CROP RESIDUE BURNING - THE SOLUTIONS

What is the problem?

- The net cropped area in India is 141.4 million hectares. Harvesting of various crops generates large volumes of agricultural waste both on and off farms. India's crop residues are estimated to be around 600 million tonnes every year, with generation being the highest in Uttar Pradesh (responsible for 17.9% of total biomass generated), followed by Maharashtra (10.52%), Punjab (8.15%) and Gujarat (6.4%).

- An estimated 140 million tonnes of crop residues are burnt in India every year. The burning of these residues creates an air pollution crisis in Indo-Gangetic Plains (IGP) during the harvest of the Kharif crop. An estimated 39 million tonnes of paddy straw are being burnt every year in Haryana, Punjab, Uttar Pradesh, and Rajasthan**. Seated at the extreme east of the IGP, West Bengal while not largely contributing to the problem, does face its consequences.**

- For the Punjab government, knowing that the water table was getting depleted, one plausible policy response to reduce over exploitation of groundwater was to do away with the short duration *sathi* crop, cultivated in April-May, and to delay the sowing of paddy. In view of the urgent need to save water, **Punjab and Haryana introduced the 'Punjab Preservation of Subsoil Water Act' and the 'Haryana Preservation of Subsoil Water Act', in 2009 banning transplantation of the rice crop before the onset of monsoon to conserve groundwater.** These policies shifted the date of paddy transplanting from June 1 to June 20 (and after the Congress government was sworn in, it was advanced to June 13). A delay in transplanting by roughly a fortnight – by shifting the transplanting period from June 1 to June 13 -- saved Punjab 2,000 billion litres of water. **The shift in paddy transplanting by a fortnight surely delayed the harvest but also meant that stubble burning coincided with the period when movement of air over Delhi NCR remains subdued.**

- Meanwhile, a study led by Indian Institute of Technology, Kanpur, using satellite data shows that an approximate 10-day shift in the timing of stubble burning made a small contribution to worsening air quality in 2016 (3% over Delhi) during the post-monsoon season. However, if the same agricultural fires were further delayed, air quality in the crop residue burning source region (i.e. Ludhiana) and for Delhi could have deteriorated by 30% and 4.4%, respectively. Simulations for other years highlight strong inter-annual variabilities in the impact of these timing shifts, with the magnitude and even direction of PM2.5 concentration changes strongly dependent on specific meteorological conditions. Therefore, **post-monsoon Indo-Gangetic Plain air quality is far more sensitive to meteorology and the amount of residue burned in the fields of Northwest India than to the timing shifts in residue burning identified. West Bengal also is largely impacted by the air pollution that travels east along the IGP during the period.**

- According to a IIT-D study, crop residue burning is a major source of fires in West Bengal.

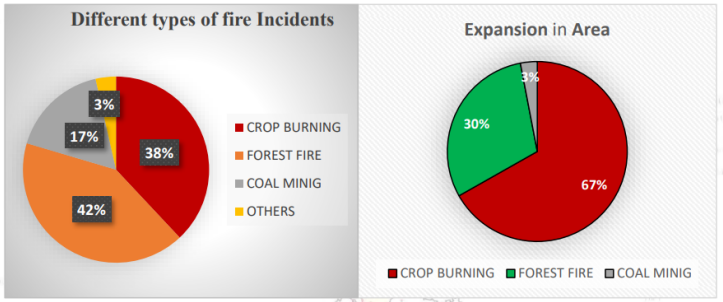

Fig. 3.12: (a) *Percentage distribution of Open Biomass Burning. (b) Area share of total Biomass Burning.*

It is found in paddy fields mainly in December in Purba Bardhhaman, Paschim Medinipur, Jhargram, Bankura, Birbhum and Hooghly. In March-April Crop residue burning observed in Murshidabad, Dakshin Dinajpur, Uttar Dinajpur, Malda and Nadia.

- The IIT-K study, conducted in partnership with University of Leicester, Kings College London, Panjab University and PGIMER Chandigarh, also shows that beyond meteorology, **the area and amount of residue burned has increased significantly over the past almost two decades** - mirroring government statistics on increasing crop yields. While the residue burning period has been delayed since the introduction of the 2009 groundwater policy, which has had a desired positive impact on the water table, the increasing amount of residue being burned is responsible - with additional year-to-year variability strongly influenced by post-monsoon atmospheric dynamics. These results show reduced meteorological ventilation which confined air pollutants near the surface, and combined with increased crop residue burning emissions, this can lead to PM2.5 spreading across the Indo-Gangetic Plain.

Policy Measures taken to address crop residue burning

- In 2014, the Ministry of Agriculture developed the National Policy for Management of Crop Residue (NPMCR) to prevent agricultural residue burning and circulated the same to all the states/union territories with the following major objectives: (i) promote technologies for optimum utilization and in situ management of crop residues, (ii) promote appropriate machineries for farming practices, (iii) use satellite-based technologies to monitor crop residue management with National Remote Sensing Agency (NRSA) and Central Pollution Control Board (CPCB), and (iv) provide financial support through multidisciplinary approach and fund mobilization in various ministries for innovative ideas and project proposals to accomplish the above.

- During March 2018, the Cabinet Committee for Economic Affairs approved INR 1151.80 crore under the central sector scheme (CSS) on 'promotion of agricultural mechanization for in situ management of crop residues in the states of Punjab, Haryana, Rajasthan, Uttar Pradesh and NCT of Delhi' to

tackle air pollution and subsidize farm machineries. As a result, 16,000 Happy Seeders were reportedly in use in Punjab as of January 2020.

- However, a study by Council on Energy Environment and Water (CEEW) estimated around 35,000 Happy Seeders would be needed to cover the approx 5.683 million acres of land on which stubble is burned every year. However, manufacturing of the machine was lagging significantly behind demand in 2018. With no standard rental rates, the rental costs for such technologies also remain prohibitive for some farmers. Experts also argue that farmers find it uneconomical to spend an astronomical amount initially on machines which are used barely for a few days during the season, and lying idle for the rest of the year.

- Political discourse in 2019 finally acknowledged the limits of relying solely on technology fixes. Instead, the policy instrument of choice in Punjab and Haryana was to provide "incentives" to farmers at Rs. 2500 per acre for not burning stubble and managing the residue in alternative ways. Unfortunately, this was announced in the last week of November after much of the residue had already been cleared and it has been dropped completely this year after several panchayats reported it was being misused.

- In March 2019, the West Bengal environment department banned burning of paddy stubble in fields across Bengal in an attempt to fight air pollution. The violators are to be prosecuted under the Air (Prevention and Control of Pollution) Act, 1981, and can land in jail. Starting 2020, the state also observes November 4 as anti-stubble burning day.

- In 2020, the Haryana government launched the Mera Pani Meri Virasat scheme, under which farmers are provided Rs 7,000 per acre if they diversify more than 50 per cent of the land that they use to grow kharif season paddy. While the scheme is aimed at saving water, experts have often insisted that crop diversification from rice will help saw the stubble problem in the IGP.

- In May 2021, the Ministry of Power set up the National Mission on Biomass Use in coal-fired thermal plants to address the issue of air pollution due to farm stubble burning and to reduce carbon footprints of thermal power generation. The duration of the proposed National Mission is a minimum five years. It will address the issue of supply chain of biomass pellets and agro-residue and its transport upto to the power plants.

Long Term Solutions repeatedly suggested by policy experts

- Experts have stressed on the need to **diversify the cropping pattern, moving away from water guzzling paddy to other crops, including maize**. Punjab did try to push in sunflower and maize to replace paddy, but in a half-hearted manner, and the experiments failed. A paper by The Energy Resource Institute (TERI) says that crop rotation in the IGP region needs to be reevaluated by encouraging farmers to other cropping cycles rather than rice–wheat cropping system.

- A report by the Centre for Policy Research (CPR) claims there has been an ongoing effort towards crop diversification in Punjab and Haryana, owing to the groundwater crisis. Indeed, the Punjab Chief Minister has said that paddy has no future in the state. This diversification appears to have been accelerated by the COVID-linked disruptions. **Absence of migrant labour from Bihar and UP for transplanting paddy in June-July owing to the lockdown had further increased the cultivated area for alternative crops like maize and cotton.** The key lies in sustaining this transition, ensuring that the harvest finds a market and reasonable prices. The extent, scale and durability of any shift away from paddy cultivation is a key determinant of future air pollution due to stubble burning.

- Another paper by TERI, "A Fiscally Responsible Green Stimulus", suggests **utilisation of crop residue in power plants.** Making the crop waste a commodity with a price that gives farmers a margin over the cost to pull out the crop residue would put an end to the burning of the crop residue in the fields. The Supreme Court had suggested as much during hearings on the air pollution crisis last year. The crop waste can be used for value addition through densification of residues into briquettes. These pellets can be used in industrial boilers for process heat. They can also be used by thermal power plants for power generation by adding it to coal. The National Thermal Power Corporation (NTPC) has shown that up to 10% crop waste briquettes can be successfully blended with coal, allowing co-firing in power plants. The NTPC, which procured pellets through open tenders also found that the cost of pellets was similar in terms of calorific value to that of the coal they were using. Hence, the cost of power generation did not go up when coal was replaced to the extent of 10% by pellets made from crop waste; a renewable source.

- A third solution suggested repeatedly is **decentralised use of crop residues in coal-intensive industrial activities such as brick kilns**. The second largest consumer of coal in India, the brick sector consumes 62 million tonnes of coal every year. Given the co-location of most brick kilns with regions that have high prevalence of agricultural residue burning (Assam, Bihar, Haryana, Punjab, Uttar Pradesh, and West Bengal account for 65% of brick production), substitution of biomass briquettes for coal would be able to absorb a significant portion of crop residues which would otherwise have been burnt in the fields.

- **Crop residues can be utilized as fuel for running biomass gasifiers for trigeneration applications** including electricity, agro-processing, and running decentralized cold storage at the village level. This can also provide farmers an alternate option to shift to horticulture crops for which farmers currently are reluctant owing to limited cold storage capacity at the local level. Although the markets for biomass power plants are currently fragmented. Biomass power plants in Punjab consume 1 million metric tons of paddy straw annually, significantly less than the 19.7 million metric tons of residue generated.

- Other options for the disposal of paddy straw include their use in paper or cardboard factories.

Dr. Ravindra Khaiwal (PGIMER Chandigarh) added that air pollution due to crop residue burning first affects the farmers and their families, including other crops/plants and livestock. Hence, farmers are also keen to be a part of the solution. However, solutions require a holistic approach having both

short and long-term planning with systematic implementation on the ground. He added that the Punjab government had given a proposal to the Commission for Air Quality Management (CAQM) that farmers should get Rs 2,500 per acre to stop burning stubble, which will have an estimated expenditure of ₹1,875 crores. Under this proposal, Delhi and Punjab governments will contribute Rs 500 each, whereas they requested the center to contribute Rs 1,500. However, it will be unsustainable to pay yearly compensation to prevent crop residue burning. He feels that incentive should be given to crop diversification, which is more sustainable and would be a step ahead in moving from food security to nutrition security. This will also boost the production of environmentally sustainable crops having health benefits. Hence, the focus should be on educating farmers about economically viable alternatives and the cumulative effects of stubble burning.

Sustainable crop residue utilization should promote startups based on the rural economy, which generate employability. We need to invest in the production of bioenergy from crop residues having climate-smart crops. Further, there is a need to explore new opportunities for commercial usage, such as the extraction of yeast protein. Dr. Khaiwal, in his study on strategies for cleaner emissions, has argued that crop residue can be utilized as livestock feed, compost, cattle house flooring, and conditioning material for agricultural fields. He proposed a model that focuses on alternative solutions synergistically depending on the type of agrarian residue, geographic location, seasons, and resource availability to manage crop residue in an environmentally friendly manner. His recent study gives seven-point agenda to reduce crop residue burning. Only a few crops have a fixed minimum sale price in India. These provisions incentivize farmers to produce those specific crops, resulting in enormous amounts of crop residue from those crops. Dr. Khaiwal highlighted that farmers should receive holistic benefits and focus on crop production rather than machine manufacturers and/or machinery because machines only perform for a few weeks and require large investments. Community-based solutions are needed for sustainable agricultural residue management because small-scale farmers and individuals lack the resources to develop a permanent solution. Community-based solutions can be achieved by integrating the Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA) with rural agriculture, and a workforce similar to ASHA workers can be explored to promote sustainable agricultural practices, including stubble management. Cost-benefit analyses from farm to market, as well as environmental and public health considerations, should inform government policy and incentive programs for agricultural production.

Ravindra, K., Singh, T. and Mor, S., 2019. Emissions of air pollutants from primary crop residue burning in India and their mitigation strategies for cleaner emissions. *Journal of cleaner production*, *208*, pp.261-273.

Ravindra, K., Singh, T. and Mor, S., 2022. COVID-19 pandemic and sudden rise in crop residue burning in India: issues and prospects for sustainable crop residue management. *Environmental Science and Pollution Research*, *29*(2), pp.3155-3161.