nine different practices of Integrated Farm Management. Among the five principles which have a direct link to regenerative practices, 68% LEAF farmers use minimum and/or zero tillage at some point during their rotation whilst 49% of LEAF farmers include cover crops in their cropping. In addition, 53% LEAF farmers use rotational paddock grazing.

Clare highlighted that this improvement can be flexible based on the farm business type and size. For example, a 30-acre family farm may not have the finances or the resources to prove their soil health improvement with laboratory tests. Instead, they can prove they have committed to doing a worm count in the fields each year. On the other hand, a proportionate measurement of soil health improvement on a large-scale arable estate would be to send off soil samples annually for testing.

The LEAF organization also has a number of corporate members including Tesco, PepsiCo and LIDL. Clare argued that the reasoning behind these retailers joining was to lead by example and to advocate for the benefit of the IFM principles. Furthermore, it would be hard for the supermarkets in particular to stipulate LEAF certification on products without being members themselves.

LEAF highlighted the financial sector as being vital to this flexible, regenerative approach. Many of their farmer members have already stated they will not be taking up new government schemes due to the lack of flexibility and prescriptive approach. There remain market opportunities to support investment for farmers to pursue nature-based climate solutions, such as regenerative agriculture, whilst remaining commercially viable. The Netherlands is leading the way with collaborative approaches to support farms implementing sustainable practices by bridging public and private sectors to provide a full package of investment, research and access to knowledge and expertise. This sort of collaborative approach could provide UK farmers with the impetus and confidence to implement regenerative practices at a broad geographical scale.



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