

Crop Residue burning and its harmful Impacts: A review

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Introduction

India has 17% of the world's population but just 2% of the world's land area, thus intense agriculture is used to feed such a large population with limited land and resources. In the green revolution belt of Punjab, Haryana, and western Uttar Pradesh, a significant transition in farming systems occurred from conventional crops like as maize, pearl millet, pulses, and oilseeds to rice-wheat cropping systems. Rice Wheat Cropping System (RWS) is one of the most widely practised cropping systems in India, according to Janaiah and Hossain (2003), with roughly 90% of the land concentrated in the Indo-Gangetic Plains (IGP). The introduction of rice- wheat cropping system became the cause of reduction of crop diversification which resulted in the high incidence of diseases and insect pest (Sidhu et al. 2007). As a result of monoculture and intense farming, a large volume of agricultural residue is generated, estimated to be approximately 500 million tonnes (MT), with cereals accounting for 70% of the total (rice, wheat, maize, millets), according to Ministry of New and Renewable Energy (2009) and IARI (2012).

The practice was widespread after the 1990s, when mechanization of agriculture was taking momentum then governments also put restrictions of stubble burning. Despite of restrictions it is being followed in mostly rice wheat growing belt of India that is U.P, Punjab and Haryana. When it comes to crop residue production, Uttar Pradesh ranks top with 59.97MT, followed by Punjab 50.75MT, Maharashtra 46.45MT, and Haryana



27.83MT; however, when it comes to residue burning, Punjab ranks first with 19.65MT, followed by U.P. 11.92MT. Farmers burn these residuals on the field throughout the months of October and November due to a shortage of time between harvesting and planting the following crop. Rice straw burning is prevalent in India's northwestern states, resulting in nutritional losses and significant air quality issues that endanger human health and safety. Farmers see it as a benefit to the land, yet there are several disadvantages to open-field fire. The pollution generated during the burning process is perhaps the topic that has gotten the most attention in recent years. On a local, regional, and global scale, crop residue burning is one of the leading sources of land, air pollution. The heat generated by the burning of straw penetrates the soil, causing a loss of moisture, the death of beneficial microorganisms, and consequently a negative impact on the soil. Burning agriculture leftovers causes a slew of difficulties for the environment. Crop residue burning has a number of negative consequences, including the release of greenhouse gases (GHGs), higher levels of particulate matter (PM) and smog, loss of biodiversity in agricultural fields, and deterioration of soil fertility and also impact human wellbeing. It articles focus on major agricultural, environmental and human health impact of crop residue burning.

Impact of stubble burning

Residue burning in open field impose many adverse impacts on environmental safety, human health and soil property along with this it also adversely impacts global economy. These adverse impacts are discussed below under following subheadings:

Impact on air

The air quality of the exposed surroundings is jeopardized when stubble is burned. Agricultural residue burning has a considerable impact on air quality due to the production of aerosols and gaseous pollutants. PM_{2.5} and PM₁₀ are said to have the greatest impact on the health of those who are exposed.

The burning of residues releases a considerable amount of greenhouse gases into the atmosphere (GHGs). When rice straw is burned, around 70%, 7%, and 0.7 percent of the carbon is released as carbon dioxide (CO₂), carbon monoxide (CO), and methane (CH₄), respectively, while 2% of the nitrogen is released as nitrous oxide (N₂ O). In November of each year, the air quality in the north Indian states deteriorates. Because of the existence of

accumulated pollutants from automotive and industrial emissions, the air quality in urban areas is more affected by stubble burning emissions, resulting in poor air quality conditions. The air quality of a region may be classified using a parameter known as the air quality index, or AQI, which is a set of category pollution level measures that aid in understanding the quality of air in a region on a scale of 0-500 (Central Pollution Control Board, 2014). Most of North India's regions have AQI levels that are higher than the recommended limit, especially during burning. For example, in November 2019, Delhi had a peak AQI of 487, Ghaziabad had a peak AQI of 493, and Greater Noida had a peak AQI of 480. (Kapil, 2019). These gases are of considerable importance because of their worldwide effect, since they may cause an increase in aerosol levels, acid deposition, troposphere ozone rise, and stratospheric ozone layer depletion. These may then migrate across borders depending on wind speed and direction, react with oxidants such as OH, undergo physico-chemical transformations, and finally wash out by precipitation.

Impact on soil

Aside from the negative impacts on air quality, stubble burning reduces soil production by destroying vital minerals (Singh *et al.*, 2018). It also raises the temperature of the soil to around 42 degrees Celsius, displacing or killing essential microorganisms in the soil at a depth of approximately 2.5 cm. The heat generated by the burning of leftovers raises soil temperature, killing beneficial soil organisms. Burning crop residues raises the exchangeable $\text{NH}_4^+ - \text{N}$ and bicarbonate extractable P content of the soil profile instantly, but there is no nutrient build-up. Burning in the field lowers the amount of N and C in the top (0-15 cm) soil layer, as well as the amount of potentially mineralizable N. This results in an additional cost of restoring soil fertility through fertiliser or compost application. Stubble burning depletes soil nutrients such as nitrogen, phosphorus, and potassium (NPK), as well as other micronutrients. Crop residues are expected to contain 80 percent nitrogen (N), 25 percent phosphorus (P), 50 percent sulphur (S), and 20 percent potassium (K) in general (K). It is also estimated that burning 1 tonne of agricultural residue results in the loss of 5.5 kg of nitrogen, 2.3 kg of phosphorus, 25 kg of potassium, and 1.2 kg of sulphur, as well as total loss of organic carbon and pollution of the atmosphere. If crop leftovers are absorbed or maintained in the soil, the soil is enriched, especially in terms of organic carbon and nitrogen.

Impact on agricultural productivity

The agriculture sector is affected by crop stubble burning. There is strong evidence that air pollution has an impact on food output. Pollutants may have a direct or indirect impact on agricultural output. The Injury to leaves, grains, or heavy metal absorption is examples of direct impacts on plants. Nitrogen oxide, for example, can harm plant tissue and produce discoloration. SO₂ may cause acid rain, which has serious consequences for plants and soil, and can even result in plant death. Plants exposed to particle pollution for an extended period of time may develop chlorosis or Bifacial Necrosis (Ghosh *et al.*, 2019). The creation of suitable conditions for the establishment of pests or illnesses is an example of indirect impacts. High concentrations of SO₂ and NO₂ encourage the proliferation of aphid pests, for example (Ghosh *et al.*, 2019).

Impact on human health

Many studies have found a relationship between air pollution and the risk of a variety of health problems, particularly in children, pregnant women, the elderly, and those with pre-existing medical conditions. The harmful effects of exposure to air pollution range from skin and eyes irritation to severe neurological, cardiovascular, and respiratory diseases. Chronic exposure to high levels of air pollution can result in long-term health effects such as asthma, Chronic Obstructive Pulmonary Disease (COPD), bronchitis, lung capacity loss, emphysema, cancer, and other lung disorders. The majorities of farmers who are exposing to stubble smoke have complained of eye and lung discomfort, and have spent a significant amount of money on medical bills. Fine particulate matter (PM_{2.5}) has a greater impact on humans than larger particles because it may pass past the trachea and into the lungs, then into the circulation (Ghosh *et al.*, 2019). PM_{2.5} pollution is responsible for around 21% of all fatalities in Asia's southern regions. Its effects ranging from a runny nose, coughing, and trouble breathing to long-term consequences including asthma and coronary artery disease (Ghosh *et al.*, 2019). According to a research, excessive levels of particle emissions can cause the human lungs' functioning to deteriorate.

Impact on the economic development

Apart from its negative impacts on human health and the environment, air pollution has a



negative impact on a country's economic growth. The efficacy of air pollution control in a nation is determined by the country's economic and technical progress, which means that rising pollution has a variety of economic consequences. Because of the increased level of air pollution in Delhi, visitor influx has fallen by around 25%-30% in recent years. According to Ghosh *et al.* (2019), the cumulative impacts of air pollution cost India's economy between 4.5 and 7.7% of GDP in 2018, and when projected to 2060, the amount climbed to over 15%. Air pollution has a negative impact on the productivity of workers in several fields due to illness and impaired visibility. According to the World Bank, air pollution cost the global economy \$225 billion in 2013, with the majority of the cost coming from poorer nations. The cost of air pollution management and welfare in India has been estimated to be approximately \$14 billion per year by the Indian government (Kumar *et al.*, 2015). On a local level, the cost of air pollution management and welfare has an influence.

Conclusion

Open field burning is a simple and cost-effective technique, but it is not sustainable in the long run. It's also likely that residue burning contributed to global warming and climate change. As a result, we must encourage farmers to combat residue burning for healthy soil, human health, environmental safety, and individual economic status. Hence there is needed to make farmers aware about ill impacts of crop residue burning by conducting awareness campaign and other educational activities.

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