

# ROLE OF BIO-CHAR IN PROMOTING CIRCULAR ECONOMY IN THE AGRICULTURE SECTOR

Anjali Mishra

## Introduction

The ever-increasing temperature of our planet has led many of us to seriously look into the problem that we are facing because of anthropogenic activities such as the burning of fossil fuels at a pace that we'll be exhausting it soon, industrial smoke, deforestation, and last but not least the natural process of respiration done by every breathing organism on this planet.

All these activities have one thing in common and that is the release of carbon dioxide into the atmosphere. The carbon released is usually absorbed by plants that change it into oxygen via photosynthesis but when we are talking about carbon emission at a massive scale the plants are unable to absorb at such a large scale in a short period. Hence this either results in the carbon staying in the atmosphere or it sinks in the ocean. Either way, it is damaging as when the carbon sinks in the ocean it makes the ocean

acidic which ultimately affects the flora and fauna of the ocean as they are unable to handle the acidification causing majority of them to die and when it is maintained in the atmosphere it results in warming up of the planet which causes melting of the glaciers, drought, crop loss, un-survivable living conditions and long summer season.

To help tackle problems associated with global warming we are in dire need of finding ways to sequester carbon one way or another. A possible solution that seems promising in mitigating all the problems related to the sequestration of carbon is "Bio-char". It has received an intense amount of attention scientists from past few decades due to its eco-friendly nature and versatile use in biomedical, agricultural and industrial sector as biofuel, catalyst, adsorbent, soil conditioner and a stable carbon.



The picture shows Biochar made from different feedstocks.

## What is Biochar and why the hype?

Biochar is charcoal made up of biomass with the process of pyrolysis. Biochar in absence of oxygen can be made from any biological material that used to be alive like logs of wood, bones, sunflower stalks, sugarcane bagasse, rice husk, corn stover, etc at around 300-700 Degree Celsius. Every bit of the materials containing cellulose, lignin, and other non-carbon materials vaporize and are consumed with extreme heat leaving behind a porous black structure that makes a clinking sound when smashed or brushed against each other. This left behind black mass possesses a great capacity to reduce the environmental impact of global warming by capturing harmful carbon-dioxide gas. Most areas where Biochar can be made use

of is in and as activated carbon helping sequester carbon and nutrients in agriculture. Although Biochar has received quite recognition in recent decades it is, however, quite an old concept. The very first shreds of evidence of the use of Biochar are from the Pre-Colombian era by the Amazonians by burning agricultural wastes in pits or kilns and adding it soil. It is commonly known as Terra Preta (roughly translated into black soil) as most of the tropical soil is poor in nutrients and minerals which is only suitable for the growth of rich rainforests with help of good sunlight as well as a prosperous amount of rainfall which had led to Amazonians developing the man-made fertile soil with help of Bio-char.



The picture above shows (left: the man-made soil by use of Biochar) and (right: normal tropical soil of Amazon rainforest).

Recently, Biochar has been widely used as a versatile material for various applications in agriculture and environmental allied sectors. It has proved to be an effective tool to economically sequester carbon, minimize waste production, and escalate the performance in the circular economy. Its unique property to lock carbon for hundreds of years is what makes it so valuable and useful. Every year we burn a billion tonnes of biomass be it in form of crop residues, fallen/damaged trees, etc. which produces an intense amount of smoke containing various greenhouse gases such as methane, nitrous oxide along with carbon dioxide and sulphur oxide which harms our planet as



well as our lungs. If instead of open burning, we use this waste in process of making Biochar it will hardly produce any kind of smoke in comparison to when it wreaked havoc whilst open burning. Every year around winter we face intense pollution with a heavy amount of smog-causing difficulty invisibility as well as breathing farmers can easily adapt the process of making Biochar out of the crop waste it will prove to be beneficial for both farmers as well as environment.

## Advantages of Biochar

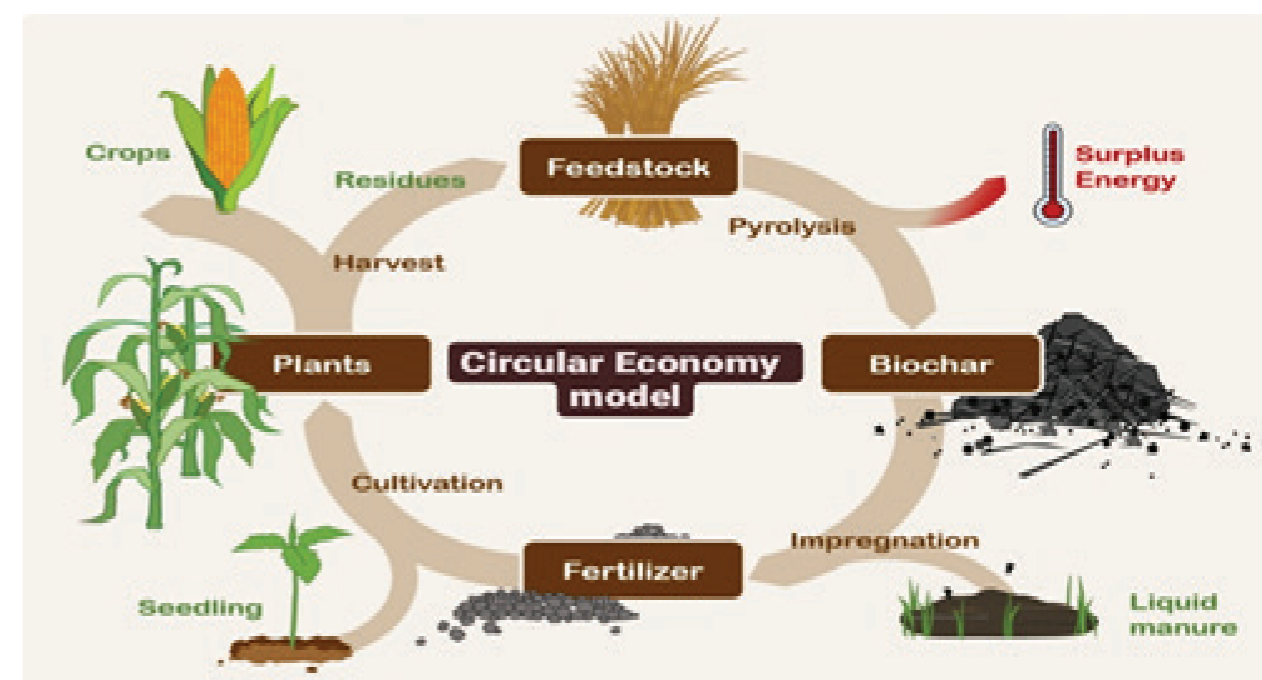


The picture above shows the comparison between the yield of the crop in two different soil conditions. (Left: plain compost soil) & (right: compost with Biochar).

Biochar is an asset for farmers as well as environmentalists. It is also known as “Black Gold” because of the reasons listed below:

- Improves texture of the soil.
- Makes the soil more fertile.
- Better yield.
- Improves the water retention of the soil.
- Locks the carbon and other nutrients into the soil.
- Promotes growth of soil microbes.
- Enriches soil's flora and fauna.
- Makes the soil less acidic.
- Removes toxins from the soil.
- Helps in carbon sequestration.
- Economical.
- Promotes better seed generation.
- Converts bad into rich soil.
- Makes the soil fit for agricultural purposes.
- Stronger root grip.

And an infinite number of other purposes concerning soil enrichment!



The picture depicts the circular model of Bio-char use.

## Role in promoting circular economy.

Like many other sectors which have started adopting the circular economy model, the agricultural sector has also witnessed a shift from the linear economy to the circular economy. The transition from linear to the circular economy is tough but not unfeasible and it is also the need of the hour since we are using too much, too fast without thinking of the consequences that we will have to face. We as an individual can help society become circular by inventing technologies and materials to be able to use the raw materials and the final product in a loop till it wears off to the extent of not being able to use again. The whole concept of the circular economy revolves around doing much more, with much less to reduce the burden and curb the resource demands. One such promising material which is sustainable and helps promote circularity in the agriculture sector is Bio-char. Biochar can be used for agricultural and environmental purposes which can promote the trend of the circular economy. From numerous studies and experiments done on the effects of Biochar on soil, we have finally concluded that

Biochar could act as a soil amendment that could lessen the use of harmful chemical fertilizers and pesticides, double the recoverable energy, close the nutrient recycle loop, and ensure cleaner agricultural production. Enriched Biochar helps in slowing down mineralization and release the adsorbed nutrients in the short term.

Endures soil fertility for a longer term as it keeps holding the organic matter and moderately releases micro as well as macronutrients into the soil. This indicates the potential of Biochar as an effective and economical alternative for chemical fertilizers and promotes the circular economy concept.

The application of Biochar has a massive positive impact on soil microbes residing in the soil prominently because of the porous structure of it which acts as a shelter for these microorganisms to reside in.

It affects the microbial activity in soil and biomass, enhances their biomass in soil along with enzymatic activities, and reshapes the microbial biome. Bio-char-microbe interaction

mechanism is led by microbial community modification by Biochar, via alteration of nutrient availability and soil characters, and the electron transfer between microbial cells and contaminants facilitated by Bio-char. These microbial activities including nitrogen-fixing and phosphorus solubilizing bacteria are helpful in the reduction of the use of NPK fertilizers. Biochar itself can represent a source of several nutrients (N-NO<sub>3</sub><sup>-</sup>, P, K, Fe, Zn, Mn) thus potentially reducing the usage of fertilizers and acting as a suitable alternative for growing media such as peat moss, coir, and perlite due to its characteristics such as increased cation exchange capacity, cost-effectiveness, high water & nutrient holding capacity, environment-friendly, and easy availability.

Usage of Biochar generally has constructive effects on crop growth and yield as it helps in improving the texture and quality of the soil. often it has been noticed that the application of Biochar helps in the reclamation of acidic soils by increasing PH. Its application in the most cultivated crops such as maize, wheat, rice, and legume crops increased their productivity.

Biochar can influence nutrient accessibility in soils because of its high surface area and the event of a few and heterogeneous surface practical gatherings influencing adsorption, surface complexation, and ligand trade responses, which eventually control the plant-accessible supplements in soils. Even the process of making Biochar can produce a large amount of heat energy which can be used for all sorts of purposes.

All these benefits of Biochar can be summed up together in a way to sustainably run agriculture and allied activities and collaborate with other programmes and projects where use of Biochar could prove to be beneficial and helpful in attaining sustainable development goals.

