Regenerative Agriculture: Arable

Why regenerative agriculture?

Regenerative agriculture is a form of agriculture designed to help address the critical issues around environmental sustainability on farms. As environmental concerns become more pronounced globally, finding new ways to reduce on farm emissions, address climate change, and tackle biodiversity losses is growing in importance.

Improving ecosystem health and farm efficiency is key to building Scotland's natural capital, while supporting resilient rural communities and moving towards self-sufficiency in food production.

Arable ecosystem services

Ecosystems services are the benefits provided by Scotland's natural capital. For arable land, these services include:

- Food production
- Carbon sequestration
- Water quantity and quality
- Nutrient cycling

These services can be enhanced through different forms of regenerative agriculture including agroforestry, crop rotation[1], cover crops, and minimum tillage, along with many other practices.

Find out more on arable land ecosystem services

Five core principles of regenerative agriculture

01 Keep the soil covered

02 Minimise soil disturbance

03 Continual living roots

04 Promote farm diversity

05 Integrate grazing livestock

How to achieve the five core principles of regenerative agriculture:

01 Keep soil covered

Good soil health is pinnacle to the arable sector, despite this much of our soils are in a degraded state. A lack of understanding of soil ecosystems, reliance on artificial fertilisers and increased mechanisation have resulted in a steady decline in soil health. Healthy soils, with good structure, high organic matter and diverse communities of flora and fauna, support the recycling, uptake and retention of nutrients. They store and regulate waterflows helping farmers combat drought and flooding, stabilising crop yield in our changing climate. Good soil health is intrinsic to crop performance.

In arable systems, leaving soils bare following harvest makes them particularly vulnerable to erosion. In arable areas, erosion rates in Scotland vary between 0.01 to 23.0 tonnes per hectare annually.[2]

Keeping the soil covered can be achieved through the use of cover crops or retaining crop residue over the winter. Cover crops bind the soil protecting it from erosion from wind and rain.

02 Minimise soil disturbance

Min or No Till systems are designed to reduce soil disturbance maintaining soil structure. In the right circumstances, reduced tillage offers huge benefits to the soil and business, however, it is not suitable for all. A total overhaul may not, however, be required and there is the potential to shift away from annual cultivation, to less frequent more target cultivation (e.g. to reduce weed burdens, or alleviate compaction). Innovation such as controlled farm traffic can also help limit compaction and there are advancements in the use of artificial intelligence to identify and destroy weeds.

Positives

- Reduces soil disturbance
- Reduces soil erosion
- Water infiltation and retention
- Reduced cost and greater energy efficiency

Negatives

- Reduced weed and pest control
- Potential carry over of pests and diseases
- Can require increase in pesticide use
- Areas of compacted soil remain

03 Continual living roots

Cover crops not only reduce the risk of soils entering the watercourse, but they also uptake residual nutrients reducing the risk of nutrient leaching.

Cover crops extend the growing season, allowing farmers to harness sunlight year -round, and the carbon captured can be incorporated into the soil as a green manure or grazed by livestock. Their living roots release exudates (fluid material), which provide nutrition for soil communities, allowing them to thrive during the winter. While cover crops can prevent weeds from establishing, they can in some instances act as a green bridge allowing the carryover of pests and diseases to the follow-on crop.

04 Promote farm diversity

In nature monocultures are extremely rare and the diversity that typifies natural ecosystems underpins a range of ecosystem services. Diverse plant communities support more complex soil communities, different flowers provide forage for a wider suite of pollinators and structurally diverse vegetation provides opportunities for different spider species to build webs. Because different species respond to environmental stress in different ways this diversity builds resilience into the farming system. In agricultural systems, the diversity that accompanies nature disappears giving rise to monocultures.

Whilst monocultures typically result in higher yields, more diverse cropping systems improve above and below ground biodiversity and are less susceptible to pests and diseases. Research is helping us to develop crop mixtures, that optimise the way different species interact combining species that increase the efficiency of nutrient and water uptake. Such plant teams not only support above and below ground biodiversity, but also help to buffer environmental extremes and are less susceptible to pest and diseases.

Legumes fix atmospheric nitrogen and when used as an intercrop, green manure or cover crop, they can reduce the need for artificial fertilisers. They can also help suppress weeds. Legumes are also rich in pollen and nectar providing important forage for pollinators.[3]

Silvo-arable systems, involve alley cropping trees with cereals. As trees occupy a different space to conventional cereals, they effectively increase the farmed area. Their deeper roots allow them to access minerals and nutrients that are unavailable to cereals, and during autumn the leaves provide an additional source of organic matter to the soil. Diversifying income (e.g. timber, fruit, nuts), reducing soil erosion and improving the water retention capacity of the soil, trees can build resilience into the farming system. Establishing agroforestry, however, does pose some challenges. Trees may damage field drains, and considerations should be given to the aspect that trees are planted to reduce shading of the crop.

Increasing the diversity of habitats at the farm level plays a vital role in supporting wildlife. Hedgerows provide key habitats and shelter for biodiversity on farm, alongside providing carbon sequestration and improving soil quality.

Establishing buffer strips along watercourses not only support a range of species, but also protects watercourses from diffuse pollution. Wildflower strips can support insect pollinators increasing pollination in insect pollinated crops such as field beans and oilseed rape.

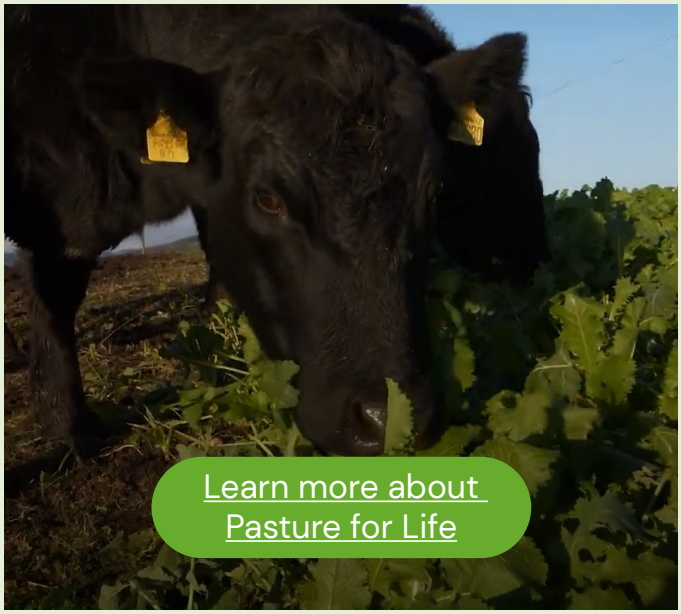
05 Integrate grazing livestock

Prior to the invention of inorganic fertilisers, the incorporation of livestock and their manures was a vital component of arable systems. It allowed farmers to replenish the nutrients and minerals removed during harvest. It was common to rotate between pasture and arable, providing a break period for the soils. Rising costs of fertilisers and increased focus on environmental sustainability has seen a return to more integrated farming systems. The integration of livestock returns nutrients into the soil and restores natural soil food webs and organic matter.

Arable farmers face a number of difficulties when it comes to livestock integration. They may have to learn about livestock husbandry and the wider supply chain. As a potential solution to this barrier, in England arable farmers can use the Carbon Dating website to find livestock farmers nearby who are looking for grazing land.

Livestock integration may also require significant investment to the farm infrastructure, for example, additional buildings may be required to house livestock and arable fields may not be stock proof or have watering points. Technology can help us overcome some of these obstacles, electric fencing or no fence collars can be used to stock proof fields and solar pumps can be used to provide alternative watering systems.[4]

Regenerative agriculture principles on farms in Scotland

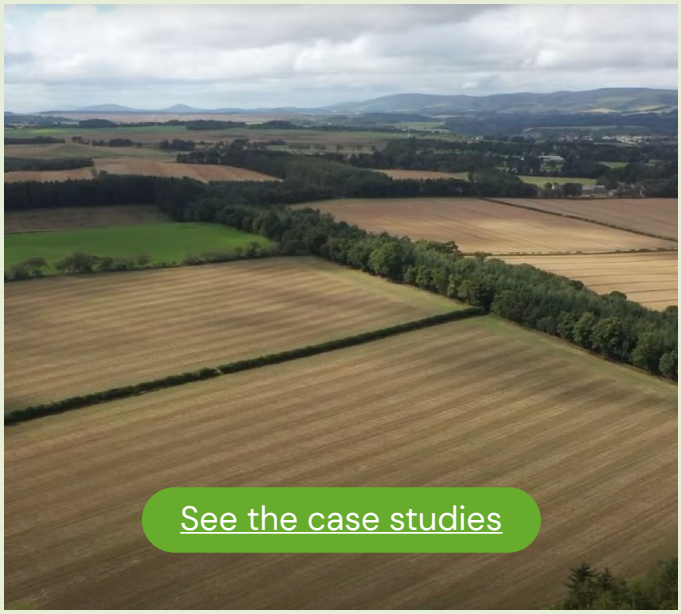


The integration of livestock into arable land has helped Balbirnie Home Farms move towards an exclusively pasture fed system. The team at Balbirnie are grazing their sheep on winter cereals returning minerals and nutrients to the soil and improving soil health.

Cattle are mob grazed on mixed forage, which gives their arable fields a break, enhances organic matter and reduces feed costs and workload. Gaining Pasture For Life certification has increased market value, which further increases profit margin.

Ensuring that you have a sustainable crop rotation plan is essential, however, looking wider and including space for biodiversity to thrive across your farm will optimise the benefits gained. At Preston Hall in Midlothian, the goal is to increase pollinators, natural enemies and biodiversity.

Preston Hall has created a diversity of different habitats both within fields (e.g. intercropping and cover crops) and throughout the farm (e.g. hedgerow restoration, buffer strip creation and flower-rich field margins).



SRDP Farm Advisory Service

The Farm Advisory Service followed six farmers who have explored alternative tillage management in their farm[5].

Further information

Rickson, R.J., Baggaley, N., Deeks, L.K., Graves, A., Hannam, J., Keay, C and Lilly, A. (2019). Developing a method to estimate the costs of soil erosion in high-risk Scottish catchments. Report to the Scottish Government. Available online from www.gov.scot/ISBN/978-1-83960-754-7

Farm Advisory Service - Practical Guide: multi-functional Hedgerows
www.fas.scot/downloads/hedgerows

Farm Advisory Service– Hedgerow Restoration and Management Video
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Ideas of how to introduce more biodiversity into your land:

Boosting biodiversity to build business: The flower field

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Exploring rural ecosystem services: 3D bufferstips

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[1] Recking, M. et al (2022) Diversification improves the performance of cereals in European cropping systems online https://pure.sruc.ac.uk/en/publications/diversifcation-improves-the-performance-of-cereals-in-european-cr

[2] Rickson, R.J., Baggaley, N., Deeks, L.K., Graves, A., Hannam, J., Keay, C and Lilly, A. (2019). Developing a method to estimate the costs of soil erosion in high-risk Scottish catchments. Report to the Scottish Government. Available online from https://www.gov.scot/ISBN/978-1-83960-754-7

[3] https://sefari.scot/sites/default/files/documents/Cole_Legumes%20SEFARI%20Briefing%20Report.pdf

[4] https://research.bangor.ac.uk/portal/files/38778608/REINTEGRATIONOFCROP_LIVESTOCKSYSTEMSINEUROPE_ANOVERVIEW1.pdf

[5] https://www.fas.scot/rural-business/crofts-small-farms/crops-soils-grasslands/soils/profiting-from-reducing-tillage-and-lowering-emissions-case-studies/

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