Regenerative agriculture – a valuable tool for the Bioeconomy

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Introduction

Developing a robust and sustainable bioeconomy on which society can rely will hinge on the long-term ability to source sustainable biomass. Debates relating to sustainable sources of biomass and the current uses of it have become common place in the press and within the scientific community. The fate of crops in particular is widely discussed and some critics argue that any crops grown for bioenergy or biofuel production displace crops grown for what can be considered as more urgent or crucial purposes (i.e. food and feed in the case of conventional cash crops, such as maize, cereals or beet).

However valid this argument may be, it relies on the assumption that land is used for growing crops for either food, feed, or energy in any one season, which provides a valuable insight into the widespread agricultural practices of today. Crop rotations and the practice of leaving land fallow over the winter periods have become the norm, which if not done effectively, can not only lead to soil degradation and nutrient depletion, but also negates more efficient methods which could optimise yields and crops diversity.

In this article, we discuss a range of conventional agricultural management practices and compare them with practices associated with **regenerative agriculture** – such as sequential cropping. Benefits of the latter within the bioeconomy context are assessed, including their potential for the co-production of crops for food, feed and energy on the same land without any displacement effects, along with a number other environmental, economic and social advantages. Finally, we will discuss existing support schemes designed to support farmers in their decision to adopt more sustainable farming practices such as cover cropping via sequential cropping.

Conventional and regenerative agricultural practices

Today's farming practices – geared towards maximising output – are often centred around a few core strategies which are designed to maximise production of cash crops. Basic **crop rotations** which include a minimum of two crop types grown on an area of land over a period of time are widely adopted; these typically comprise a range of winter sown and spring sown cash crops, to allow timely planting, harvest and natural pest or disease management where possible. In a basic crop rotation, maize would be grown from May to October during Year 1, then winter wheat would be sown on that same field in October and harvested during the summer of Year 2. Crops used in a crop rotation system are grown on the same field but not simultaneously. A rotation can extend over any period of time, typically ranging from 2 to 7 years, depending on the diversity of crop types included and market access.

Alternative production methods still adopted in parts of the UK or on farms where diversity of options is constrained, include crop rotations where a series of annual crops is grown on the same field across multiple years (with the land being left fallow over winter in some cases), or **double cropping**, which involves growing two cash crops consecutively within the same year, on the same field. Such practices, which often require a lot of chemical pest control or fertiliser use, can produce a lot of crops in a short amount of time, but can lead to soil damage, nutrient leaching, loss of biodiversity and long-term nutrient depletion in soils. From the perspective of such strategies, the production of crops for use as bioenergy or biofuel is indeed debatable as the advantages of using natural renewable resources may

not outweigh the disadvantages of using fossil fuels. However, some conventional practices may be modified to become less intensive and more mindful of sustainability and long-term approaches.

There can be endless variations of crop rotations, with some practices such as **intercropping** proving beneficial to soil health as well as boosting crop yield. This is the practice of growing two or more crops on the same field at the same time in a way that increases the yield on any given field by choosing crops that will complement each other in terms of resource usage and nutrient input. The main crop can be under-sown with a different species, so when the first (main) crop is harvested, the second grows providing cover and nutrition. The second, under-sown crop, is then known as a **cover crop** which will benefit the soil, biodiversity, and nutrition for further generations of main crops. Cover crops may also be planted on their own to protect soils during the summer or winter months, rather than leaving the land fallow.

Within the context of the bioeconomy, cover crops could also serve an additional purpose by becoming a source of biomass feedstock, without negatively impacting the ability of the same land to continue serving food and feed markets, as would traditionally be the case. Through our work, NNFCC has defined **sequential cropping** as the practice of growing two or more crops on the same field, one after the other, at different times in the year. Typically, this would involve a main crop grown for commercial purposes, and another crop used as cover in the winter or summer months which could be harvested and removed from the field rather than being incorporated into the soil at the end of the growing season. Sequential crops are also referred to as "energy cover crops" elsewhere in Europe, where the practice has become more widespread over the past few years. Crop rotations which include sequential crops are typically developed to span across a number of years (5 to 7 years), to account for delays in planting, longer growing seasons or bad weather conditions. In addition, sequential crops are often planted as a "multi-species mix", to maximise results (i.e. optimise soil protection and nutrient repletion).

Crop rotation and sequential cropping designs are tailorable, which makes the practice highly adaptable, and therefore, reliable in the long term. This could provide a steady stream of sustainable biomass for the bioeconomy and a stable income for farmers throughout the year, on a continual basis.

A farming business model that includes sequential cropping to produce biomass feedstocks can prove very valuable for the anaerobic digestion (AD) sector. AD currently provides the cheapest and most scalable source of renewable gas. It can directly substitute natural gas and be injected into existing gas infrastructure, making it readily usable by the industry. A recent study performed by the European Biogas Association (EBA) has revealed that regenerative agriculture and AD go hand-in-hand to create a virtuous circular system on farms, which benefits the wider community and the entire economy. First, crops destined to feed AD systems are grown in a way that benefit soils and the environment, and which reduce nutrient leaching and water degradation. Then, the resulting digestate produced by the AD process can be re-applied to soils to promote nutrient content, hence negating the need for chemical fertilisers. This results in an integrated system which produces clean gas while promoting ecosystem services and while not impacting the production of food on land. The report published by the EBA estimates that by 2030, the whole-system benefits of the AD biomethane sector in the EU could be valued between 38-78€ billion per year, outweighing current production costs and providing a strong financial incentive to further both regenerative agricultural practices and AD.

Incentives

To pave the way towards a Net Zero economy, EU-wide and UK-specific policies and strategies have (and are still) been introduced and revised. In particular, incentives to promote the production of bioenergy and biofuels have become an integral part of the push towards Net Zero. Naturally, this push to produce more sustainable goods is leading to an increase in feedstock demand, which increases

competition, highlights shortfalls, and sparks ethical debates on the best use of key biomass feedstocks. As such, it is crucial that the EU and the UK develop policies and strategies for the production and sourcing of "truly" sustainable feedstocks.

In the UK, England's Sustainable Farming Incentive (SFI) aims to provide financial support for activities that promote land management activities which deliver and sustain key ecosystem services. The SFI identifies a number of targets (i.e. activities) for which landowners can claim benefits against. Through those, farmers adopting cover cropping and sequential cropping within their rotations would be eligible to receive payments under SFI for the planting of "mixed species winter cover crops". As of the 2023 recast of the Incentive, farmers growing "non-horticultural permanent crops" such as short rotation coppice and Miscanthus may also receive payments under the SFI through an action incentivising the planting of "flower-rich grass margins or in-field strips". Additional funds can also be received for the monitoring and reporting of nutrient levels in soils, and to discourage the use of insecticides.

So far, Scotland and Wales do not have similar schemes, however both countries are preparing national frameworks of their own. Wales's Sustainable Farming Scheme is the most advanced of the two, with a launch date expected in 2025 and planned measures very similar to England's SFI where winter cover cropping would be incentivised. On the other hand, Scotland's scheme remains less close to implementation, with announced measures focusing mainly on carbon audits and soil nutrient monitoring.

In Northern Ireland, several farming support schemes are expected to be introduced in the coming years, including the Farm Sustainability Payment (to support farmers' transition towards sustainable practices by cushioning the financial blow), the Farming with Nature Package (which encourages replanting and rewilding on at-risk land), and the Soil Nutrient Scheme (promoting the monitoring and reporting of carbon stocks and nutrient content in soils). Similarly to the Scottish scheme, no direct support for cover cropping or sequential cropping seems planned, but payments could still be received for activities associated with the practice (i.e. nutrient content reporting and/or grassland management). Crucially, the Future Agricultural Policy for Northern Ireland seeks to empower the farming industry by promoting innovation and by considering all aspects of the sectors: other support schemes are aimed at the dairy and meat industry, as well as future farming generations and the promotion of innovative farming practices.

Conclusion

The adoption of tailored sustainable farming practices, which rely on a holistic understanding of local areas, holds a key to securing sustainable, reliable and longstanding sources of biomass feedstocks. Although it could be argued that current policies are not doing enough to incentivise such practices, there is still room for bespoke business models which fit existing legal requirements, to benefit from financial support which indirectly pay for regenerative agricultural practices.

In the short-term, the most direct use of sequential crop biomass is likely to be as feedstocks for bioenergy, via on-farm and larger-scale commercial AD sites particularly. However, in the longer-term, as energy production moves away from biomass towards electrification, the biobased products and chemicals sector could create significant demand for sustainable crop biomass, providing further financial stability for farmers. As such, pursuing the establishment of a robust biomass feedstock market, which hinges on sustainable farming practices, presents itself as a significant opportunity for the UK.

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