

# In focus

A series of deep dives into AGCO Finance's whitepaper  
Farming for a better future.



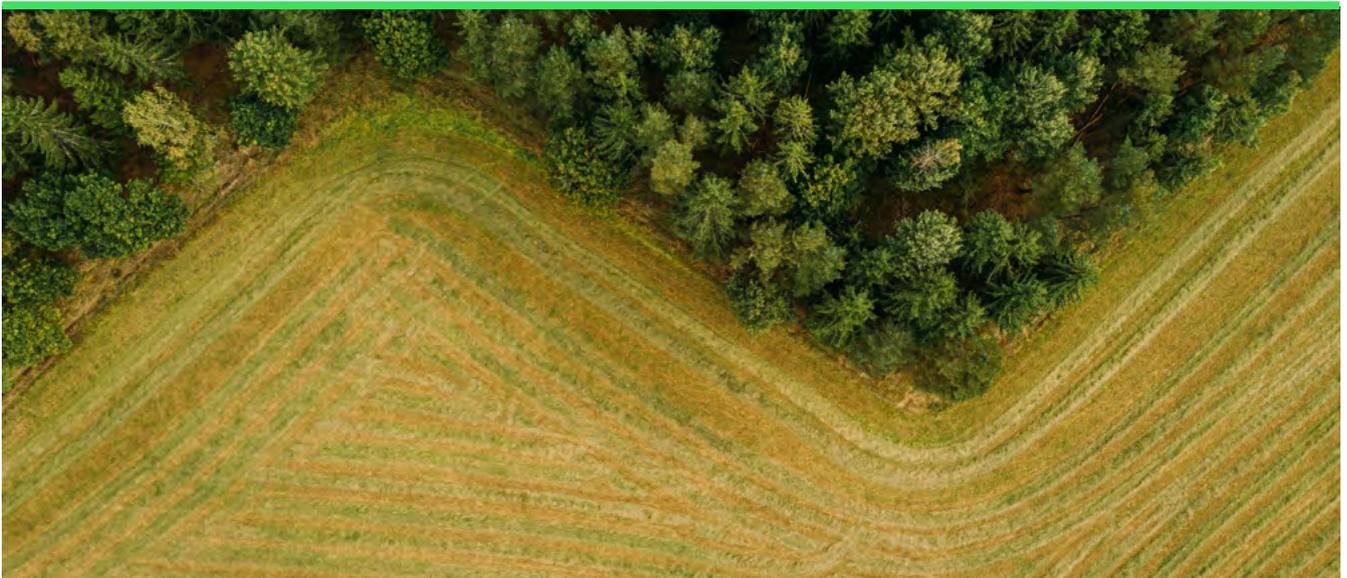
**Biochar: the bright future  
of an old technology**

## Introduction

In a past age, thousands of years ago, farmers in the Brazilian Amazonian forest utilized a 'dark earth' to enrich their soil and maximise crop yields in a challenging tropical soil environment. Known today as biochar, this carbon-rich material is being explored for its extensive properties which could help us deal with two of the biggest challenges in world agriculture today: enhancing soil fertility and mitigating climate change in a way that agriculture could provide the food needed for the ever growing and urbanizing populations sustainably.

Modern responses to growing demand for food have not been ideal. The excessive use of chemical fertilizer and pesticides to maximise yields have led to the lessening of soil fertility, nutrient imbalances, and emissions contributing to global warming.

Bluntly, these methods have depleted soil fertility and increased GHG emissions, when we know they must be cut. Presently, agricultural production contributes to an estimated 25% of total world greenhouse gas emissions.



## The oldest new thing you've never heard about

'Dark earth' or biochar results from the burning of biomass such as tree and crop residue, grasses, manures, agricultural waste and wastewater sludge at high temperatures under low oxygen conditions, a technology known as pyrolysis.

In a TED talk eight years ago, former manufacturing engineer Wae Nelson referred to biochar as 'the oldest new thing you've never heard about'. He extolled its qualities to store nutrients, water and micro-organisms, key ingredients to soil fertility, as well as its future role in storing carbon and mitigating climate change.

Not surprisingly, researchers are looking closely at this material to see what it actually does in the field. And reports have been largely promising, showing that it significantly enhances soil quality, crop yield, and soil carbon sequestration.

Drilling down, research shows that it enhances soil microbial activity and soil properties such as PH, bulk density, organic carbon and water holding capacity. And that it enhances soil nutrient bioavailability, cuts down on the leaching of nutrients and immobilizes toxic elements.

The potential value of using biochar is not just about maximising crop yields and soil fertility but also about enhancing agriculture's capacity to mitigate climate change, especially pertinent when we know that the world's soil is the largest terrestrial reservoir of carbon that we have. The top one meter is estimated to contain roughly double the amount held in the atmosphere. According to research, 12% of total man-made carbon emissions could be offset by shifting from slash and burn to slash and char.





## Soil health benefits of biochar

The ultimate goal of soil health is that it's fertile enough to deliver vital nutrients and water supply for plant growth without the need for toxic elements. This is especially a challenge in low fertile soils such as tropical rainforests, where the soil leaches nutrients in heavy rainfalls and has a low binding capacity. Biochar can help. A recent field study demonstrated the positive impact of wood-based biochar added with compost to tropical soils (sandy clay loam). By adding a high amount of the biochar and compost mix to the soil, they were able to lower the soil's bulk density by 16% and increase its porosity by 22%, increasing its ability to support plant growth and allow for roots to get through.

Further field studies showed that biochar application helped increase water holding capacity in sandy soil, acted as a binding agent in clayey soils, reduced soil alkalinity and upped the PH (potential of hydrogen), improving nutrient supply to plants. As well, biochar helped mitigate against the salt content in some soils, which was creating a low soil stability.

Cation Exchange Capacity (CEC) represents soil's capacity to retain positively-charged ions known as cations, leading to more soil fertility. A two-year study in tropical soil in East Java, Indonesia, demonstrated biochar's capacity to increase CEC. It was also shown to boost CEC in temperate, non-calcareous soils.

Tropical regions have to contend with heavy nutrient leaching in monsoon seasons. Here again, biochar can be a benefit. Indeed, field studies in varying regions including using maize-cob derived biochar in Zambia, rice husk biochar in India and wheat bran biochar in Italy, all produced positive results in which the biochar application increased nutrient retention.

## Biochar and crop productivity

Biochar has also been found effective in reducing contaminants in the soil such as a reduction of cadmium and lead by 67% and 69% respectively, demonstrated in one three-year study. It can also increase crop productivity especially in nutrient-deficient and degraded tropical soils, such as one study in the Philippines and Thailand showed. There, the application of rice-husk biochar improved crop productivity by 16-35%, due to enhanced water retention and the increased availability of K (potassium) and P (phosphorous). A thorough meta-analysis of biochar impact showed a 25% crop yield increase in tropical soils, whereas its impact on temperate regions was less dramatic. The studies, which show biochar improves crop yield significantly in more acidic, weathered soils, is highly important as more than 30% of the world's soil is acidic and can therefore expect to benefit.

As Wae Nelson said in his TEDx talk, biochar is indeed a 'marvellous material', ready to be exploited by farmers worldwide to try out this seemingly magical material to mitigate climate change and boost yields.

### Recommended Reading:

*Farming for a better future, AGCO Finance whitepaper, December 2021.*

*Vijat, V., et al, Review of Large-Scale Biochar Field-Trials for Soil Amendment and the Observed Influences on Crop Yield Variations, Frontiers in Energy Research, 30 August 2021.*

*Nelson, Wae, 'The oldest new thing you've never heard of', TEDxOrlando, 2013.*