

STUBBLE BURNING AND ITS IMPACT ON ENVIRONMENT AND HUMAN HEALTH

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Abstract: *Our environment is facing a major problem of burning residue, called stubble burning. Large amount of residue is generated in the fields because of modern technologies, which had come up in the field of agriculture. The practice is to free the field from stubble burning because it is creating problems for environment and humans. Stubble burning releases carbon, which causes air pollution and is harmful for flora and fauna. Such practices pose a wide variety of environmental problems. Residue burning emits carbon sinks in air causing pollution, which is harmful for human beings as well as flora and fauna. Stubble burning effects the soil fertility; erode the content of nutrient in the soil, and kills pests. According to soil department PAU, carbon present in the soil has been lost in the atmosphere due to stubble burning. As a result, there is loss of 0.824million tonnes of NPKfrom soil. The problem is not only limited to a single state or country but it has spread all over the World. Various institution is using this Rice residue for generation of electricity. At village Jalkheri, Fatehgarh Sahib a biogas power plant is situated and was set up in the year 1992. The farmers are using paddy stubble as bedding material for crossbred cows during winters. The paddy straw can also be used in paper production. Paddy stubble can be used as a raw material in pulp board and paper manufacturing. Farmers says the high cost of baler to (10-12 lakhs) used to make bundles of straw is crippling factor for its alternative uses. Since the machine is idle for most parts of year, a farmer will not be able to pay the loan instalments for it. Most of the wheat straw is used for fodder but with paddy, the case is different. There is little market or storage space for the dispose of bales of hay. So, farmers had hardly any option other than burning it on site. There are numerous effects of SB as it causes serious health issues like eye diseases, allergies, respiratory disorder and lungs disease because of the release of (PM) in the atmosphere.*

Keywords: *Particulate matter, NPK (nitrogen, phosphorus, potassium)*

1. INTRODUCTION:

Present study deals with stubble burning and its impact on environment and human health - a case study of Punjab. Agriculture is the primary activity, which serve both secondary and tertiary activities. According to 2011 census the population engaged in agriculture activities was 54.6%. In Punjab various crops are grown like barley, wheat, sugarcane, cotton etc. but wheat and rice are important crop. May-August is the season to sow rice and it harvested in November-September and in October-November wheat is sown and harvested in April-May. After the harvest of crops, residue is generated which is called stubble. Farmers burn their field after the harvest, to prepare their field for next cycle of grain crop and they get scarce time after the harvest and sow of rice and wheat. So farmers select the way of burning the residue, which is called stubble burning.

Due to stubble burning large amount of PM (particulate matter) increases in the air which is harmful for our health and the carbon component in stubble is lost by burning. It is a major issue, which is affecting the environment as well as humans. So an aggressive approach is needed on behalf of the government as well as farmers to adopt 'straw management technology'. Various government schemes which provides machines like happy seeder, rotavator, baler, paddy straw chopper (these machines help to grow crops in areas of stubble burning), these are the machines which was given to the farmers of Haryana, Punjab, Uttar Pradesh and others states under NPMCR (national policy for management of crop residue). It also focuses that crop residue can be used for livestock feeding; generation of power; Biofuel etc. or it can be used in making toys and mat- making. (Mohan and Vishwa 2016). In India, Average share of wheat and rice stands about 20% and 10%. In green revolution period Punjab made progress due to technological advancements, land reforms and govt. policies related to minimum support price and institutional reforms.

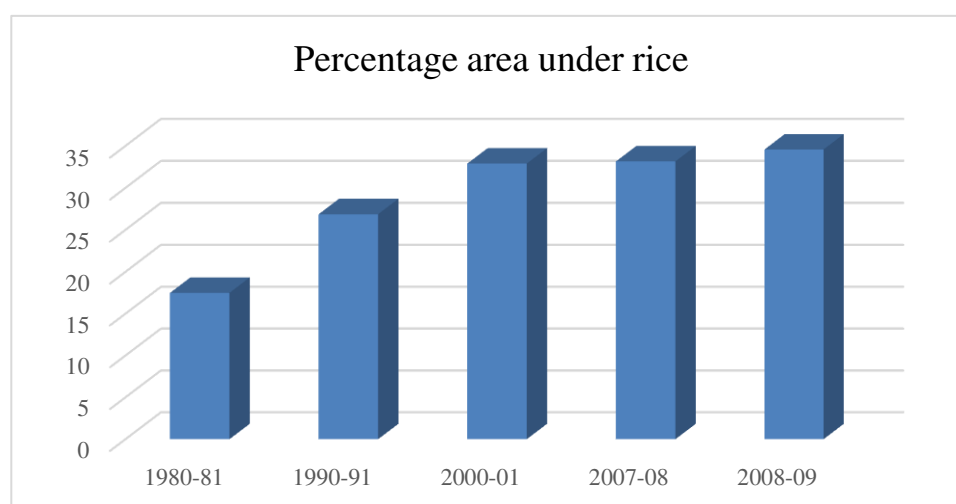
With the green revolution, new high yield varieties of wheat, rice, maize and bajra also arrived with inputs like insecticides, pesticides, chemical fertilizers and irrigation facilities. It focuses on the use of modern practices for the production and high yield seeds shows results was important feature of the strategy. With the advancement of this new strategy, India show a high development in the field of agriculture. When this revolution started agriculture was limited to wheat only crop but later on it was made available to other commercial and local crops.



Table 1.1 Shift in cropping pattern of rice in Punjab (1980-81 to 2010-11)

Year	1980-81	1990-91	2000-01	2007-08	2008-09	2009-10	2010-11
% age area under rice	17.49	26.86	32.89	33.15	34.57	35.58	35.85

Fig 1.1 Shift in cropping pattern of rice in Punjab (1980-81 to 2010-11)



Source: Statistical Abstract, Punjab

The gross cropped area under rice has increased from 17.49% in 1980-81 to 33.15% in 2007-08 and it rose further 35.85% in 2010-11. More area under rice cultivation contribute significantly to release of greenhouse gases such as methane, carbon dioxide, nitrogen oxides and its derivatives to the environment (Miranda, 2015). The imbalance in rice cropping pattern has increased despite of taking efforts to diversify the state agriculture. There are some serious concerns that are emerging for the future. Harvesting of paddy leaves large quantities of straw in the fields. The are other alternatives for wheat straw in the form of cattle feed but paddy straw usually burnt in field releasing large quantities of aerosols and tracer gases like sulphur dioxide and carbon dioxide (Singh, 2014).

Earlier harvesting was done manually and the stubble which was generated was less in amount and it was easy for the farmers to manage it. But now, as the time has changed and new machines have been invented, mechanised farming and harvesting is done which generate a large amount of stubble and it become very difficult for the farmers to handle it, so they burn stubble. When stubble is burned, the smoke, which generate from it causes invisibility in the atmosphere and it release PM which is affecting lungs and heart and it is causing serious health issues. Asthma, eye disease, Allergies, respiratory disorders are some of the problems.

The Punjab Pollution Control board has said to its staff to take action against the farmers who are involved in the illegal practice of stubble burning, because it pose a serious threat to environment and the health of people. Stubble burning is a serious concern as it is not only affecting the areas of Punjab but the neighbouring states like Haryana, Delhi are also getting very much affected by the smoke generated by burning of stubble. Though the pollution control board said that there has been reduction in the practice, which has been clearly seen in the satellite images (Figure 1.2). This reduction is because of the efforts taken by the state government.

Burning of crop stubble releases many gases in the atmosphere. Like CO₂, NO₂, N₂O, SO₂, CH₄ along with (PM). These effects are only seen on environment but also on human and animal health (Gupta and Sahai 2005; Lal 2006; Agarwal et. Al. 2006; Canadian lung association 2007). Plant nutrient and soil properties are also affecting.

Stubble burning effects the soil fertility, erode the amount of nutrient present in the soil, and also kills pests. According to the department of soil, Punjab Agriculture University, carbon present in the soil has been lost in the atmosphere due to stubble burning. As CO₂, nitrogen equilibrium in the soil changes rapidly and nitrogen is converted to nitrate, there is loss of 0.824million tonnes of NPK from soil.

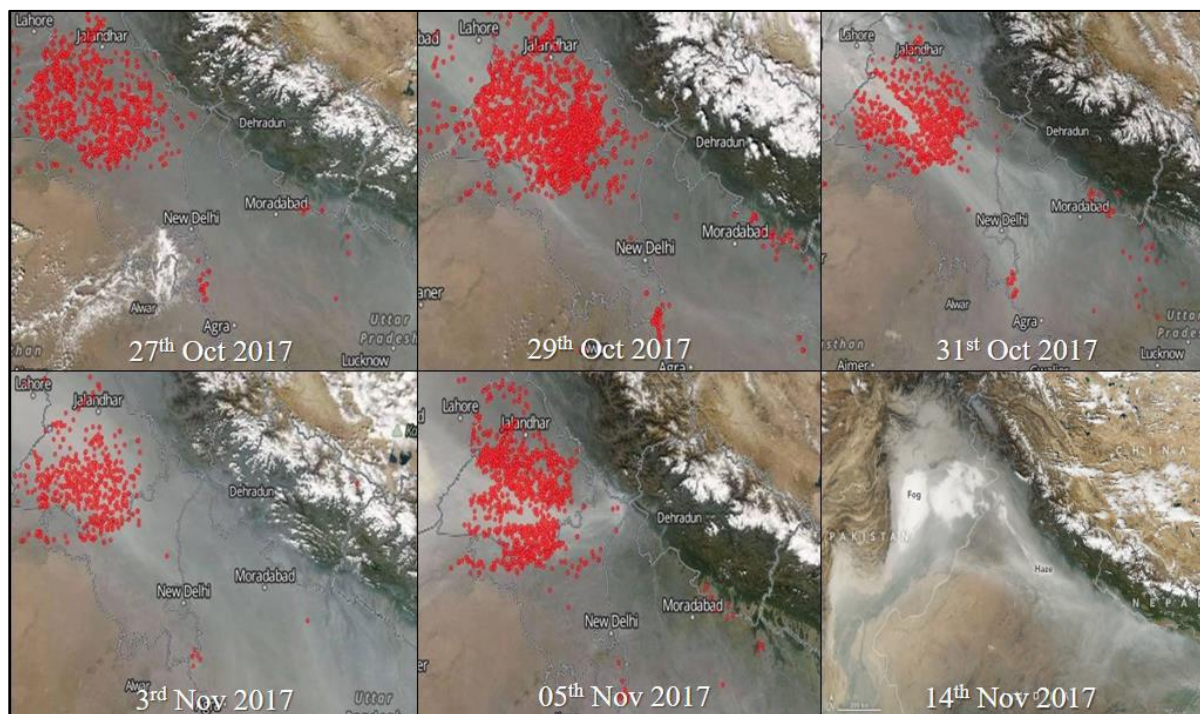


Fig. 1.2 Location of Stubble Burning identified through satellite images

Source: <https://www.geospatialworld.net>

The images which are shown above are taken from satellite which shows the changes in atmospheric conditions. Due to stubble burning a thick smog was observed in 27 Oct., 2017 the area shows high stubble burning and in Oct. 29 the burning incident has increased. On 31 Oct 2017 the fire cases were less because of the warning given by NGT (national green tribunal). On third November the dots on the images has increased but it has increased more on 5 Nov. On 14 November 2017 there was fog all over the area. These changes happened due to stubble burning.

Production of crop stubble and its burning - There are many studies conducted which shows the quantity of crop stubble produce in India and the part of stubble produced from rice and wheat. As per various studies stubble generated from wheat and rice contribute major load in India. One of the studies conducted by Garg (2008) in which he says that wheat and rice contribute to the agriculture waste as 36% and 41%, in the year 2000, while Punjab contribute the total burnt stubble of wheat and rice to be 11% and 36% during the same period.

Amount of pollution generated by residue burning- Burning of residue generates harmful gases to the environment like carbon monoxide along with particulate matter (PM) and hydrocarbon. These gases are not only harmful to the atmosphere but also harmful for animal health (Gupta and Sahai 2005; Lal 2006; Agarwal et al. 2006; Canadian lung association 2007). It also effects the nutrients of plant and effects soil properties. The gases CH₄, CO, N₂O was 110, 2306.2 and 84Gb from the fields of wheat and rice (Mandal et al. 2004).

Table 1.2 Major pollutants emitted during crop residue burning

Category	Pollutants	Source
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Particulars	SPM (PM ₁₀₀)	Incomplete combustion of in organic material, particle on burnt soil
	RPM (PM ₁₀)	Condensation after combustion of gases and incomplete combustion of organic matter
	FPM (PM _{2.5})	
Gases	CO	Incomplete combustion of organic matter
	NO ₂	Oxidation of N ₂ in air at high temperature
	N ₂ O	
	O ₃	Secondary pollutant, form due to Nitrogen Oxide and Hydrocarbon
	CH ₄ /Benzen	Incomplete combustion of organic matter
	PAHs	Incomplete combustion of organic matter

Source: SPM Suspended particulate matter; PM particulate matter; FPM fine particulate matter Source Singh et al. (2008).

Stubble burning impact on soil productivity- When stubble is burnt in open field it is very harmful for soil fertility, and it erodes the nutrient present in soil. According to soil department of Punjab Agriculture University, residue burning results in carbon lost in atmosphere as CO₂, 0.824 million tonne loss of NPK from soil. A study conducted by Gupta et al (2004) due to stubble burning temperature has increased upto 33.8-42.2 degree Celsius. It also results in the loss of 27-73% of nitrogen present in the soil and it reduces the bacteria and fungal population on the top 2.5cm of the soil. Continuous burning diminish the bacterial population by more than 50%. It also reduces nitrogen and carbon. Essential soil nutrients are lost and affect fertility. Heat generated by burning increases the temperature of soil, kills fungi, reptiles that are important for agriculture. It also reduces the soil structure and its stability by making it prone to wind and water erosion.

Table 1.3 Nutrient losses due to burning of rice residues in Punjab, 2001–2002

Nutrient	Concentration in straw (g/kg)	Percentage lost in burning	Loss (kg/ha)
Carbon	400	100	2,400
Nitrogen	6.5	90	35
Phosphorous	2.1	25	3.2
Potassium	17.5	20	21
Sulphur	0.75	60	2.7

Source Singh et al. (2008)

Others effects of stubble burning- Due to stubble burning the environment is covered with smog which causes grave accidents. Due to poor visibility, six people loss their lives in every 24 hour on highways. There are more than 2000 cases of stubble burning recorded by Punjab Pollution control board in Patiala. Level of respiratory suspended particulate matter(RSPM 2.5)between 301 and 500 are classified as hazardous, while anything over 500 is beyond the official index (The Tribune November 6,2017).

Health affect due to stubble burning- The stubble burning has severe impact on human health like Asthama, cough, bronchitis, eye related problems and skin diseases. This practice also causes heart and lung diseases and premature deaths of people who are suffering from these diseases. Poor visibility is also a result of stubble burning which leads to road side accidents. Thus it is important to mitigate the impact of burning stubble in the open field as it is effecting the soil, air quality and living organisms.

Impact of stubble burning on air quality- In Punjab, stubble burning is a common practice and it is openly burn the residue of agriculture after the harvest of the crop by machines. Central and Punjab pollution control board (PPCB) recorded the ambient air quality in certain areas. PPCB had monitored air pollution in Patiala district in November 1-3 2006. It poisons the air. Air pollution levels go up by several notches during the harvesting season. People had complained that it becomes very difficult and heavy to breathe because air is so much polluted because of stubble burning. In winters, due to burning of residue the air was so polluted that the cold air was condensed so the dust particles or PM get trapped in air and creates invisibility in the environment. The smog combine with the pollution caused from cares and other sources and generate heavy haze.

2. SUBSTITUTE FOR CROP RESIDUE BURNING:

Crop residue may put under various uses to curb the environmental problems. There are number of alternatives/substitute for crop residue as:

Rice stubble used as animal fodder - Residue, which was left after harvesting of rice, can be used as animal fodder. But this is not popularly performed among the farmers of Punjab. This is only because of high chemicals content in rice stubble. The amount of straw used for animal fodder is very less. Haryana, Punjab and Bihar is having highest per animal availability as compared to other states.

Using residue in bio thermal power plant- Rice residue is also used for generating electricity. A 10 mega watt power plant was set up in Jalkheri in 1922, in which paddy straw was used as a raw material. There is another power plant in Muktsar, this project was started in May 2005. In this plant crop residue of various crops like stalks of cotton, mustard etc has been used to generate electricity.

Using rice stubble for cattle bedding material - A study conducted by college of veterinary sciences, PAU in which they said that the bedding, which was made by stubble for animals are very helpful for them and improve the quality of milk. It is very comfortable for animals. It also give them clean, hygienic, dry and comfortable environment. The paddy straw which is used in bedding is also useful for biogas plant. Due to this bedding material the amount of milk production has increased.

Rice stubble used for mushroom cultivation - Mushroom cultivation can also done by rice stubble (*VolvariellaVolvocea*) mushroom in south Asia. It is grown on agricultural waste to increase the yield of the crop. Mushroom named Oyster, is commonly cultivated in many parts of world, mostly in china this is cultivated on cotton hull and sawdust.

Stubble used for paper production- Rice residue can be used for paper production. The technology is used in many paper mills. Straw can be used as a raw material in paper industries from which many products can be made. Due to rapid industrialization, urbanization and increase in population there is is high demand of paper industry and this is putting load on natural resources. So, there is a need to find a solution to use less natural resources and find alternative. So rice residue can be used for the pulp and paper industry.

Biogas production from rice stubble – SPRERI has started a project for using residue into biogas by developing new technologies. The power plant has been setup in Ladhawal. To reduce the problem of waste without affecting the environment the rice straw is converted into bioethenol.

Mixing crop residue with coal to reduce stubble burning - The power ministry directed NTPC to mix the residue with coal, to reduce generation of stubble. Farmers use machines to harvest crops and the residue leftover is a big concern. Burning of residue is a major concern because it is causing smog in Delhi and in nearby parts. Back October, more than 40,000 cases of stubble burning has been observed in Punjab because farmers throw away 20 million tonnes of rice waste, environmental groups said. NTPC buy the residue and used it in power plant. This step will give farmers a monetary return of Rs 5,500 per tonne of crop residue and create a market for it. This step will bound the huge burning of residue in short period and prevent states from the pollution caused by stubble burning in winter season. (Source <http://www.com/india-news/>).

Other use for the Stubble- Crop residue had a lot of benefits like thatching, or making beds for livestock and cattle. This step is taken to curb crop burning and uses for the stubble. One option is to produce biomass with the residue to generate power.

A waste decomposer's solution to avoid stubble burning – A solution was made in order to decompose bio-waste and to reduce stubble burning. The solution was sprayed on the post harvest stalks of crops and left for a month and it was observed that it decompose more than 5000 metric tonne of bio-waste.

Use of Stubble in different ways- In kamoda village, Haryana farmers use machines to harvest crop and make bundles of the stubble despite of burning it. Farmers sold these bundles to the cardboard manufacturers and the farmers got 2000 to 3000 from selling these bundles of stubble. From this process the environment is not getting polluted.

3. CONCLUSIONS:

After deep deliberations and insight into the problem, this has been come to conclusion that:

- Due to stubble burning large amount of particulate matter has increased in the air which is harmful for the health of human and cattle. The carbon component in stubble is lost by burning, which is a major issue affecting the environment.
- The increase in area under rice cultivation has been increased since 1970 also be the important reason for generating huge residue waste.
- Due to Stubble burning soil losses its fertility and the nutrients present in the soil are also reducing. The pests which are very good for the health of crops has also been destroyed.
- The smoke produces after residue burning contains particulates of combusted materials, which is carried through the air and when inversion sets in it creates the situation of smog. The problem further intensified due to winter season and sinking of cold air. Smog is very toxic due to the existence of heavy metal like zinc and iron. It reduces the visibility and creates respiratory disorders.
- Burning of residue in fields leads to the death of soil micro flora and fauna and it may damage the nearby trees and standing plantation.
- Thus it is suggested that the residue of crop is required to put under other uses eg. for generating electricity, can be used as fodder for animals and also as cattle bedding material, paddy straw can also be used for the Mushroom cultivation, use of stubble for paper production and for making of biogas. It is also suggested that to reduce stubble burning, residue should be mixed with coal. A waste decomposer's solution may also be used to avoid stubble burning.

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