

## Issues and strategies for rice residue management to unravel winter smog in North India

Rice is the most popular *kharif* food crop grown in North India. In Punjab, 75–80% of area under rice is machine-harvested and based on harvest index, 18–20 million tonnes of rice straw production is estimated. Approximately 95% of paddy straw and 25% of wheat straw are burnt every year in Punjab, making the state the major culprit for greenhouse gas emissions. The emissions from wheat crop residues in Punjab are relatively low compared to those from paddy fields. Residue burning in agricultural fields of North India is a major source of smoke, smog and particulate pollution. With the onset of winter months, the decrease in temperature results in a temperature inversion, favouring the accumulation of pollution near the earth's surface, in combination with high relative humidity and other meteorological parameters like calm winds typical of post-monsoon months. The smoke that arises from the burning results in the emission of toxic substances, including PM<sub>2.5</sub>, CO<sub>2</sub>, CH<sub>4</sub>, CO, NO<sub>x</sub> and SO<sub>x</sub> in the atmosphere. These emissions have several atmospheric, biospheric and ecological implications<sup>1</sup>.

A study conducted by the Agricultural Development and Rural Transformation Centre at the Institute for Social and Economic Change, Bengaluru, reported that harmful effects of this smog account for Rs 76 million of health hazards in rural Punjab only. The vast cloud of smoke in the form of smog resulting from rice residue burning in October not only poses a serious threat to human health, but also to soil and environmental quality. Although a legal ban was imposed on stubble burning in 2005, the practice still continues due to proper non-implementation of the ban. Farmers opt for burning as it is a quick and easy approach for disposal of residue and for cleaning the fields for sowing the next crops like

wheat, potato, etc. After rice harvest, the sowing window period for the subsequent wheat crop is narrow. Most of the farmers in North India grow Pusa 44, a late maturing variety. Therefore, for the early vacation of fields, they practice burning of rice straw. An alternative use of paddy straw needs a change in the mindset of farmers with technology innovations along with a huge investment of time, money and energy.

The new hope in this direction are the recently released rice varieties (PR-121, PR-126, HKR-47, HKR-47 and HKR-127), especially in Punjab and Haryana, that are now not only contributing yield almost at par with the earlier released/popular long-duration varieties like Pusa 44, but mature 2–3 weeks earlier; thereby, yielding more per unit area, time and inputs, and showing better resource use efficiency. These recent varieties vacate the fields by mid-October, providing farmers enough time for residue management and timely sowing of the succeeding wheat crop. Among newly released varieties, PR-121 has emerged as the most popular among farmers of Punjab, occupying more than 7 lakh ha (30%) during *kharif* 2016, while the area under the long-duration variety Pusa 44 has come down to 20%. Fire incidents are still reported more in the area where Pusa 44, a long-duration variety, is grown, because farmers have a narrow window for wheat sowing. The Act regarding transplanting date, i.e. not to transplant paddy before 10 June, also helped in decreasing fire incidents by discouraging farmers to grow long-duration varieties like Pusa 44.

Farmers are well aware of the environmental ill-effects of residue burning, but are forced to do so in the absence of any compensation and easy alternatives. Farmers need to be provided with a subsidy on farm implements like the Happy

Seeders, rotavators, straw reapers and balers for managing straw in a sustainable manner, as these are expensive and require heavy machinery for working. The cooperative approach for such heavy machinery may be promoted for effective residue management.

Research is underway to evolve rice varieties that may have low silica content, lodging tolerance and high harvest index so that these varieties can easily be decomposed and will strengthen rice residue incorporation practices. The fine-tuned Happy Seeders are now available that have overcome problems of loose straw and crop emergence, and can easily incorporate the rice residue in the field.

In conclusion, burning of rice residue although is a regional incident, its impact is not bound to a specific area, therefore, issues need national concern and northern states like Punjab, Haryana, Delhi, and Uttar Pradesh should act together to mitigate the menace.

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1. Gupta, P. K. *et al.*, *Curr. Sci.*, 2004, **87**(12), 1713–1717.
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