

## Biochar: An alternative method for stubble burning

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### Introduction

Stubble burning is a prominent anthropogenic activity that emits a substantial amount of gaseous and particulate pollutants having serious health and environmental repercussions. The cut stalks of crop plants, particularly cereals, that are left on the field after the grains have been harvested are known as stubbles. Farmers intentionally burn stubbles after harvesting crops. Globally stubble burning accounts for around a quarter of all biomass burning. The suffocating haze seen over South Asia during the winter has been related to stubble burning. In many countries especially India, pollution from haze and fog induced by numerous anthropogenic activities, as well as lower temperatures throughout the winter, specifically during the months of November and December, have been a problem in New Delhi and other National Capital Region (NCR) cities.

In Indo-Gangetic plains, the common farming system is rice-wheat rotation system and farmers of this region harvest their crops by combine harvesters as this machine combines operations like reaping, threshing, and winnowing into a single operation. However harvesting by such machinery generates tonnes of stubbles consisting of stalks of about 15 cm length, which are challenging to be incorporated into the soil and thus is being burned in field. Estimates of the Indian Agricultural Research Institute (IARI) show about 63.6 per cent of total the rice stubble produced yearly in India is intentionally incinerated by farmers. Punjab and Haryana alone contribute for 48per cent to this amount. Farmers lack enough time for proper management of stubbles, especially after rice harvesting, as the average time interval between harvesting of rice and sowing of wheat is about two weeks, and thus becomes the reasons for burning of crops by farmers.

Burning of stubbles releases a significant amount of carbon monoxide, carbon dioxide, Sulfur dioxide, nitrous oxide and methane, all of which severely affect human health. Among these pollutants the carbon dioxide is the one of the major contributes to green house



effect and its concentration is steadily increasing in day to day life. It was 280ppm in preindustrial times, and now increased up to 415ppm. Carbon dioxide being the most oxidized and thermodynamically very stable form of carbon does not easily transform into other compound. Collecting and storing it may be the only practical option for getting rid of it. The oceans are the prime source of sink for carbon dioxide emissions, however carbon dioxide makes the oceans to become more acidic and due to which marine ecosystems get affected. Terrestrial sinks of carbon sequestration also known as biological sources of sequestration are forests and soil conservation practices significantly improving the storage of carbon, However, a very small amounts of carbon is sequestered by such sinks the and thus a high level of carbon dioxide is being maintained in the atmosphere resulting in warming up of the planet which causes melting of the glaciers, drought, crop loss, un-survivable living conditions. To help tackle problems associated with stubble burning we are in dire need of finding alternatives to stubble burning and to sequester huge amounts of carbon one way or another. Among the best possible alternatives Bio char seems promising in mitigating all the problems related to the Stubble burning. It has earned a lot of attention from scientists in recent decades because of its environmentally friendly characteristics and several applications in the biomedical, agricultural, and industrial sectors as a bio-fuel, catalyst, adsorbent, soil conditioner, and a stable carbon.

## **1. Consequences of stubble burning**

### **1.1. Air quality deterioration**

Stubble burning releases gaseous pollutants and harmful particulate matter which being too light weight stays in air causes smog and move along distances with wind. Rice stubble burning accounts for over 40per cent of all stubble burning related emissions, while sugarcane and wheat stubble burning account for 20per cent and 22per cent , respectively leading to deterioration of air Quality.

### **1.2. Health hazard**

Stubble burning adds to the release of dangerous air contaminants, having serious health impacts. Vertigo, shortness of breath, nausea, irritation in eyes, headaches, bronchitis, asthma, blood cancer, aplastic anaemia, bone marrow illness have all been linked to consequences of stubble burning. The farmers associated with burning get exposed to stubble

smoke and suffer serious health issues and have to spend a significant amount of money on treatment.

### **1.3. Depletion in Soil quality and fertility**

Stubble burning raises soil temperature which decreases beneficial microbes, alters soil ecology, which leads to the reduction in organic matter of the soil. Stubble burning depletes soil of macro as well as micronutrients. Each year burning of rice stubble results in losses of huge amounts of almost 0.445 Mt of nutrients.

### **1.4. Climate change**

Carbon dioxide and Methane emitted during stubble burning directly impacts weather and climate as they are the major greenhouse gases and their increased emissions in atmosphere leads to global warming and an overall change in climate. The agricultural industry accounts for 17 percent to 32 percent of global annual greenhouse gas emissions.

### **1.5. Loss of economy**

Besides the negative impacts on the environment, air pollution also strikes down the country's economic growth. According to the estimates of World Bank, pollution of air costs the world economy \$225 billion almost every year, with the majority of this coming from developing countries.

## **2. Bio-char**

Bio-char is a stable, carbon-rich, and persistent product of crop stubbles used by farmers to improve the health and quality of soil. Bio-char is generated from the crop stubbles by combustion, torrefaction, gasification or pyrolysis. Among different treatments pyrolysis is the most favored, simple and effective technique. Pyrolysis occurs in a furnace, under oxygen-deficient conditions. Bio-char is proven to be potentially successful in enhancing carbon sequestration by soil, increasing crop productivity, reducing leaching of nutrients, and mitigating greenhouse gas emissions. Thus, the bio-char produced from agricultural stubble instead of burning is a viable and sustainable way of management of stubbles and reducing the harmful consequences of stubble burning.

### **2.1 Biochar as an alternative to stubble burning**

Biochar is an excellent alternative to reduce and address the problems related to waste generation and its burning in many ways. Some important ways are:-



- The massive amounts of rice and wheat stubbles produced in India's Punjab and Haryana region could be pyrolyzed into bio char. This is cost-effective technique and will also benefit the environment and makes garbage valuable.
- Bio-char has high carbon content, large surface area, ability to improve soil porosity, rhizospheric microbial population, soil water retention capacity and the overall soil health and soil fertility thereby making it a better soil conditioner. Bio-char also reduces leaching losses by enhancing soils cation exchange capacity. Moreover, bio char being alkaline helps to neutralize acidic soils and thereby enhances plant productivity.
- Bio char is a potential source for carbon sequestration and thus plays a key role to potentially deal with the menace of climate change. The large amounts of carbon in stubbles is converted to a more stable form when pyrolyzed to form bio char and thus reducing carbon dioxide levels in atmosphere. Thus, bio char prepared from paddy and wheat straw will be an effective strategy for properly managing crop residues in Punjab and Haryana region.
- Emissions released during biomass pyrolysis are collected and condensed into bio-oil, which can be a potential bio-energy source. Bio-oil would be a viable alternative to fossil fuels, resulting in decreased carbon emissions.
- Bio char, an innovative carbonaceous material is highly potent sorbent for removing organic as well as inorganic contaminants that include heavy metals, from the water and soil, and thus can be used in bio-remediation. Bio char being a better source of soil conditioner as well as soil amendment helps maintain the nutrient cycle, reduces the cost of fertilizers, pesticides and helps us achieving sustainable goals and thus promote circular economy.

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