

Paddy Stubble Burning and Some Alternative Solutions

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Introduction

Harvesting is a labour-intensive work. To reduce this stress, we've got harvesting machines. These harvesting machines left crop residues. These crop residues are burnt out by the farmers by the myth of increasing fertility of the land. Also, it's an easy & zero-cost method of getting rid of the stubbles. Farmers often wait for the monsoon season to begin, due to the state laws restricting groundwater use until the monsoon arrives. Since crops rely on rainwater, a delayed monsoon leads to a delay in sowing, which ultimately results in a late harvest. Poor farmers always stay in pressure to sow the next crop as they get very shorter window for the next crop.

But, here comes the twist now. This zero-cost method reduces fertility & also a significant amount of N, P, K, & S from the soil. Almost all soil nutrients besides organic carbon are reduced. However, a petty amount of nutrients is left over in the ashes which can be counted as negative in terms of benefitting the health of the soil. According to a report, one ton of stubble burning leads to a loss of 5.5 kg N, 2.3 kg P, 25 kg K, & more than 1 kg of S, besides organic carbon. And on the other hand, for cropping, massive use of DAP, SSP & Urea is seen. By these zero costs of burning, firstly, we're losing nutrients and then we're buying more & more fertilizers for the sake of crop health. Our fertile soil is now becoming more prone to soil erosion. Burning the upper layer kills the micro-organisms and natural enemies essential for the soil & crop. Due to the loss of these friendly organisms, diseases-pests are becoming more prevalent. Pests attack and there are no friendly organisms to defend. Hence, buying pesticides is the only solution. Pesticide contains poison and these are not only consumed by pests but also by us. No matter what the degree of poison is, it's creating minute issues daily and after years it's leading to death causing disease, infertility, and mutation in genes.

Stubbles are mainly burnt at the beginning of winter in Southeast Asian paddy growing countries

like Bangladesh and India. In winter the air gets heavier and stuck in a particular space. Burning stubble releases ample amount of CO₂, CO, SO₂, CH₄, and NO particulate matter creating smog and hence respiratory diseases. Inhaling this air is much more fatal than a chain-smoking. This burning also causes the loss of habitat of the surrounding ecosystem and leads to loss of biodiversity.

A joint research collaboration between Tata-Cornell Institute for Agriculture and Nutrition, Cornell University, International Rice Research Institute (IRRI), International Maize and Wheat Improvement Centre (CIMMYT), Bihar Agricultural University, found that in Eastern Indian states like Bihar, communities where combine harvesters are used, rice residue burning is not an inevitable outcome. Instead, it emerges from a chain of interconnected factors: (1) a decline in household labour, which leads to (2) a reduction in livestock holdings, resulting in (3) diminished demand for crop residues as fodder, and (4) the adoption of labour-saving combine harvesting, followed by burning of the loose residues. These residues are harder to collect and have lower nutritional value compared to manually harvested straw. The local demand for crop residues as livestock feed plays a pivotal role in influencing the shift toward burning. Therefore, policy responses that focus solely on the role of combine harvesters are likely to fall short. Innovative approaches, such as establishing decentralized commercial models for dairy value chains, could help address household labourer shortages and sustain livestock holdings, thereby increasing the demand for crop residues and reducing the need for burning.

Now, what's the solution to it?

- A Proper mass awareness program for the farmers is necessary. Crop diversification in stubble burning prone areas can solve the problem. Already, in our country, rice is grown in around 47 million hectares area. Nation-wide food security can be achieved, if hybrid rice cultivars are introduced in 30-35

million hectares and in rest areas, pulses and oilseeds can be grown where our country stands deficit. Lucrative MSP and the newly launched 'National Mission on Edible Oils-Oilseeds' (2024-31) can be proved as game-changer, if implemented properly.

- Promoting Early varieties of paddy is the necessary need, which can be harvested within October 2nd fortnight to November 1st week. Recently, Punjab government banned cultivation and sale of Pusa-44, which takes 160 days to mature and needs 4-5 extra irrigation cycles, causing massive depletion of groundwater reserves. A report by the Central Pollution Control Board and The Energy and Resources Institute suggests, biomass burning is reported to contribute up to 42% of PM concentrations in Delhi and NCR region. Instead, now the Punjab government is suggesting farmers to grow PR-126, which attains harvest maturity at 123-125 days. PR-126 offers an average yield of over 30 quintals per acre. In 2023, PR-126 was cultivated on an area of approximately 8.59 lakh hectares, accounting for almost 33% of the area cultivated with non-Basmati paddy in Punjab. According to Union Agriculture Minister Shivraj Singh Chouhan, (reports from The Indian Express on 27th October, 2024) incidents of stubble burning dropped by 35 per cent in Punjab and 21 per cent in Haryana compared to last year. The incidents of stubble burning in the country have reduced by over 51 per cent compared to 2017.
- Pusa Bio-decomposer, developed by the Indian Agricultural Research Institute is a hopeful solution for in situ crop residue management. It is a microbial liquid solution containing fungal strains *Aspergillus nidulans*, *Aspergillus awamori*, *Phanerochaete chrysosporium* and *Trichoderma viride*. It accelerates process of paddy straw decomposition and makes the field ready for wheat or any other crop sowing in 25 days. According to a satellite-based monitoring study by the Minister of State for Environment, Forest & Climate Change reported a decrease in stubble burning cases by 7.71% in 2021 kharif season compared to 2020 in Punjab,

Haryana, Uttar Pradesh, when the farmers started adopting Pusa Bio-decomposer under a central government subsidy scheme.

- Nowadays, agriculture in India is shifting towards mechanization due several subsidy schemes. As paddy combine harvester have created such a nuisance, introduction of handy machineries is crucial for now, which can harvest paddy/wheat at the ground level; or agricultural engineers need to make changes in combiner enabling the machine to cut the crop close to ground. Happy seeder can be another good solution which also needs popularization among masses.
- Mushroom cultivation offers a profitable venture for farmers exploring for an affordable cash crop. The straws and stubble needed to set up the green nurseries that ensure optimum conditions for mushroom growth, can all be derived locally from the field. Popular mushrooms like oyster or button mushroom requires a temperature range of 20-30 degree centigrade which can be easily obtained after the paddy harvesting season.
- One of the easiest and affordable solution for paddy residue management is, using it as cattle feed. But nowadays, rice straw is considered as poor cattle feed due to its poor protein content (around 3-5%) and high silica content (around 8%). But poor rice straw can be biofortified with groundnut vines or any other legume leaves which contain high leaf protein.
- Adopting zero tillage or mulching strategies in subsequent crop can also help farmer in better crop and soil conservation management. By laying stubble in a thin, even layer over the soil, farmers create a natural cover that conserves moisture and protects young plants. The cover eventually decomposes, adding nutrients back into the soil.
- Ex-situ management of stubble like biochar or bioethanol production can be another option in future time, when we will be searching for newer energy sources.
- NGOs and the government need to be aware of and address the affordability issues before insisting on a ban on stubble burning. They

<p>must take appropriate steps to make alternative solutions more accessible and affordable for farmers.</p> <p>References</p> <p>Urban Cordeiro, E., Samaddar, A., Munshi, S., Ajay, A., Rossiter, D. G., Sohane, R. K., Malik, R., Craufurd, P., Pingali, P., & McDonald, A. J. (2024). Transitions to crop residue burning</p>	<p>have multiple antecedents in Eastern India. <i>Agronomy for Sustainable Development</i>, 44(6), 59.</p> <p>Gatkal, N. R., Nalawade, S. M., Sahni, R. K., Walunj, A. A., Kadam, P. B., Bhanage, G. B., & Datta, R. (2024). Present Trends, Sustainable Strategies and Energy Potentials of Crop Residue Management in India: A Review. <i>Heliyon</i>.</p>
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