

Paddy Straw: A Boon from Bane

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Introduction

Rice (*Oryza sativa*), the staple food of more than half of the population of the world, is an important target in providing food security and livelihoods for millions. (Bindu *et al.*, 2018). India is the second-largest producer of rice in the world. Cultivation of rice results in two types of biomass residues- straw and husk- having attractive potential in terms of energy. The rice crop residue generated is around 23 million tons i.e., 62.4% of the total crop residue generated annually in the Indian sub-continent (National Policy for Management of Crop Residue, NPMCR). The grain-to-straw ratio varies from 1:1.3 to 1:3. The percentage of rice in paddy varies from 65 to 72 and the percentage of bran in rice husk is 15 to 20%. The grain and straw yields depend on environmental and genetic factors like variety, season, location, plant height, soil texture and fertility, plant density, available water, fertilizer, weeds, harvesting stage and methods. (Singh *et al.*, 1995). Rice straw biomass is mainly composed of cellulose (21-31%), hemicelluloses (30-35%), lignin (4-19%) and ash content. It is an organic matter in which solar energy is stored in the chemical bonds of cellulose, hemicelluloses and lignin molecules. (Dhakate *et al.*, 2019)

What is actually done to rice straw?

Rice straw is produced after harvesting rice in very large amounts. One kilogram of paddy generates 1-1.5 kilograms of straw. The dumping of such a huge amount of crop residues is a remarkable challenge. The crop stubbles that are left in the fields after combine-mediated harvesting reveal the farmers with significant challenges due to the height of the stubbles, the poor nutritional value of paddy straw, the expense associated with collection and transportation, the lack of buyers for the stubbles, and the lack of an effective *in situ* stubble management system. These factors lead farmers who are unaware of public health concerns to view OPEN STUBBLE BURNING as the simplest and most cost-effective method of managing stubble. (Lyngdoh *et al.*, 2018)

How is it a bane?

- ✚ **Depletion of air quality:** The emission from stubble combustion contains a significant amount of carbon dioxide, carbon mono- oxide, nitrous oxide, methane, sulphur dioxide and smoke particles of various sizes depending on the phase of burning. (Ordouand Agronovski,2019). Burning of one tonne of rice straw emits 3.7 kg of particulate matter, 1.0 kg of volatile organic compounds, 3.1 kg NO_x, 0.7 kg SO_x and 34.7 kg of carbon monoxide. (Kadam *et al.*, 2000). These gases and aerosols contain carbonaceous material, which could cause acid deposition, an increase in tropospheric ozone, and the thinning of the stratospheric ozone layer in a given region.
- ✚ **Deterioration of Soil Health and Fertility:** Burning of straw affects the soil quality, the burning of its essential nutrients like nitrogen, phosphorus and potassium. (Yadav, 2019). Long-term burning reduces total N and C in the 0-150 mm soil layer. The residue burning kills microflora and fauna beneficial to soil and removes a large portion of the organic material, thereby depleting the organic matter in the fields. . (Singh *et al.*,2009).
- ✚ **Health hazard:** Straw burning enhances the number of dangerous air pollutants resulting in a detrimental impact on people's health. For instance, shortness of breath, coughing, eye irritation, asthma, bronchitis, aggravated chronic heart diseases, and other lung disorder primarily affects older people, children, and pregnant women. (Mittal *et al.*, 2009).

How can it be converted into a boon?

- ✚ **Composting:** Composting is an organic process in which the organic matter of straw is consumed by micro-organisms and earthworms to convert the dry matter into soil nutrients (Bernal *et al.*, 1996). It appears to be a viable method to stop rice straw burning and also crop yield can be increased by 4-9%.
- ✚ **Mushroom cultivation:** Mushroom cultivation is a profitable agri-business endeavour that produces food from rice straw facilitating the proper disposal of by-products in an environment-friendly manner. The paddy straw mushroom, *Volvariellavolvaceais* considered being one of the easiest mushrooms to cultivate because of its short incubation period of 14 days. (Rayes,2000).

- ✚ **Biochar production and utilization:** The synthesis of biochar provides us with a remarkable solution to the threat posed by residue production. The large amounts of rice straw could potentially be pyrolyzed to create biochar under a limited supply of oxygen at temperatures from 500 to 700⁰C. Additionally, biochar has enormous potential for reducing greenhouse gas emissions and mitigating climate change through carbon sequestration, reduced waste biomass burning, clean bioenergy production, and decreased methane and nitrous oxide emissions, enabling the achievement of sustainable development goals(Tokas *et al.*, 2021).
- ✚ **Biofuel production:** The lignocellulosic compositions of plants are hard to decompose and hence, can be employed as a source of raw materials for bio fuel. Plant biomass is pre-treated for degradation by selected microorganisms and transformed into monomers and sugars, serving as an efficient bio fuel. (Bhuvaneshwari *et al.*, 2019). Biomass can also be converted into biogas by anaerobic digesters. This method has proved to be a viable alternative if followed efficiently.
- ✚ **Initiatives by the Indian Government:** Indian Government-furnished numerous laws to alleviate the hazards caused due to open field burning of crops like Section 144 of the Civil Procedure Code (CPC) to ban the burning of rice crops; The Air Prevention and Control of Pollution Act, 1981; The Environment Protection Act, 1986; The National Tribunal Act, 1995; and The National Environment Appellate Authority Act, 1997. The states of Rajasthan, Uttar Pradesh, Haryana and Punjab have enacted the National Green Tribunal (NGT) to limit crop residue burning. (Lohan Kumar, 2015).A programme called the National Policy for Management of Crop Residue (NPMCR) has recently been established by the Ministry of Agriculture of India. It aims to encourage crop residue management technology and also track crop residues using the National Remote Sensing Agency (NRSA).

Summary

Despite extensive efforts, there has only been a marginal decline in the paddy straw burning problem and has not yet decreased to tolerable levels. The management of crop waste is a huge task in India. The Indian government is constantly vigilant about finding sustainable ways to reduce crop residue burning. However, farmers do not effectively accept them.

Therefore, in order to manage paddy straw and prevent losses, an appropriate management strategy must be developed and the policy might also be advantageous to the environment.

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