

STUBBLE BURNING: A MAJOR CAUSE FOR AIR POLLUTION

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India being an agrarian country generates a large quantity of agricultural wastes. Every year large quantities of crop residues are generated, in the form of cereal straws, woody stalks, and sugarcane leaves during harvest periods. Some portion of these residues are used as animal feed, thatching for rural homes, residential cooking fuel and industrial fuel. However, a major portion of the crop residues is not utilized and left in the fields. The disposal of such a large amount of crop residues is a major challenge. To clear the field rapidly and inexpensively and allow tillage practices easily, the crop residues are burned *in situ*. Farmers opt for burning because it is a quick and easy way to manage the large quantities of crop residues and prepare the field for the next crop well in time. Farmers especially in the northern belt of India, practice stubble burning to utilize the period left between two growing seasons for growing leafy vegetables to encash higher economic returns. Stubble burning is the deliberate setting fire to the straw stubble that remains after paddy, wheat, and other grains have been harvested. Stubble is nothing but the left-over crop residue. It is the biomass produced as by-products from harvesting and processing of agricultural crops. In north India, stubble burning is a practice of removing paddy crop residues from the field for sowing next crop viz. wheat. Where 'combine harvesting' method is applied and their Stubble burning becomes essential because combine harvester leaves crop residue behind. These residues put a burden on farmers back because these residues are not so useful for the farmer and there is pressure on the farmer to sow the next crop in time. Therefore, they clear the field by burning the stubble. Stubble burning is a global phenomenon and can be an important contributor to poor air quality worldwide. This practice was widely carried out across the world until well into the 1990s, until most governments outlawed it, including ours.

Stubble burning contribute towards the emission of greenhouse gases (CO₂, N₂O, CH₄), air pollutants like (CO, NH₃, NO_x, SO₂, NMHC, volatile organic compounds), particulates matter and smoke thereby posing threat to human health. Stubble burning not only

leads to pollution but also results in loss of nutrients present in the residues as well as in the soil. The entire amount of C, approximately 80–90% N, 25% of P, 20% of K, and 50% of S present in crop residues are lost in the form of various gaseous and particulate matters, resulting in atmospheric pollution. According to different studies, the residues of paddy and wheat crops are major contributors to the total stubble loads in India. In India, about 2.5 million farmers in the Indo-Gangetic plains grow two crops a year—paddy and wheat. Paddy is planted in such a way that its water requirements are met from the monsoon rain, and the fields are cleared within a short period of 10 to 20 days, for the cultivation of wheat. A convenient and easy way to get rid of grass and hay left behind by paddy cultivation is to burn them. However, this practice contributes to air pollution in cities like Delhi, where the air quality is the worst of any major city in the world.

Stubble burning in India

India, with 17 percent of the world population and an agrarian background generates large volumes of food grains such as rice and wheat for domestic consumption as well as for export. According to the Directorate of Economics and Statistics, in 2017–2018, India generated 99.7 Mt of wheat and 112.9 Mt of rice. Of the various crops grown, mostly crop residue of rice, wheat and sugarcane are being burnt.

Jain *et al.* and the Intergovernmental Panel on Climate Change (IPCC) found that the highest contribution of residue burned on the farm is from the states of Uttar Pradesh, followed by Punjab and Haryana. According to IPCC, over 25 percent of the total crop residues were burnt on the farm. Jain *et al.* also reported that the amount of crop residue burned ranged from 8–80 percent for paddy waste across all states. Among different crop residues, the major contribution was 43 percent of rice, followed by wheat around 21 percent, sugarcane 19 percent and oilseed crops around 5 percent.

The Ministry of Agriculture attributes the increase in on-farm crop residue burning is due to a shortage of human labor. Saini *et al.* (2014) observed that 80 percent of the crop residue burning took place during the post-harvest period of April-May and November-December. The reason behind this stubble burning is the cropping patterns used to ensure higher economic returns which leave limited time between two crop cultivations. Some farmers even grow three crops a year with a short gap between harvesting and sowing.

On December 10, 2015, the National Green Tribunal (NGT) had banned stubble burning in the states of Haryana, Punjab, Uttar Pradesh, and Rajasthan. As per section 188 of the IPC and Air and Pollution Control Act of 1981 crop residue burning is a crime. However, there is a lack of strength in its implementation from the government side. The Delhi high court had also ordered against burning residues, while the Punjab government imposed a penalty of Rs 73.2 lakh farmers in 2016 for the burning of crop residue. Although the actual amount of fines charged was not available; farmers continue to burn residues every season — this making both the soil and air poisonous. In addition to wheat and paddy, sugarcane leaves are most commonly burnt. According to an official report, more than 500 million tonnes of crop residues are produced annually in the country, among these cereal crops (rice, wheat, maize, and millets) account for 70 percent of the total crop residue. Of this, 34 percent comes from rice and 22 percent from wheat crops, most of which is burnt on the farm. According to an estimate, every year Punjab alone produces around 23 million tonnes of paddy straw and 17 million tonnes of wheat straw annually of which 80 % of paddy straw (18.4 million tonnes) and almost 50 % wheat straw (8.5 million tonnes) produced in the state is being burnt in fields. Almost whole of paddy straw, except Basmati rice, is burnt in the field to enable early sowing of next crop.

Instead of burning the stubble, it can be used as feed for animals, as bedding material for animals, as compost manure, for roofing in rural areas, biomass energy, bio-thermal power plants mushroom cultivation, packing materials, fuel, paper, bio-ethanol, and industrial production, etc.

Environmental and health risk

A study estimates that crop residue burning released 149.24 million tonnes of carbon dioxide, over 9 million tonnes of carbon monoxide, 0.25 million tonnes of oxides of Sulphur, 1.28 million tonnes of particulate matter and 0.07 million tonnes of black carbon. These pollutants are directly contributing to environmental pollution, and are also responsible for the melting of Himalayan glaciers and for the haze in Delhi. The heat resulting from burning paddy straw penetrates 1 centimeter deep into the soil, elevating the temperature to 33.8 to 42.2 degrees Celsius. This heat resulting from stubble burning kills the bacterial and fungal populations which are essential for fertile soil. Stubble burning also causes damage to other micro-organisms which are a friendly pest that is present in the upper layer of the soil as well as its organic quality. Due to the loss of these ‘friendly’ pests, the wrath of ‘enemy’ pests has

increased and because of this crops are more prone to diseases. The soluble capacity of the upper layers of soil also decreases. According to a report, one tonne of stubble burning leads to a loss of 5.5-kilogram nitrogen, 2.3 kg phosphorus, 25 kg potassium and more than 1 kg of Sulphur and all soil nutrients, besides organic carbon. Burning leads to a rise in ground temperature, as a result, the soil dries up, necessitating additional water for irrigation. Livestock, too, is impacted by crop burning. It has been found that milk production falls up to 50% during the two months of stubble burning.

A study conducted by Gupta in 2016 showed that 84.5 percent of people were suffering from health problems due to the increased incidence of smog. 76.8 percent of people expressed irritation in eyes, 44.8 percent noted irritation in the nose, and 45.5 percent reported irritation in the throat. Another study by the Institute for Social and Economic Change, Bengaluru, founded that every year in rural Punjab people spends Rs 7.6 crore on treatment for ailments caused by stubble burning. During 2017 one in eight deaths in India was due to air pollution, which contributes to more disease burden than tobacco use. The practice of stubble burning around October raises the concentration of particulate matter (PM) in the air to 1,000 micrograms per cubic meter.

This particulate pollution in Delhi's air spikes 20 times above safe levels (World Health Organization). Every year September and October happen to be the time when acute respiratory infections peak in North India. The risk of getting a respiratory infection goes up by thrice as much as any other time of the year.

Alternatives to stubble burning

1. Farmers can manage crop residues effectively by employing agricultural machines like:

- Happy Seeder (used for sowing of the crop in standing stubble)
- Zero till seed drill (used for land preparations directly sowing of seeds in the previous crop stubble)
- Baler (used for the collection of straw and making bales of the paddy stubble)
- Rotavator (used for land preparation and incorporation of crop stubble in the soil)
- Paddy Straw Chopper (cutting of paddy stubble for easily mixing with the soil)
- Reaper Binder (used for harvesting paddy stubble and making into bundles)

2. Technological Interventions like:

- Retention of Crop Residue as Mulch and Incorporation of in soil.
- Use of crop residue for compost/vermicompost/FYM.
- Crop residue utilization for Mushroom Cultivation.
- Incentivize the purchase of improved machinery to ensure minimum leftover of crop residue.
- Promotion of Custom Hiring/ Agriculture Service Centers.
- Improvement in combine harvester for In-situ management and other mechanisms for collection of crop residue.
- The government should Involve or invite benefiting industries like the cement industry to collaborate in husk/hull or stubble collection to use it proficiently.
- Inviting packaging industries to collect stubble to make packaging boxes that are more environmentally friendly than other non-disposable materials like thermocouple and plastic.

3. Diversified Uses of Crop Residue:

- Use in Power Generation, production of cellulosic ethanol in PPP mode.
- Use of Crop Residue for paper/board/panel and packing material.
- Promotion of collection of crop residue for feed bricks making and its transport to fodder deficient areas.
- Decomposing stubble in the farm field and turning it into useful manure.

Conclusion

Stubble burning is a hot topic at the present time, especially during a time of wheat and rice harvesting. There is no doubt that smoke from burning crop residues affects people's health, road safety, and the environment. Therefore, farmers need to be educated about the ill-effects of crop burning and proper monitoring and regulations should be enforced through government policies. It is the farmer's responsibility to ensure that burning is conducted legally and safely and that the smoke does not cause problems that type of knowledge and awareness is required. Awareness about the negative impacts of stubble burning and the importance of crop residues incorporation in the soil must be created among the farming communities for maintaining sustainable agricultural productivity. An all-round aggressive approach is needed on behalf of the government, scientists, and farmers in the form of adoption of 'straw management technologies.

Reference

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