

Biochar: A Green Revolution in Forestry

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ABSTRACT

Biochar, a carbon-rich product derived from pyrolyzed organic materials has gained attention for its role in sustainable forestry. It enhances soil properties, sequesters carbon and mitigates climate change. Biochar improves forest productivity by increasing nutrient retention, water holding capacity and reducing greenhouse gas emissions. It also aids in waste management by converting forest residues into valuable resources. Its applications in forest restoration and carbon sequestration make it a critical tool for sustainable forestry practices. This article explores the production, properties and benefits of biochar in forestry management.

INTRODUCTION

What is Biochar?

Biochar is a carbon-rich product obtained through the process of pyrolysis—the thermal decomposition of organic material, such as plant residues and wood debris in the absence of oxygen. This

process leaves behind a fine-grained, porous material that has incredible benefits when applied to the soil. Biochar can be made from various biomass sources including tree branches, grasses, agricultural waste and even industrial by-products.

Importance of Biochar in Forestry

The application of biochar in forestry holds immense potential both from an environmental and an economic perspective. Here are some key areas where biochar shines:

- 1. Enhancing Soil Quality:** Forests, particularly degraded and deforested areas often suffer from poor soil quality. Biochar acts as a soil amendment, improving the physical, chemical and biological properties of the soil. Its porous structure helps retain water, improve soil aeration and facilitate nutrient retention leading to healthier and more productive forests. One of biochar's key benefits is its ability to enhance nutrient-use efficiency. It improves the soil's cation exchange capacity (CEC), enabling it to hold onto essential nutrients like nitrogen, phosphorus and potassium for longer periods. This reduces the need for chemical fertilizers which can be costly and harmful to the environment (Joseph, 2012)
- 2. Carbon Sequestration:** Forestry is increasingly viewed as a frontline solution for mitigating climate change, and biochar plays a crucial role in this effort. Biochar is a stable form of carbon that remains in the soil for centuries. By converting plant biomass into biochar, we can lock carbon into the soil, thereby reducing atmospheric carbon dioxide (CO₂) levels. According to studies, diverting just 1 per cent of annual plant biomass into biochar could help offset nearly 10 per cent of human-caused carbon emissions. This makes biochar an essential tool in the global fight against climate change, especially for forest-rich regions (Lehmann *et al.*, 2006)
- 3. Forest Restoration and Management:** In forest restoration projects, particularly in areas prone to wildfires or where deforestation has left large amounts of woody biomass, biochar can be produced from forest waste. Instead of leaving behind waste that could fuel wildfires, this biomass can be converted into valuable biochar. This not only helps manage forest waste but also turns it into a product that enhances soil fertility and promotes tree growth. For example, in the United States, biochar production from woody biomass has been successfully implemented in forest restoration projects. This approach not only generates revenue from biochar sales but also contributes to sustainable forest management practices (Apostol *et al.*, 2017).
- 4. Improving Tree Growth and Productivity:** Research has shown that biochar can boost tree growth and forest productivity. In an oak forest study, biochar applications led to a 22 per cent increase in tree growth over a three-year period. In Eucalyptus plantations, biochar applied at 10-15 tons per hectare combined with reduced fertilizer use resulted in tree growth comparable to full fertilizer application. This suggests that biochar can be an effective tool for improving forest productivity while reducing reliance on chemical fertilizers (Ohtsuka *et al.*, 2021).
- 5. Waste-to-Wealth Opportunity:** Biochar represents a sustainable way to convert organic waste into a valuable product. In forested areas, where wood waste and other plant residues accumulate, biochar production provides a way to turn this waste into wealth. This is particularly important in rural and forest-dependent communities, where biochar production can create new economic opportunities.
- 6. Mitigating Climate Change:** Beyond its role in carbon sequestration, biochar helps reduce emissions of other greenhouse gases. Studies have shown that biochar can reduce methane (CH₄) and nitrous oxide (N₂O) emissions from soil both of

which are potent greenhouse gases. When used in forest soils biochar not only stores carbon but also reduces the overall carbon footprint of forestry practices.

CONCLUSION

Biochar is a powerful tool that holds immense promise for the future of forestry. Its ability to improve soil health, sequester carbon, manage forest waste and enhance tree growth makes it a valuable asset in sustainable forest management. As we face the dual challenges of climate change and deforestation, biochar offers a practical and eco-friendly solution that can help create resilient forests for future generations. The potential of biochar in forestry is just beginning to be realized. By incorporating biochar into reforestation projects, forest management and climate change mitigation strategies, we can pave the way for a greener, more sustainable future.

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