Biochar: A Practical Guide for Farmers

Purpose of Guide.

This guide is designed for farmers interested in the production or use of biochar. It aims to answer key questions, such as: 'What is biochar?', 'How is it applied?', and 'What options for biochar production and use are available to me?' By reading this guide, you will gain an understanding of biochar, discover its various uses, and learn practical ways to produce and apply biochar in your farming operations. The options outlined in this document are based on ideas from stakeholders within and beyond agriculture and from those with direct experience of producing and/or using biochar. Incorporating the perspectives and direct experiences of stakeholders—such as farmers, agricultural advisors, and farming organisations—not only builds trust between those developing biochar guidance and the farming community but also fosters innovation and ensures that the guidance reflects the practical needs of those most impacted by biochar.

What is biochar?

Biochar is a carbon-rich material made by heating natural plant materials to high temperatures with very little oxygen. This process is called pyrolysis. Biochar can be made from different types of plant-based materials, including wood, agricultural and forestry residues, and garden waste. When biochar is made, it stores the carbon from these materials, keeping it locked away for hundreds or even thousands of years.

What does biochar have to do with agriculture?

Agricultural land serves a dual purpose: it can provide biochar source materials such as biomass crops, wood and agricultural residues, while also acting as a location for the use of biochar. This can be for improved soil health, carbon storage, or biodiversity benefits. Biochar can also be potentially fed to livestock for health benefits and used in bedding to reduce ammonia emissions. It may also help with reducing runoff from fields.

Several voluntary biochar standards, including the European Biochar Certificate (EBC), specify maximum allowable levels of pollutants—such as heavy metals—for biochar used in agriculture. For biochar intended as animal feed, these standards are even more stringent, reflecting the higher safety requirements for animal consumption. Currently, in England, the Environment Agency (EA) restricts farmers to applying a maximum of 1 tonne of biochar per hectare within any 12-month period. At present, policy and regulation surrounding biochar remain limited. There are no public subsidies available for biochar, although both the Department for Environment, Food and Rural Affairs (Defra) and the Department for Energy Security and Net Zero (DESNZ) are actively exploring ways to support the use of biochar in agriculture.

How is biochar applied to land? Insights from farmers with direct experience

As biochar is a new technology for the agricultural sector, farmers are experimenting with its application to arable and pastureland. Biochar can be the size of woodchip or pellets. Farmers can apply biochar in different forms using standard agricultural equipment. When biochar is produced at woodchip size, it can be spread using a lime spreader, typically covering a width of up to 10 metres. If the biochar is pelleted, it can be distributed using a fertiliser spreader, which allows for a wider application, generally up to 24 metres. This flexibility enables farmers to choose the most suitable method and equipment based on the form of biochar available and the scale of application required.

Biochar options for farmers in the UK.

Research with stakeholders suggests that there are at least five main options for biochar production and/or use for farmers considering biochar. Each option is described below and illustrated with a quotation from a farmer. It is important to note that the options described below have not been fully costed, so farmers should consider the potential financial implications before making decisions.

A biochar producer sells biochar to farmers to add to soil for carbon storage.

A growing number of companies and local authorities produce biochar. They sell carbon credits in addition to the biochar they produce. These carbon credits do not get passed to farmers. The carbon credits are traded through companies such as Puro.earth and Carbon Futures and are sold to companies like Microsoft or British Airways. Farmland is viewed as a storage site for biochar for carbon removal. Many farmers believe they need to be paid for this as a 'public good' due to the costs of purchasing biochar and the spreading to land. Biochar currently costs between £400 and £1,000 per tonne.

"I think probably some financial incentive would benefit people if you really wanted to try and push the wider use of biochar. It feels like *that would need some financial support to do that*" (arable and horticulture farmer, England, trial farm in Biochar Demonstrator project).

On-farm biochar production: Diversifying income and sustainable practices.

Some farmers are already actively producing biochar either as individuals, or as collectives/clusters. They produce biochar on-farm either with a pyrolysis unit, an Exeter Retort or a Kon-Tiki Kiln. On-farm biochar production provides farmers with an additional income stream and supports diversification, although it does entail associated costs. By managing their own residues and waste materials, as well as purchasing similar materials from neighbouring farms, farmers can produce biochar and benefit from sustainable

practices. There are two income streams from biochar for farmers: 1) biochar can be sold to gardeners and potentially to farmers as a soil amendment; 2) biochar carbon credits can be sold through the voluntary carbon market.

"Carbon sequestration through afforestation, through biochar production and through peatland restoration have huge opportunities and I think that once farmers realise that there's an opportunity in carbon as well as food, they will realise that they have the tools to make money and to secure their business future" (livestock farmer, England, using biochar).

Biochar use: Enhancing farm resilience.
Farmers are already purchasing biochar from producers for a range of uses. They are interested in the potential benefits for improving soil health, managing ammonia emissions in cattle and poultry farming systems, and feeding biochar to animals for improved health. Farmers see the potential of biochar to increase the resilience of their farm businesses. When biochar is applied in combination with compost or digestate, it helps to retain nutrients in the soil and reduces their loss.

"But we've come to the conclusion now you need to blend your biochar with the compost or animal manure to activate it, and then when you apply that you get a much better result than just putting biochar or just animal manure on their own" (livestock farmer, Wales, producing their own biochar for their own use and for sale).

Supplying source materials to local biochar manufacturers.
Biochar source materials are kept local with farmers supplying local authorities such as Shropshire Council or other local biochar manufacturers including other farmers. The source materials are derived from on-farm wastes and are either agricultural residues such as straw, or residues from on-farm woodland or hedgerow management. Farmers receive an income from selling the source materials. There is the potential for a fair distribution of biochar benefits because production remains local and centralised systems are avoided.

"I think we have plenty of woodlands that aren't being managed that can generate significant feedstock to feed into it [biochar]" (arable farmer, England, not yet used biochar but interested).

Enhancing biodiversity on farms through biochar.
The management of hedgerows and woodlands for biochar feedstocks serves as a catalyst for enhancing on-farm biodiversity. Farmers actively manage hedgerows and woodland for biodiversity and improved habitat with the waste material being used for biochar source materials (used by the farmer themselves to produce biochar on farm or sold on to a local biochar producer including a local authority). Hedgerows can be managed differently with coppicing every ten or twenty years instead of trimming each year or every third year. Biochar may also have positive effects for below-ground biodiversity when added to soil. While the primary goal for farmers is to enhance soils for higher crop yields, some recognise

a potential simultaneous benefit for biodiversity. This may be relevant to schemes in which farmers are paid to deliver environmental benefits as a 'public good.'

"Biochar, the story that tells is that we're managing woodlands to encourage more biodiversity. Woodland needs managing just like anything else, but we can manage it for better habitat and therefore, there's a really good story behind biochar" (livestock farmer, England, not yet used biochar but interested).

Understanding stakeholder perspectives on biochar: Insights from Social Science research.

Since 2022, social science researchers on the UKRI-funded Biochar Demonstrator Project have actively engaged with a wide range of stakeholders to gather their views on biochar. This approach has been fundamental in shaping the guide, as it ensures that the hopes, concerns, and practical experiences of those most affected by biochar are at the forefront of its development to reflect real-world needs and perspectives. By engaging with a broad range of stakeholders, potential opportunities, challenges, and co-benefits can be identified that may not be immediately apparent from a purely scientific perspective.

Contact details.

If you have any questions about this resource or the Biochar Demonstrator project, please contact Dr Catherine Price via email at catherine.price@nottingham.ac.uk

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