



# Stubble burning: Effects and management strategies – A review

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## Abstract

Stubble burning is a major issue of present time. In our India the rice-wheat system is most common. The rice crop is also responsible for this. The stalks of rice is called stubbles and waste material of rice called Parali. The farmer burn the residue on own land is called burning results to free the field for sowing of next crop. After burning they release the some oxides like nitrous oxide, Sulphur oxide, methane, carbondioxide and they effect on the fertility of soil. They also effect on human health and cause some diseases related to lungs and kidney cancer. They also effect on growth of fungal, bacterial population and kill the beneficial microorganisms. Then, their management is important aspect for saving the future generations. The different uses of waste material like paper industries, biofuel production, biogas, composting and controlled by happy seeder, in-situ or ex-situ management etc. and centre and state government make the policies and rules for controlling the burning.

**Key words:** Stubbles, Effects, Parali, Rice, Burning

## 1. Introduction

India is the powerhouse of agriculture. The 80% population of India is dependent upon agriculture and various type of crops grown in India. Rice- wheat system is more common and these crops also responsible for stubble burning (Sain 2020). These two crops like rice and wheat, its play major role in our economy. After the harvesting of these crops they produce a large amount of residue remain in the field. The farmer burnt the residue or this waste material on our farm. The stubbles is also the not waste but according to the farmers i.e. the waste of the rice or wheat after the harvesting when extraction of grains. The stalks of rice or stubbles of rice remain in the field and burnt by farmers on their own land is called the stubble burning. Mainly the farmer burn the stubbles because there is less time for sowing of next crop. When the farmers harvest the crop with combine the grains are threshed but stubbles remain in the field i.e. not useful for farmers, so farmers have less time and there is pressure on back or no other choice except burning. The major problem of stubble burning in Punjab and Haryana. The two things for burning of residue, first is difficult to collect the residue or ex-situ management is a expensive or labour requiring process, then second is short period between after rice for sowing of wheat. So, burning is easy and less comfortable process for farmers. The 2.5 million farmers burn the 23 million metric tonne residue of rice

crop in October and November (NAAS, 2017). Garg et al. 2008 observed that the total contribution of stubbles in Punjab of rice and wheat i.e. 36 and 41 %, but before 4-5 years they was in rice and wheat i.e. 11 and 36 %. In 2020 kharif season only Punjab burning the more than 50 % residue burn under paddy field (CREAMS 2020). The 30.67 lakh tonne area under paddy in Punjab and they produce the 16 million tonne residue in 2021.



Fig. 1

**Table 1. Residue generated and burned by different states in million tonne**

Name of state	Generated residue	Burned residue
Haryana	27.8	9.06
Punjab	50.8	19.8
U.P.	59.8	21.3
Assam	11.4	0.74
Gujarat	28.6	3.9
Andhra Pradesh	43.9	2.8
Chhattisgarh	11.3	0.9
Karnataka	33.8	5.7
Rajasthan	29.4	1.8
Maharashtra	46.5	7.6
West Bengal	35.8	4.5
Odisha	20.1	1.4
Tamilnadu	19.8	4.1
Madhya Pradesh	33.2	1.8

(MOAFW, 2019)

It is the major constraint to increase the pollution, imbalance the ecology, loss the fertility of soil, environment and human health issues because after burning they have a source of carbon monoxide, nitrous oxide, Sulphur dioxides, carbondioxides, methane etc. Delhi, Punjab, U.P., Haryana, Bihar are states affected by pollution. Mohammad et al. 2020 reported the 63 mt burning residue produce the 90 mt carbondioxide, 3.3 mt carbon monoxide, 0.7 mt methane etc.

So, management of stubble burning is also important for our ecology, maintain the soil fertility, balance the health consequences etc. The various techniques for management of residue like parali char, happy seeder, ex- situ or in-situ management, composting, bedding purpose, mulching, biochar production, energy purpose, feeding for animals etc.

### 1.1 Stubbles are waste or not ?

According to different studies the stubbles are not waste. They have a lot of nutrients. Sidhu et al. 2007 recorded that the stalks of paddy has a 38, 6, 140, 10 nitrogen, phosphorus, potassium, Sulphur kg/ha. After the burning of stubbles they loss the 59000 t, 20000 t, 33000 t, 3.85 mt nitrogen, phosphorus, potassium, organic carbon. So, clearly the stubbles is not a waste.

## 2. Reviews on Effects of stubble burning

Gupta et al. (2004) observed that the increase of temperature of soil upto 38-420C results to kill the microbes at 3 cm depth. The burning also reduce the 28-72% nitrogen from soil and growth of microbe population. They reduce the 50% population of bacteria from soil. The long term burning results to reduce the nitrogen as well as organic matter from soil upto 0-15 cm.

Mandal et al. (2004) examined that the loss of nutrients from soil like nitrogen 79%, phosphorus 26%, potassium 22%, Sulphur 5-59%.

Singh et al. (2008) revealed that the more than 60% population of Punjab live in rice growing region. According to study, the data of civil hospital Zira in Punjab recorded the 10 % patient increased during burning period within 25 days.

Awasthi et al. (2011) observed that the concentration of PM<sub>2.5</sub> in Chandigarh, Delhi, Kolkata like 23%, 10-27%, 38-69%, and then due to burning if rice stalks the PM<sub>2.5</sub> concentration in Delhi increased by 78 %. The air quality index (AQI) of Delhi, Greater Noida, Gaziabad etc. also increase from previous 6-7 years when was the farmer more burn the crop residue own field. They also deplete the quality of air.

Jain et al. (2014) also reported that the loss of 0.444 mt N:P:K due to burning of stubbles, 0.145 mt loss of N:P:K due to burning of wheat residue and 0.83 mt due to burning of sugarcane older leaves. They also reduce the other micro-nutrient, soil fertility, growth of microbes, increase the soil temperature about 42<sup>0</sup>C, this is harmful for growth of beneficial microbes then kill the microbe due to high temperature.

Ravindra et al. (2018) noticed that the oxide release from burning material effect on the climate and weather and also increase the global warming. They increase the 16-33% warming increased due to burning.

Sharma et al. (2019) examined that the nitrogen oxide and Sulphur oxide also effect on the agriculture productivity. These oxides effect on growth of leaves, soil, grains, inhibit photosynthesis and ozone layer also effect on plants results to decrease the yield of crops.

Ghosh et al. (2019) revealed that the burning effects on human health. It was reported that effect on lungs and particulate matter enter through trachea into kidneys and also causes the chronic diseases like stroke, fever, lung cancer, tuberchlosis, coughing, breathing problems etc.

**Table 2. Nutrient loss in Punjab due to stubble burning**

S. no.	Nutrient	Straw g/kg	Burning loss	Loss kg/ha
1	N	6.4	90	36
2	C	401	100	2400
3	P	2.2	24	3.1
4	S	0.76	61	2.8
5	K	17.4	20	22

(Singh et al. 2008)

### 2.1. Reviews on Management of stubble burning

- **Used for animals as feed and bedding purpose**

The residue of crop mainly rice and wheat is primary source of North India used as a feed and bedding purpose. The straw and husk also used for bedding purpose. Before this practice is common in South India but now used in North India as a litter in cold regions. The use material to make the healthy animals and increase the milk yield, provide the hygiene conditions, dry, secure and avoid from injury. The data showed that 415.2 mt crop residue required for animals but its availability only 253.6 mt, i.e. very less. (Parmod et al. 2015).

- **Used in paper industries and for compost making**

The straw of rice also used in industries for paper making and it is best alternative for deforestation. The papers and some mats also made from parali. The 40:60 ratio of rice and wheat residue used for paper making. (Sain 2020). Then material is used for compost making. Compost is organic manure made from breakdown of residue and waste of crop, animals. This is also responsible to cure the soil biological, chemical, physical properties of soil. The one hectare paddy straw produce the 3 ton of compost material and made by farmer on their farm house, used as manure in fields. The one kg of manure absorb the large amount of urine from shed of animals.

- **Happy-seeder**



Fig 2.

This is new implement for controlling the residue burning. It is used in rice-wheat cropping system when the harvesting of rice then sowing of wheat by happy seeder in paddy stubbles. It cuts the stubbles of rice in field and used as a mulch. The mulch is responsible for reduce the weed growth, help in moisture conservation and save the labour requirement. It is developed by PAU, Ludhiana in 2001 and also called super straw management machine. Presently, 11000 happy seeders are used in Punjab for residue management. (NAAS, 2017).

- **Used as mulching and biochar production**

Mulching is the waste material of paddy stubbles i.e. spread on land for controlling the population of weed, prevent the soil erosion, conservation of soil. The mulched crop have higher water use efficiency, increase the crop yield, and 40 % increase the root length as compare to non- mulch crop. The another used for production of biochar. It is also similar with charcoal and increase fertility of soil. The straw is used for packing, brick making and used in vegetables, fruits at transportation time.

- **Incorporation in soil**

The incorporation of residue into the soil is best strategy to increase the soil fertility, organic matter and carbon content in soil. It increase the 14-30% carbon content in soil. The 14 % of rice and 9 % of wheat residue incorporate into soil in Punjab every year. The some micro-organism like Azospirillum, Azotobacter increase the nutrition value through burying the stubbles in soil and they take food from residue. The incorporation of material before sowing of 3-4 week to increase the yield of wheat. (Kumar et al. 2015).

- **Policies and Government legislations**

The Prime minister of India Narinder modi in 2018, according to NITI, aayog policy provide the 80% subsidies on machinery i.e. related to residue management provide to Punjab, Haryana, Uttar Pradesh to avoid the burning. There are 11 pollution control acts in India and section 144 under to prohibit the burning is compulsory. The Punjab government also make the strict rules and provide the machinery for farmer to control the burning.

## **Conclusion**

From above all reviews, concluded that the stubble burning is most common debate in present time. The farmer continuously burn the residue on field due to sowing of next crop, lack management practices. The release of various type emissions from burning cause health, environment, soil hazards. So, we all are aware about stubble burning and to give the new suggestions of farmers. The state government make the policies and take the strict action against farmers. The other practices for control of burning like happy seeder, biochar production, biofuel, composting, mulching, used in industries, incorporation into soil etc various practices used results to balance the ecology, fertility of soil, health issue etc. As opposed to burning, the stubbles can be used to create ecologically benign and advantageous products like compost or biochar. They may also be used as raw materials to make cement and bricks, as fuel for power plants, as biomass for biofuel production, or for cement and gasoline materials and used to make paper and pulp. The most of farmers in North India, to lack the knowledge then best choice is to burn it.

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