

Beyond Stubble Burning

"I don't like burning stubble, but what other option do I have?"

– Paddy farmer, Punjab, August 2023



Asar Social Impact Advisors Pvt. Ltd.

Asar Social Impact Advisors Pvt Ltd is a development startup based in Bangalore. Our work is centered around enabling a 'collective impact' approach to address significant environmental and social challenges, including air pollution and climate action. We believe that to effectively tackle the systemic problems we face today, collaborations are essential. We offer strategic advice, informed analysis, and support for planning and evaluation to funders, non-profit organizations, and for-profit enterprises, aiding them in making a more substantial impact on environmental issues. Asar coordinates the national Clean Air Collective, which boasts more than 200 member organizations, movements, individuals, and citizen groups.

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Designers: Pallavi Basri & Mohammed Sajjad

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Executive Summary

Stubble burning, the practice of burning crop residue after harvest, remains a significant issue in India, particularly in Punjab, Haryana, and Uttar Pradesh. Despite government efforts to curb the practice, farmers continue to burn large amounts of crop residue each year. Stubble burning has serious environmental, health, and economic consequences, including the release of harmful pollutants into the atmosphere, negative effects on soil quality and crop health, and increased financial burdens for farmers.

To understand why farmers in Punjab continue to burn stubble, Asar Social Impact Advisors collaborated with Researchers, Clean Air Punjab (a network of citizens, CSO members, professionals and other key stakeholders) and CMSR Consultants Private Limited to develop a comprehensive report on stubble management. The report provides farmers' perspectives on the challenges they face in reducing stubble-burning, and aims to support policy development and decision-making processes. The creation of the report involved a literature review and field research with farmers in eight districts of Punjab to collect primary data.

The historical context of paddy straw residue burning in India is closely linked to the Green Revolution, a period of agricultural development that aimed to increase productivity through the adoption of new technologies and practices. However, this agricultural model had negative consequences, including the indiscriminate disposal of paddy residue. The extensive use of pesticides led to insecticide-resistant pests, soil degradation, and health issues. The burning of paddy residue became a prevalent practice, negatively impacting air quality and exacerbating environmental issues. The Green Revolution also led to challenges such as the overexploitation of natural resources, declining crop diversity, imbalances in soil fertility, and unsustainable water use.

Stubble burning is practiced by farmers to clear fields for new crops, but it releases toxic smoke into the atmosphere. Farmers face several challenges like the short window between paddy harvesting and sowing of the next crop, a lack of awareness about the magnitude of harm caused by stubble-burning and the lack of assured procurement at minimum support price for other crops.

Many farmers who engage in stubble-burning expressed a desire to explore and put into practice novel approaches that do not involve burning. They have tried alternatives like Happy Seeder, Super Seeder, Combine Harvester fitted with Super SMS, and Pusa Decomposer, and additionally, the ex-situ management practice of baling. But farmers have faced several challenges in in-situ and ex-situ straw management, including ineffective technologies, inadequate or mismanaged subsidies, and gaps in policies shaping water and electricity management.

For small and marginal farmers, the high price and scarce availability of machinery pose considerable obstacles. Other concerns in the adoption of these technologies for stubble management include fear of pests, time-consuming processes, lack of nearby industries to take the stubble, and lack of storage space for stubble.

Various policy and regulatory frameworks have been put in place by the Government of India and Punjab Government to address the issue of stubble burning. These frameworks aim to promote alternative methods of stubble management that are more environmentally friendly. The initiatives include providing subsidies for straw management equipment, establishing biomass power plants, promoting crop diversification, implementing in-situ management techniques, and supporting the use of biofuels. While these efforts have led to a reduction in crop residue burning events in 2022 compared to the previous year, there are still many regions such as Sangrur,

Bathinda, Ferozpur, Muktsar, and Moga that have a high number of fires and need further attention.

The government can incentivize farmers to adopt alternative methods of stubble management through financial payments, ensure hassle-free subsidies for purchasing machinery, address concerns about subsidies and middleman exploitation, attract more industries to process stubble, promote crop diversification through

Minimum Support Prices, sensitize farmers about the consequences of stubble burning, improve infrastructure for stubble collection and disposal, rebuild farmers' trust in government institutions, and create village-level committees for decision-making.

Many of Punjab's farmers are willing to protect the environment and public health by not burning agricultural residues. But there are barriers to the general adoption of sustainable farming methods. To address these issues and establish an environment that supports agriculture, what is essential is collaboration between the government, agricultural institutes, and the private sector.



Introduction

Context

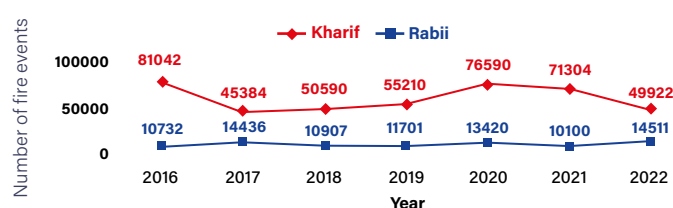
India is primarily an agricultural nation with various farming practices tailored to different agro-climatic zones. In the states of Haryana, Punjab, northern Rajasthan, and western Uttar Pradesh, rice, paddy, and wheat cropping patterns are prevalent. Punjab, in particular, which shares a border with Pakistan, is known as the "breadbasket" of India as it produces two-thirds of the country's food grains.

Stubble management has become an urgent issue in India, particularly in Punjab, Haryana, and Uttar Pradesh. With the introduction of mechanized harvesting techniques, farmers are faced with the challenge of dealing with large amounts of crop residue, commonly known as stubble, left in their fields. Unfortunately, these regions have become hotspots of stubble burning after the harvesting season.

Despite government efforts to restrict the practice since the 1990s, farmers in Punjab and Haryana continue to burn approximately 30 million tonnes of crop residue from their fields every year (more than 30% of all crop residue burnt in the country).¹ This practice is seen as the most economical way to dispose of straw and reduce the time gap between harvesting and sowing for the second (winter) crop.²

India is the second-highest crop-residue-burning country in the world.³ Approximately 85-90% of paddy straw, and some wheat straw, is burned in the fields.⁴

Number of fire events during Kharif and Rabi season in Punjab.⁵



Although the problem of straw burning exists in multiple states, it is particularly extensive in Punjab and Haryana. These two states produce 48% of all stubble in India, which is openly burned where it stands ("in situ").⁶

Every October and November, an estimated 7-8 million tonnes of crop residue are set ablaze in Punjab over two to three weeks.⁷ The figure below illustrates the occurrence of fire incidents during the rice harvesting period in Punjab.

- <https://www.sciencedirect.com/science/article/pii/S2405844023041464#:~:text=The%20tagged%20tracers%20for%20CO,first%20week%20of%20November%202021>
- Badarinath, KVS., et al (2006), Agriculture crop residue burning in the Indo-Gangetic Plains—A study using IRS-P6 AWiFS satellite data. *Current Science*, Vol. 91, No. 8, pp 1085-1089.
- Grover, D., Chaudhry, S., 2019. Ambient air quality changes after stubble burning in rice–wheat system in an agricultural state of India. *Environ. Sci. Pollut. Control Ser.* 26 (20), 20550–20559
- Mukherjee P. (2016). Crop Burning: Punjab and Haryana's killer fields, *Down to Earth*, <https://www.downtoearth.org.in/news/air/crop-burning-punjab-haryana-s-killer-fields-55960>
- Figure drawn by Shubham Aanand based on data from Crop Residue Burning (CRB) Information and Management System, Government of Punjab, Active Fire Events, <https://punjabgis.punjab.gov.in/CRBMAPS/>
- Singh, J. (2018), Paddy and wheat stubble burning in Haryana and Punjab states of India: A menace for environmental health, *Environmental Quality Management*, Volume 28, Issue 2, pp 47-53, <https://onlinelibrary.wiley.com/doi/epdf/10.1002/tqem.21598>
- <https://www.sciencedirect.com/science/article/pii/S2405844023041464#:~:text=The%20tagged%20tracers%20for%20CO,first%20week%20of%20November%202021>

Fire events during rice harvesting season in Punjab.⁸

Burnt area: 10 Oct 2019



Burnt area: 25 Oct 2019



Burnt area: 9 Nov 2019



Environmental, health and economic impact of stubble burning

Stubble-burning has several adverse effects on air quality, public health, and the climate. It releases many harmful pollutants into the atmosphere, including particulate matter, carbon monoxide, nitrogen oxides, and volatile organic compounds.

- Around 149.24 million tonnes of carbon dioxide, nearly 9 million tonnes of carbon monoxide, 0.25 million tonnes of sulphur dioxide, 1.28 million tonnes of particulate matter, and 0.07 million tonnes of black carbon are emitted from agricultural residue burning.⁹

8. Crop Residue Burning (CRB) Information and Management System, Government of Punjab, Active Fire Events, <https://punjabgis.punjab.gov.in/CRBMAPS/>

9. Jitendra, et al (2017), India's burning issue of crop burning takes a new turn, Down To Earth, <https://www.downtoearth.org.in/coverage/india/river-of-fire-57924>

- Burning paddy straw raises the soil temperature by 33.8 to 42.2 degrees celsius, leading to the elimination of essential bacterial and fungal communities, reducing soil fertility and increasing erosion.¹⁰
- Crop residue burning harms soil quality, organic matter and microorganisms, making crops more susceptible to disease and reducing the ability of higher soil layers to dissolve.
- One tonne of stubble burnt leads to a loss of 5.5 kgs of nitrogen, 2.3 kgs of phosphorus, 25 kgs of potassium and more than 1 kg of sulphur - all soil nutrients - besides organic carbon.¹¹
- According to a 2016 study in Punjab, 84.5% of people in the states experienced health issues due to increased smog, including eye, nose, and throat irritation, coughing, and wheezing.¹²

In addition, stubble burning also has economic implications. A study by the Institute for Social and Economic Change estimated that individuals in rural Punjab spend approximately INR 7.6 crore annually on medical care for diseases caused by stubble burning.¹³

Further, the traditional method of burning stubble not only wastes a valuable resource but also reduces soil fertility by depleting organic content. This in turn affects agricultural productivity and necessitates additional fertilizers and inputs, further increasing the financial burden on farmers.



According to the Global Burden of Disease Study 2019, 16,7 lakh Indians died in 2019 due to air pollution. In Punjab alone, up to 41,090 deaths in 2019 could be attributed to air pollution, accounting for 18.8% of all fatalities.¹⁴

In recent years, the central government and Punjab state governments have introduced several policy measures aimed at promoting sustainable agricultural practices and reducing air pollution caused by stubble burning. These initiatives encourage the adoption of alternative methods of stubble management and provide financial support to farmers for the implementation of these practices. A list of some of these measures is provided in Annexure 1.

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10. Yadav Ramesh Singh (2019), Stubble Burning: A problem for the environment, agriculture and humans, Down To Earth, <https://www.downtoearth.org.in/blog/agriculture/stubble-burning-a-problem-for-the-environment-agriculture-and-humans-64912>
 11. Yadav Ramesh Singh (2019), Stubble Burning: A problem for the environment, agriculture and humans, Down To Earth, <https://www.downtoearth.org.in/blog/agriculture/stubble-burning-a-problem-for-the-environment-agriculture-and-humans-64912>
 12. Mohan, V. (2018), Study confirms adverse health impact of stubble burning, The Times of India, <https://timesofindia.indiatimes.com/city/chandigarh/study-confirms-adverse-health-impact-of-stubble-burning/articleshow/66000859.cms>
 13. Mohan, V. (2015): Stubble burning costs Punjab farmers Rs 7.6 crore per year in bills, The Times of India, <https://timesofindia.indiatimes.com/india/stubble-burning-costs-punjab-farmers-rs-7-6cr-per-year-in-medical-bills/articleshow/49654508.cms>
 14. Jassowal, G. (2021), Rising air pollution lead to 41,090 deaths in Punjab in 2019, Hindustan Times, <https://www.hindustantimes.com/cities/others/rising-air-pollution-led-to-41-090-deaths-in-punjab-in-2019-report-101614594082244.html>

GREEN REVOLUTION

The “Green Revolution” in India, which began in the 1960s, aimed to boost agricultural productivity through the adoption of new technologies and practices. It introduced high-yielding variety seeds, mechanization, irrigation, pesticides, and fertilizers. These technologies were facilitated by legislative measures such as water and energy subsidies, minimum support prices, and procurement.

The Green Revolution increased the production of wheat and rice, considerably benefiting India's food security and economic development, in addition to helping to enhance agricultural output. Punjab was the first state to use and benefit from these technologies.

But there were also negative impacts. Punjab faced challenges related to the disposal of paddy residue. The extensive use of pesticides led to pesticide resistance, in turn leading to increased pesticide use, environmental contamination, and risks to plants and humans. This, along with other factors, contributed to soil degradation, ground water exploitation and health issues.

The rice-wheat cropping systems which became dominant in Punjab's agriculture due to the Green Revolution, led to a decrease in the cultivation of other crops like maize, millets, sugarcane, and legumes. The cultivation area dedicated to rice and wheat in Punjab skyrocketed from 47% in the 1970s to over 80% in 2019. This decrease in crop diversity has had negative consequences for agriculture in the state.

The excessive reliance on wheat and rice, coupled with the intensive utilization of agricultural land has resulted in a dire situation of overexploitation of vital natural resources such as soil and groundwater. Productivity levels of wheat and rice have plateaued and imbalances in soil fertility have emerged. To maintain productivity, farmers have had to use higher quantities of inputs (chemical fertilizers & pesticides), threatening the long-term sustainability of agriculture in the state. The rate of output growth is decelerating, farmers' incomes are declining, and rural distress is increasing.

Additionally, as other states improve their productivity and total production of wheat and rice, the demand for these crops from Punjab is expected to decrease, posing marketing challenges for the state. The monoculture of wheat and rice, along with high cropping intensity, has led to nutrient depletion, emergence of pests, diseases, and weeds.

Rice-wheat cropping systems have also led to stubble management issues. The burning of paddy residue became a prevalent practice, negatively impacting air quality and exacerbating environmental issues. Many farmers consider agricultural burning the most effective and cost-efficient way to clear land, fertilize soil, get rid of pests and prepare it for new plantation.

In 2022, a decline in instances of paddy crop residue burning compared to the preceding year was observed. According to data collected following the Standard ISRO Protocol for monitoring such events, the collective occurrences of paddy crop residue burning from September 15 2022 to November 30 2022, across regions including Punjab, Haryana, Delhi, the NCR Districts of Uttar Pradesh, and Rajasthan, decreased from 78,550 cases in 2021 to 53,792 cases in 2022 – marking a reduction of approximately 31.5%. While there is an evident decrease between these two years, attributing this decline solely to a shift in farmer behaviour - rather than other factors - would be premature. Continued reduction over the upcoming years would be necessary to attribute the decrease to behaviour change.



Methodology

This report by Asar Social Impact Advisors, in partnership with Clean Air Punjab and CMSR Consultants Pvt. Ltd, was prepared in order to review the existing literature on stubble burning and its consequences and complement it with focus group discussions with farmers across Punjab who practice paddy cultivation.

The purpose of the study was to identify key concerns that farmers had with existing technologies to reduce stubble burning, their awareness of government initiatives on stubble management, the challenges they encountered, and why they felt the need to continue the practice.

The literature review was conducted by scholars from Clean Air Punjab. It involved going through peer-reviewed scientific studies, civil society reports, journalistic articles and government publications on crop residue burning, alternative management techniques, economic implications, and environmental impacts.

The focus group discussions were conducted by the research team at CMSR in collaboration with Asar. The team carried out eight focus group discussions with 400 respondents in all between May- July 2023. The FGDs were conducted in villages in the districts of Fatehgarh Sahib, Patiala, Ludhiana, Sangrur, Bhatinda, Malerkotla, Moga, and Gurdaspur, which have a high incidence of stubble burning.

The respondents represented diverse socio-economic strata. Over half were small-scale farmers (with landholdings of 1-2 hectares) and semi-medium-scale (landholdings of 2-4 hectares) farmers. Around a quarter possessed medium-sized land holdings (4-10 hectares), while about 5 percent were large-scale farmers (more than 10 hectares). About 25% were farmers who farm on leased lands.

While efforts were made to involve women farmers in the focus group discussions as well, the patriarchal nature of rural Punjab made it difficult for women to participate. As a result, unfortunately, all the respondents who took part were men.

Each discussion lasted for 4-5 hours. The list of questions asked at each FGD is provided in Annexure 2. All the focus groups were conducted in Punjabi, the local language spoken by all participants. Participation was voluntary and confidential. All discussions were audio-recorded with the permission of the participants. The anonymity of all participants is protected in this report.



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Farmer Perspectives and Challenges

Reasons for burning stubble

Short window between harvesting and sowing

Farmers in Punjab typically harvest their summer-sown rice crop between 15 October and 25 October and sow the winter crop by 5 November, to ensure optimal yields.¹⁵ This means that they have a narrow window of one to two weeks to clear the fields and prepare the land for the next sowing. Respondents in the focus groups said the easiest and quickest way to get rid of the crop waste was to burn it.



THE TIME FOR NEXT CROP SOWING IS VERY LIMITED. SO, WE CAN'T TAKE ANY RISK."

"Farmers do not have any other options but to burn the stubble. It takes nearly 1.5 months for stubble to decompose if left in the field."

"I can only use 4 tractors in 15 days since I work on 70 acres of land. I have to plough and also prepare the land for next crop sowing in those 15 days."

Many respondents also said that they burnt crop residue to eliminate harmful insects, which sometimes live in paddy stalks.

"Burning the stubble is essential to get rid of insects, pests, rats, and snakes."

Some believed that the ash left behind after burning helped soil fertility. They also said that undecomposed stubble can interfere with the growth of newly-planted wheat seedlings.

15. This practice increased after the state government passed the Punjab Preservation of Subsoil Water Act in 2009 in order to curb the use of groundwater to irrigate paddy crops. The Act stated that farmers could transplant paddy from nurseries to fields only after a date set by the government, which is usually after the start of the monsoon in mid-June.

Lack of awareness about air pollution

Many of the respondents did not believe that air pollution from stubble burning was a serious problem.

"We have been doing this since long and it has not affected us at all. How can it affect people sitting far away in other cities?"

"We can clearly see the mountains of Naina Devi from here. If there would have been so much pollution then the mountains would not have been visible from here."

“

We are unable to understand how the pollution from stubble burning reaches Delhi - which is far away from here - but it has not affected Chandigarh, which is nearer than Delhi."

“

Even if stubble is burning in 10 villages here, we are still able to breathe. Even the donkeys breathe perfectly at that time."

"None of us have ever fallen ill due to stubble burning."

"Many Bollywood celebrities living in Mumbai have also died due to cancer. Do they stay near Punjab?"

A common response was that the pollution from stubble burning was not as dangerous as other sources.

"Stubble burning only constitutes about 1 to 2% of the total pollution. The smoke from stubble burning is not so dangerous as compared to the smoke from industries."

"The cars and factories cause more pollution as compared to stubble burning."

"Cancer is more due to the use of pesticides and not stubble burning."

“

The increase in cases of cancer is not due to stubble burning. It is due to contaminated and polluted water."

When we burn stubble, it is for a maximum of 10-15 days. The smoke that is generated from the industries is round the year."

Challenges in In-Situ paddy straw management

The central and state governments have launched several programmes to enable farmers in Punjab to clear stubble where it stands in the fields ("in situ") with new subsidised technologies. Respondents were asked about their experiences with some of the commonly-used technologies.

Happy Seeder

The Happy Seeder is a tractor-operated machine designed to cut and lift paddy stubble, sow wheat seeds into the soil, and deposit the straw over the sown area as a natural mulch that enriches the soil as it decomposes. Respondents said it cost about INR 1,75,000, and about INR 90,000 with the government subsidy.

Some respondents said they found the Happy Seeder an effective option to manage stubble.

"90% of the villagers here are using Happy Seeders and Super seeders. Both are equally good."

However, many respondents pointed out challenges to using this technology, which included tractor requirements and its efficiency on different kinds of soil.

"Most farmers in the village have 30-35 horsepower tractors and hence are not able to use Happy seeders or Super seeders as the minimum requirement for using the Happy seeder is a 60 horsepower tractor."

"Rodents damage our seeds badly when we sow using the Happy seeders or Super seeders. We have to spray medicine after harvesting paddy in order to get rid of rodents."

"The happy seeder is successful only in heavy soil. But here the soil is light soil and hence it does not work well".

Some respondents also said that the subsidies offered for the purchase of Happy Seeders were siphoned off by government officials or middlemen.



The subsidies are taken away by officers, industrialists, politicians etc. Farmers don't even get a single penny out of it."

"As soon as government announces subsidy like 80% subsidy, the price of the happy seeders and super seeders increase drastically to almost double the original price."

Others said that they had purchased the machines, but stopped using them after they failed to deliver results.

"It has not proved to be successful. I have personally used it on 1 acre of land. The crop was damaged after using it."



They are not in use because of poor quality or incomplete parts in the machinery."

Super Seeder

The Super Seeder is another machine designed to efficiently manage stubble by incorporating it into the soil while simultaneously sowing wheat seeds. It costs about INR 2,50,000 prior to the government subsidy.

Respondents identified many similar concerns with this machine too, including its requirement of tractors with a minimum of 55 horsepower, its inability to manage the stubble of certain varieties of paddy, and the persistence of certain pests like pink stem borer and army worm.

"Even when we use Super Seeders, we have to opt for partial burning of the stubble."

"Super Seeder is not efficient in sowing the seeds deep inside the soil."

"We don't prefer the Super Seeder due to the potential increase in pink stem borer as the larvae of stem borer is present in the stubble."

“

Between 2014 and 2017, 85% of farmers in our village stopped burning stubble and instead used the happy seeder and super seeder for stubble management. However, the rampant growth of weeds became a significant challenge. We all became frustrated and were left with no choice but to resort to stubble burning”.

One respondent also pointed out large fluctuations in the price of the Super Seeder.

“

Can the iPhone be sold at different prices within a period of few days? But it happens in case of agricultural equipment. Super seeder of a particular brand was initially sold at ₹ 2,45,000 to ₹2,60,000 and on the very last day, it was sold at ₹ 2,10,000. A difference of ₹ 40-50,000 within 20 days is a huge one.”

Combine Harvester fitted with Super SMS

One low-cost and environment-friendly technique is to fit a combine harvester with a Super SMS (straw management system) attachment that harvests paddy while simultaneously managing the stubble by cutting it into small pieces and spreading it in a uniform layer. Combine harvesters in Punjab are required by the government to have the SMS attachment.

However, respondents pointed out various challenges with using this technology, including decreased yields, increase in pest attack, and missing subsidies.

“Using this technique increases the insects’ attacks.”



We have undergone debts as a result of trying alternative methods to stubble burning. ...Some bought SMS. But the problem is that the harvest was not so good.”

“It is very expensive for us to buy super sms. It costs us around ₹1,05,000.”

“If we purchase SMS directly, it costs us ₹50,000. But if we wish to avail the benefit of subsidy scheme, then we have to purchase it for ₹1,20,000. The farmers are not even sure about whether they would get the subsidy later or not. So, subsidy schemes have not proved to be beneficial for us. The manufacturers and middlemen take the benefit of subsidy.”

“The government has made it mandatory that super sms should be fixed with combine harvesters. As a result, providers of these machineries started exploiting farmers by charging them heavily for the same.”

Pusa Decomposer

The Pusa bio-decomposer is a capsule prepared by extracting fungi strains that helps the paddy straw to break down and decompose quicker than usual. This strain of fungi produces several essential enzymes which aid the entire degradation process.

Many respondents said that the Pusa decomposer simply did not work.



The Pusa decomposer is not effective at all. It yields zero results”.

“We waited for 10-15 days. But nothing happened. It doesn’t even get mixed in the soil.”

Even those who said that the decomposer was effective said that it took about 1.5 months to work, which was too long for them.



We have used it and it is good. The only problem is the time lapse. The time taken by it to decompose the stubble is much more as compared to the time that we get between harvesting and sowing the next crop. We have to leave the land idle after spraying PUSA decomposer as we can’t use it before the stubble gets decomposed. It takes around 40 days to decompose the stubble.”

One respondent who found the Pusa decomposer effective in breaking down the stubble of a radish crop suggested that it could be used for other crops, but not paddy.



I used the Pusa decomposer after harvesting radish during the end of October before the next sowing season that is during November end. I sprayed the decomposer at that time...It is useful for crops where the time duration between harvesting and sowing the next crop is at least 40 days."

Challenges in Ex-Situ paddy straw management

Farmers can also manage paddy stubble by removing the crop residue from the fields and using or selling it for other purposes such as fodder, fuel, compost or industrial processes.¹⁶

Residue removal through balers

Balers are sometimes used in Punjab to collect paddy straw for a price, compress it into round or rectangular bales, and transport it to industries for further use. Round balers cost about INR 3,75,000, while square balers cost around INR 12,00,000.

In theory, balers represent a cost-effective way for paddy farmers to get rid of stubble. However, respondents said there were several challenges to residue removal through balers, including issues of time, space and cost.

Firstly, respondents said that baling is only feasible in areas within 5-10 kilometres of processing industries. Otherwise, high transportation costs discourage balers from taking the stubble from farmers.

"There are people in our villages who have balers but they don't take our stubble because the industries are very far away and it is not profitable for them due to the high transportation charges."

16. These practices can have detrimental effects on soil quality in certain cases. Some of the detrimental effects include soil erosion, nutrient depletion, loss of organic matter etc. Therefore, it is important to estimate sustainable residue removal rates to ensure good soil quality. Andrews, S.S. (2006), Crop residue removal for biomass energy production: Effects on soils and recommendations, US Department of Agriculture, https://www.nrcs.usda.gov/sites/default/files/2022-10/Crop_Residue_Removal_for_Biomass_Energy_Production.pdf

“

Farmers are willing to give the stubble for free. But no one is willing to take it from the fields...Hence, the only alternative is burning. The factory where the stubble is processed is at a distance of 100 kms away from the village. Hence, the charges to transport the stubble to the industries are very high.”

“If a farmer has to spare one acre specifically for storing stubble, it would be stupidity on his part. Farmers are mostly under debt. Why would farmers block their limited area of cultivation?”

For baling to work, farmers need to have enough space to store their stubble, and the stubble needs to be picked up quickly before the wheat crop is sown. Many respondents said that they lacked the space to store stubble for too long.

“Factories need to collect the stubble after 5-8, or even 10 days, as the time available for sowing the next crop is extremely limited. Therefore, we cannot take any risks or chances. It is not feasible for us to waste our land and store the stubble for an extended period while waiting for them to collect it. Additionally, keeping the crop residue for several days attracts rodent attacks. Once rodents infest the area, it takes nearly 2 years to eliminate them completely”.

Respondents also said that baling was an expensive proposition. Some respondents said they had to pay balers between INR 1500-2000 per acre to remove the stubble.

“Baling is very heavy on our pockets. The use of balers takes a lot of time, fuel and other expenses”.



We need to find the right person with machinery to handle it since we cannot take stubble on our cycles. We have to visit them again and again and request them to pick up the stubble since we have to clear our land for cultivation. Then they demand and ask ₹1500 per acre from us to pick up the stubble."

"Government officials tell us not to burn the crop residue, and say they will buy it from us at the rate of Rs. 1000-1500 per acre. However, no government officials have ever purchased the crop residue from us. Many times, we have sent the residue ourselves by bearing the transportation cost of Rs. 1500 per acre, but we have never received any money."

"We don't get any amount in exchange for stubble."

Some respondents suggested the government could do more to help.

"The government should support us by providing a designated place or dumping yards for collecting the stubble."

"We will not burn stubble if the government gives us assurance of picking it up at the earliest and that too within a specified period of time and give us money in exchange."

Some respondents opposed baling, though, saying that the factories which processed the stubble ended up polluting soil and water.

“The wastewater released from those factories is very harmful for our health, soil and crops. The villagers suffer from many diseases (even cancer) due to the release of harmful wastewater.”

Using rice straw as cattle fodder

Almost all respondents said that they do not feed their dairy animals rice straw because it lacked sufficient nutrients and was less palatable than other fodder crops.

“The content of silica in rice stubble is very high and it is not good for use as fodder for cattle. It causes various deficiencies or diseases in cattle.”

“We have tried sending the stubble to gaushalas but they also refused to take stubble.”

Other factors

MSP and other crops

Following the Green Revolution, farmers in Punjab moved away from cultivating a diverse set of crops to only cultivating wheat and rice, which the government continues to buy at an assured Minimum Support Price.

Several farmers pointed out that the lack of assured procurement on MSP for crops other than paddy and wheat remains a major concern that compels them to continue cultivating these two crops.

“We currently receive MSP only for paddy and wheat, despite the government announcing MSP for 23 crops. As a result, we are forced to cultivate these two crops.”

“We can also cultivate peas, potato and even mustard. But the problem is that we don’t get assurance of any MSP on these crops.”

“

Few years ago, we grew maize, sugarcane, lentils, mustard, black and white gram, millets, peanuts, etc. But we don’t get MSP on these crops now, that is why we don’t cultivate most of them.”

“The government announced MSP for maize at ₹1900 but it is being sold in the market at ₹1300-1400. There is no assurance for us. MSP implementation is not there.”

Respondents expressed their willingness to stop burning stubble if the government provides them guidance on which crops to cultivate, and assures procurement at MSP.

The MSP system covers a total of 23 commodities, although as per farmers they only get it on rice and wheat.

Cultivation of non-recommended varieties of rice

Farmers in the region predominantly grow paddy varieties that are not recommended by the Punjab Agricultural University, such as Pusa 44. These varieties are long-duration crops that require higher amounts of water and chemical fertilizers. Consequently, the window for subsequent crop cultivation is significantly reduced.

The stubble generated from Pusa 44 is also considerably higher than other paddy varieties. Farmers choose these long-duration varieties primarily due to their superior milling quality and higher yields.

“The recovery rate of Pusa 44 variety of rice is better and more beneficial for us.”

Policy Factors

Several policy factors contribute to the problem of paddy straw residue burning in Punjab:

- **Agricultural policies:** Agricultural policies have played a significant role in indirectly enabling the burning of paddy straw residue. Traditionally, farmers have been encouraged to burn the residue as a quick and cost-effective method of clearing the fields for the next crop. The lack of alternative and sustainable methods of crop residue management exacerbates the problem.
- **Subsidies:** The government provides subsidies for the purchase of agricultural machinery, including combine harvesters, which are used to harvest paddy. However, these machines are not equipped to handle paddy straw residue and often leave it behind in the field. Subsidies provided for the use of technology to manage stubble are often mismanaged.
- **Lack of financial support:** Farmers often lack the financial resources to adopt alternative methods of crop residue management, such as using machines to collect and bale the straw for use in other industries. The absence of financial support and incentives from the government hinders the adoption of sustainable practices.
- **Limited infrastructure:** The inadequate infrastructure for the collection, storage, and transportation of paddy straw residue intensifies the problem. Without proper infrastructure, farmers have limited options for managing the residue and are more likely to resort to burning.
- **Coordination and enforcement:** Coordination among various government agencies is crucial in addressing the issue. However there seems to be a lack of coordination between the government agencies regarding how crop residues can be used for bioenergy purposes. The ministry of Power, MNRE, and other agencies all target crop residue, but very little has been done in terms of implementation and planning.¹⁷
- **Awareness and education:** Limited awareness and education about the environmental and health hazards associated with paddy straw burning also contribute to the problem. Policies should focus on creating awareness and providing education to farmers about the negative consequences of this practice and promoting alternative methods of residue management.

17. Sinha, P. (2023), New report estimates district-wise crop residue estimates for bioenergy production, Mongabay, <https://india.mongabay.com/2023/07/new-report-unveils-district-wise-crop-residue-estimates-for-bioenergy-production/>



Conclusion

Punjab's struggle with pollution highlights the unintended consequences of well-meaning policies. The Punjab Preservation of Sub-Soil Water Act, 2009, which was aimed at protecting dwindling groundwater by delaying harvesting, narrowed the window that farmers had before the wheat harvest, which in turn increased stubble burning.

Mechanization, advanced irrigation techniques, and hybrid crop varieties have led to monocultures of rice and wheat. The lack of successful procurement models for alternate crops and challenges in the supply chain discourages diversification. Financial viability and lack of support further hinder participation.

Policies that recognize the potential of utilizing paddy straw for power generation and biofuels have faced challenges. Combine harvesters have made straw collection difficult. The lack of storage facilities and high transportation costs burden farmers and biomass power plants.

Effective crop residue management schemes were introduced, but farmers face challenges with implementation. Insufficient horsepower of tractors, limited usage periods, machine malfunctions, and low productivity contribute to traditional methods and crop burning. Standardized rental rates and comprehensive support are needed for successful implementation.

Harvesting and sowing during the festive season have also created a labour shortage. Mechanization has reduced the need for manual labour, and alternative employment opportunities have decreased seasonal migration. This has made it challenging to manage crop residue and implement diversification programs. Innovative solutions are needed to address labour shortages, promote crop diversification, and ensure effective residue management.

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Asar Social Impact Advisors

References

- Ali, S., et al (2012), Effectiveness of Minimum Support Price Policy for Paddy in India with a Case Study of Punjab, *Agricultural Economics Research Review* Vol. 25(No.2) pp 231-242.
- Anand S, et al (2023), Agricultural residues and manures into bioenergy. Agroindustrial waste for green fuel application, *Clean Energy Production Technologies*, https://doi.org/10.1007/978-981-19-6230-1_3.
- Andrews, S.S. (2006). Crop residue removal for biomass energy production: Effects on soils and recommendations, US Department of Agriculture, https://www.nrcs.usda.gov/sites/default/files/2022-10/Crop_Residue_Removal_for_Biomass_Energy_Production.pdf
- Balingbing, C., et al (2020). Mechanized Collection and Densification of Rice Straw, *Sustainable Rice Straw Management*, https://doi.org/10.1007/978-3-030-32373-8_2
- Bhagawati, R., et al (2020). Chapter-5 Farm Waste Management. *AGRONOMY*, p.77.
- Bhuvaneshwari, S., et al (2019), Crop residue burning in India: policy challenges and potential solutions, *Int. J. Environ. Res. Publ. Health* 16 (5), p. 832.
- Bilalis, D., et al (2003). Effect of different levels of wheat straw soil surface coverage on weed flora in Viciafaba crops, *J. Agron. Crop*; 89: pp 233–241.
- Brtnicky, M., et al (2021), A critical review of the possible adverse effects of biochar in the soil environment. *Science of the Total Environment*, 796, p.148756.
- Chaba, A. (2020), Centre should support crop diversification in Punjab like it did during Green Revolution: Experts, *Indian Express*, <https://indianexpress.com/article/cities/chandigarh/centre-should-support-crop-diversification-punjab-experts-6919312/>.
- Chhatre, A., et al (2016), Crop diversification and risk management in Indian agriculture. *Decision* 43, pp 167–179, <https://doi.org/10.1007/s40622-016-0129-1>.
- Choudhary, A. K. (2020). Adoption of paddy straw management techniques in selected villages of Sangrur district of Punjab State, M.Sc. thesis, Punjab Agricultural University, Ludhiana.
- Committee for Formulation of Agriculture Policy for Punjab State, (2013). *Agriculture Policy*.
- Department of Science and Technology and Non-Conventional Energy, Government of Punjab, NRSE Policy, (2012), <https://www.peda.gov.in/media/pdf/nrse%20pol%202012.pdf>
- Directorate of Information and Public Relations, Punjab, (2018), Punjab govt signs MoU with IOC for setting up Bio-gas & Bio-CNG plants, <http://diprpunjab.gov.in/?q=content/punjab-govt-signs-mou-ioc-setting-bio-gas-bio-cng-plants>.
- Dobermann, A.T.H.F., et al (2002), Rice straw management. *Better Crops International*, 16(1), pp 7-11.
- Gadde, B., et al (2009), Air pollutant emissions from rice straw open field burning in India, Thailand and the Philippines, *Environ. Pollut.* 157 (5), pp 1554–1558.
- Goswami, S.B., et al (2020), Crop residue management options in rice–rice system: a review., *Archives of Agronomy and Soil Science*, 66(9), pp 1218-1234.
- Government of Punjab (2014). *Management and Utilisation of Paddy Straw in Punjab: Earn, Don't Burn Initiative*, Draft White Paper, Department of Science, Technology and Environment, Chandigarh.
- Grover, D., et al (2019), Ambient air quality changes after stubble burning in rice–wheat system in an agricultural state of India, *Environ. Sci. Pollut. Control Ser.* 26 (20), pp 20550–20559.
- Gupta, H.S., et al (2012), Crop residues management with conservation agriculture: Potential, constraints and policy needs, *Indian Agricultural Research Institute*.
- John, D. A., et al (2021), Lessons from the aftermaths of green revolution on food system and health. *Front. Sustain. Food Syst.*, 2021, 5, pp 644559, <https://doi.org/10.3389/fsufs.2021.644559>.

- Kang, M. S. (2013), Achieving crop diversification in Punjab. The Tribune, https://www.academia.edu/26065277/Achieving_crop_diversification_in_Punjab
- Kang, S Manjit (2021). Crop residue management: Innovative solutions can douse farm fires, The Tribune, <https://www.tribuneindia.com/news/punjab/crop-residue-management-innovative-solutions-can-douse-farm-fires-310450>
- Kaskaoutis, D.G., et al (2014), Effects of crop residue burning on aerosol properties, plume characteristics, and long-range transport over northern India, J. Geophys. Res.: Atmospheres 119 (9), pp 5424–5444.
- Kaur A (2020), Problems and prospects of paddy straw management technologies in Bathinda District, M.Sc. thesis, Punjab Agricultural University, Ludhiana.
- Kaur, A. (2021), Adoption of paddy straw management technologies by potato growers of Jalandhar District of Punjab, M.Sc. thesis, Punjab Agricultural University, Ludhiana.
- Kaur, Prabhjyot, et al (2020). Does smog in Punjab affect neighbouring states?, Progressive farming, Punjab Agricultural University.
- Kumar, A. (2019), Why Farmers Are Forced to Choose Stubble Burning Over Happy Seeder, The Quint, <https://www.thequint.com/news/india/air-pollution-in-delhi-ncr-stubble-burning-in-punjab>.
- Kumar, P. (2015), The Extent and Management of Crop Stubble, Socioeconomic and Environmental Implications of Agricultural Residue Burning, https://link.springer.com/chapter/10.1007/978-81-322-2014-5_2.
- Kumar, S., et al (2022), Impact assessment study of central sector scheme for promotion of agricultural mechanisation for in-situ Paddy stubble management in Punjab, Department of Economics and Sociology, Punjab Agricultural University.
- Lal, R. (1997), Residue management, conservation tillage and soil restoration for mitigating greenhouse effect by CO₂-enrichment, Soil and tillage research, 43(1-2), pp 81-107.
- Lenka N. K., et al (2012), Soil carbon sequestration and erosion control potential of hedgerows and grass filter strips in sloping agricultural lands of eastern India, Agriculture, Ecosystems and Environment; 158: pp 31–40.
- Lohan, S.K., et al (2018). Burning issues of paddy residue management in north-west states of India, Renew. Sustain. Energy Rev. 81, pp 693–706.
- Mandal, K. G., et al (2004), Rice residue-management options and effects on soil properties and crop productivity, J of Sci Techno 2: 224-31.
- Meena, H.N., et al (2022), Crop Residue: Waste or Wealth? Technical Bulletin 2022, ICAR- Agricultural Technology Application Research Institute, pp 1-30.
- Ministry of Agriculture (2021), Promotion of Agricultural Mechanization for In-situ management of crop residue in the states of Punjab, Haryana, Uttar Pradesh and NCT of Delhi, <https://pib.gov.in/PressReleaseIframePage.aspx?PRID=1780261>
- Ministry of Agriculture, (2014), Crop diversification program in Haryana, Punjab & Western Uttar Pradesh, Government of India, http://agricoop.nic.in/sites/default/files/CDPGuidelines_0.pdf
- Motghare, V. S., et al (2014), Generation cost Calculation for 660 MW Thermal Power Plants, Int J Innov Sci Eng & Technol 1: pp 660-64.
- Mukherjee P. (2016), Crop Burning: Punjab and Haryana's killer fields, Down to Earth, <https://www.downtoearth.org.in/news/air/crop-burning-punjab-haryana-s-killer-fields-55960>.
- National Food Security Mission (2018). Brief Note on CDP, https://nfsm.gov.in/ReadyReckoner/CU2/CUII_Brief.pdf
- Pandey, R., et al (2020). Addressing Air Quality Spurts due to Crop Stubble Burning during COVID19 Pandemic: A case of Punjab, National Institute of Public Finance and Policy, https://www.nipfp.org.in/media/medialibrary/2020/06/WP_308_2020.pdf

- Paolini, V., et al (2018), Environmental impact of biogas: A short review of current knowledge, *Journal of Environmental Science and Health, Part A*, 53(10), pp 899-906.
- Pingali, P., et al (2019). Transforming food systems for a rising India, Springer Nature, p.368, <https://link.springer.com/book/10.1007/978-3-030-14409-8>.
- Porichha, G.K., et al (2021), Crop residue management in India: Stubble burning vs. other utilizations including bioenergy, *Energies*, 14(14), p. 4281.
- Press Trust of India (2018), BioCNG to be manufactured from paddy straw: Minister, Business Standard, https://www.business-standard.com/article/pti-stories/biocng-to-be-manufactured-from-paddy-straw-minister-118061100980_1.html.
- Press Trust of India (2019), Over Rs 1,600 cr central funds to combat pollution, stubble burning: RTI. MoneyControl, <https://www.moneycontrol.com/news/india/over-rs-1600-cr-central-funds-to-combat-pollution-stubble-burning-rti-4728881.html>.
- Punjab Energy Development Agency (2022), Waste to energy projects, <https://www.peda.gov.in/waste-to-energy-projects-on-21.05.2023>.
- Punjab Energy Development Agency, (2020), Biomass Power Projects, <https://www.peda.gov.in/biomass-power-projects>.
- Rasul, G., (2016). Managing the food, water, and energy nexus for achieving the Sustainable Development Goals in South Asia, *Environ. Dev.*, 2016, 18, 14–25; <https://doi.org/10.1016/j.envdev.2015.12.001>.
- Roul, C., et al (2022), Assessment of agrobiodiversity in the intensive agriculture: a case study of the Indo-Gangetic Plains of India, *Biodivers. Conserv.*, 2022, 31, 397–412; <https://doi.org/10.1007/s10531-021-02336-y>.
- Sharma, S., et al (2019), Ethanol production from NaOH pretreated rice straw: a cost effective option to manage rice crop residue, *Waste and Biomass Valorization*, 10(11), pp 3427-3434.
- Sidhu H.S, et al (2015), Development and evaluation of the Turbo Happy Seeder for sowing wheat into heavy rice residues in NW India, *Field Crops Research*, 184, pp 201-212. <https://doi.org/10.1016/j.fcr.2015.07.025>. December 2015.
- Singh, B. K. et al (2022). Crop Diversification: Transforming Lives, One Farmer At A Time, BKC Aggregators, <https://www.bkcaggregators.com/2022/03/diversifying-agriculture-in-punjab-by.html>
- Singh, B., et al (2019), Tradeoffs between groundwater conservation and air pollution from agricultural fires in northwest India, *Nat Sustain* 2, pp 580–583, <https://doi.org/10.1038/s41893-019-0304-4>
- Singh, J., et al (2008), Energy potential through agricultural biomass using geographical information system—A case study of Punjab, *Biomass and Bioenergy*, 32(4), pp 301-307.
- Singh, T. (2020), Assessment of rate of adoption of happy Seeder technology by characterizing technological attributes and extension efforts, M.Sc. thesis, Punjab Agricultural University, Ludhiana.
- Singh, Y. et al (2014), Management of cereal crop residues for sustainable rice-wheat production system in the Indo-Gangetic plains of India, *Proceedings of the Indian National Science Academy*, 80(1), pp 95-114.
- Streets, D.G., et al (2003), An inventory of gaseous and primary aerosol emissions in Asia in the year 2000, *J. Geophys. Res.: Atmospheres* 108 (D21).
- Tisdale, S., et al (1985), Soil fertility and fertilizers. Collier Macmillan Publishers.
- Tripathi, A., et al (2016), Impact of Preservation of Subsoil Water Act on Groundwater Depletion: The Case of Punjab, India. *Environmental management*, 58(1), pp 48–59, <https://doi.org/10.1007/s00267-016-0693-3>
- Vibhaw, N., et al (2020). Ordinance Passed to Constitute a Commission to Control Air Pollution in the National Capital Region (NCR) And Adjoining States, Mondaq, <https://www.mondaq.com/india/clean-air-pollution/1003864/ordinance-passed-to-constitute-a-commission-to-control-air-pollution-in-the-national-capital-region-ncr-and-adjoining-states>.

Annexure 1

Policy and Regulatory Measures for Stubble Management

There are various policy and regulatory frameworks by Government of India and Punjab government for stubble management which are aimed at addressing the issue of stubble burning. These frameworks are designed to promote alternative methods of stubble management that are more environmentally friendly.

Project for promotion of technologies to stop burning of straw under RKVY (2009-2010)

From 2009 to 2010, the 'Project for promotion of technologies to stop burning of straw' was implemented as part of the Rashtriya Krishi Vikas Yojna (RKVY). The objective of this initiative was to deter straw burning among farmers by offering a 50% subsidy on straw management equipment like rakes, balers, and Happy Seeders.¹⁸

New and Renewable sources of Energy Policy (2012)

The policy aimed to establish small, highly efficient biomass plants in rice mills. The objective was to generate 600 MW of power from biomass and agricultural residue by 2022. Currently, there are 11 biomass power projects operating in Punjab, with a total capacity of 97.50 MW. These projects use 8.8 Lac metric tons of paddy straw annually. Two biomass power projects with a capacity of 14 MW became operational by June 2021, utilizing 1.26 Lacs metric tons of paddy straw per year. The Punjab government has proposed allocating 100 MW standalone biomass power projects and 25 MW biomass solar hybrid power projects.¹⁹

Agriculture policy for Punjab (2013)

The policy aimed at enhancing mechanisation in agriculture to achieve precision in farm operations, ensure cost-effective repair and maintenance, and upgrade and standardise available equipment.²⁰

Crop Diversification programme in Punjab and other states (2013)

In 2013-14, the central government earmarked Rs 500 crores for crop diversification in Punjab and other states. The aim was to decrease reliance on water-intensive paddy cultivation by promoting improved production technologies for alternate crops, restoring soil fertility through leguminous crops, and diverting at least 5% of paddy-growing blocks to other crops. However, funding for the program varied over the years, with some years receiving higher amounts.

For example, in 2013-14, INR 24,950 lakhs was allocated for the program. In the following fiscal year, INR 25,000 lakhs was allocated. However, in 2015-16, the funds allocated decreased to INR 7,500 lakhs. This trend continued in 2016-17, with a total of INR 7,947 lakhs allocated, and in 2017-18, the allocated funds decreased further to INR 1,766 lakhs. Finally, in 2018-19, the allocation for the program significantly reduced to INR 706.6 lakhs.²¹

18. Meena, H.N., et al (2022), Crop Residue: Waste or Wealth? Technical Bulletin 2022, ICAR- Agricultural Technology Application Research Institute, pp 1-30.

19. Punjab Energy Development Agency, (2020), Biomass Power Projects, <https://www.peda.gov.in/biomass-power-projects>.

20. Committee for Formulation of Agriculture Policy for Punjab State, (2013). Agriculture Policy.

21. National Food Security Mission (2018). Brief Note on CDP, https://nfsm.gov.in/ReadyReckoner/CU2/CUII_Brief.pdf.

National Policy for Management of Crop Residue (NPMCR) (2014)

The policy aims to tackle the environmental degradation caused by burning crop residue and promote efficient utilization. The policy's objectives include preventing burning through in-situ management techniques, diversifying the use of crop residue for various purposes, raising awareness about the harmful effects of burning, and implementing suitable legislation to control the practice. In 2018, the central government introduced several initiatives to encourage the wider utilization of crop residue. These initiatives include the Promotion of Agricultural Mechanization for In-Situ Management of Crop Residue and the National Biofuel Policy. These policies are designed to support the adoption of remote sensing techniques and aerial surveillance to identify areas where crop burning is occurring.

Management and utilisation of paddy straw in Punjab (2014)

The document took a comprehensive approach to managing paddy-straw and promoted the idea of 'Earn, Don't Burn' by advocating for a combined strategy to prevent resource loss from burning. It stressed the importance of reducing the paddy cultivation area and proposed incorporating paddy straw into fields as an in-situ management strategy. The goal was to utilize 5.73 million tonnes of paddy straw in 2016-17, with industries using it as a raw material eligible for incentives under the 'Fiscal Incentives for Industrial Promotion - 2013' scheme in Punjab.

Scheme for promotion of Straw Management Equipment under Sub-Mission ON Agricultural Mechanisation (SMAM) (2016)

The Department of Agriculture, Ministry of Agriculture, Cooperation, and Farmer Welfare launched this scheme in 2016. Its objective was to promote and provide financial incentives for the purchase of equipment pertaining to straw management in Punjab and other states covered under the SMAM (Straw Management Awareness and Application Model).

National Biofuel Policy (2018)

The Goal of the policy is to enable availability of biofuels in the market, thereby increasing its blending percentage. The Ministry of Petroleum & Natural Gas notified that Oil Companies shall sell Ethanol Blended Petrol (EBP) with up to 20% blending of ethanol throughout the country from April 2023. The blending of ethanol in petrol is to gradually be increased in the coming years. A target of 20% blending of ethanol in petrol is proposed by 2025-26. An indicative target of 5% blending of biodiesel in diesel /direct sale of biodiesel is proposed by 2030. This goal is to be achieved by: (a) reinforcing ongoing ethanol/biodiesel supplies through increasing domestic production, (b) setting up second-generation bio-refineries, (c) developing new feedstock for biofuels, (d) developing new technologies for conversion to biofuels, (e) creating suitable environment for biofuels and its integration with the main fuels.

While bio-ethanol blending is already mandatory, the policy currently recommends bio-diesel blending. To support this, the government provides a Minimum Support Price for non-edible oilseeds used in bio-diesel production. Additionally, various financial and fiscal measures are being considered to ensure a fair and competitive environment for biofuels in the energy sector. The MSP mechanism guarantees fair prices for oilseed farmers, while the National Rural Employment Guarantee Programme offers employment opportunities in biofuel plantations.

In 2018, the Punjab government entered into a Memorandum of Understanding with Hindustan Petroleum Corporation Limited, Indian Oil Corporation, Verbio India Private Limited, and Rika Biofuel Development Limited to establish Bio-gas and Bio-CNG plants within the state.²²

Promotion of Agricultural Mechanisation for in-situ Management of Crop Residue in State of Punjab, and other states (2018)

The Scheme's primary objectives are to protect the environment from air pollution and preserve soil health by preventing the burning of crop residue. To achieve

22. Directorate of Information and Public Relations, Punjab, (2018), Punjab govt signs MoU with IOC for setting up Bio-gas & Bio-CNG plants, <http://diprpunjab.gov.in/?q=content/punjab-govt-signs-mou-ioc-setting-bio-gas-bio-cng-plants>.

effective residue management, the Scheme supports the establishment of Farm Machinery Banks, which provide farmers with access to necessary machinery through custom hiring. This helps address economic challenges faced by small landholders.²³

In 2019-20, the number of machines delivered declined from 28,609 in 2018-19 to 14,625, likely due to increased availability of machines.²⁴ The Punjab government has established 7,378 custom hiring centers (CHCs) within two years and plans to set up an additional 5,200 CHCs in 2020 to ensure each village has access to at least one.²⁵ As part of the scheme, farmers in Punjab have received a subsidy of approximately INR 460 Crore on 50,815 farm machines.

To ensure a consistent supply of farm equipment and machinery, the Government of India has identified around 180 manufacturers from Punjab. In Punjab, during 2018-19, various in-situ crop residue management machinery managed an area of 1,602,822 hectares, with happy Seeders specifically managing an area of 449,529 hectares.²⁶

National Clean Air Programme (NCAP)

The National Clean Air Programme (NCAP) has the following objectives:

- Implement stringent measures to prevent, control, and reduce air pollution.
- Establish a reliable and comprehensive ambient air quality monitoring network.
- Enhance public awareness and capacity-building for effective air pollution management.

The NCAP is a mid-term, five-year action plan that can be extended based on outcomes. It aims to coordinate efforts among central ministries, state governments, and local bodies.

To address the issue of stubble burning, the central government has allocated over INR 1,600 crore under two schemes. One scheme focuses on tackling pollution in Delhi-NCR, while the other aims to discourage stubble burning. INR 1,178.47 crore has been disbursed for the "Promotion of Agricultural Mechanisation for In-Situ Management of Crop Residue" in Punjab, Haryana, Uttar Pradesh, and Delhi. Additionally, around INR 460.96 crore was released for a separate program called "Control of Pollution" in 2019-20. This program supports state pollution control boards, committees, and the implementation of the National Clean Air Programme.

Furthermore, an ordinance was issued to establish a Commission for Air Quality Management in NCR and surrounding areas. This commission aims to foster a coordinated approach to combat air pollution.

Agro Machinery Service Centres (AMSC)

The Government of Punjab launched the Agro Machinery Service Centres (AMSC) project to tackle the high cost of agricultural machinery and guarantee its accessibility to farmers through rental services. Initially, individual farmers, cooperative societies, and entrepreneurs were incentivized to set up AMSCs with government subsidies. These centres were mandated to offer a Happy Seeder and Laser land leveller.

23. Ministry of Agriculture (2021), Promotion of Agricultural Mechanization for In-situ management of crop residue in the states of Punjab, Haryana, Uttar Pradesh and NCT of Delhi, <https://pib.gov.in/PressReleaseSelfFramePage.aspx?PRID=1780261>.

24. Pandey, R., et al (2020). Addressing Air Quality Spurts due to Crop Stubble Burning during COVID19 Pandemic: A case of Punjab, National Institute of Public Finance and Policy, https://www.nipfp.org.in/media/medialibrary/2020/06/WP_308_2020.pdf

25. (Ramachandran, 2020)

26. (MoAFW, 2019)

Annexure 2

Listening to farmers of Punjab on The problems in managing crop residue of kharif crop Before rabi crop operations

The listening exercise will be carried out in a 2.5 hr. meeting divided broadly into 4 sections. While most of the time will be devoted to conversing with the farmers directly, certain technical inputs will be required when dealing with alternatives and crop diversification. Therefore, it will be a good idea to find some time to have a transect walk in the village where the listening exercise is being conducted, so that questions can be asked while visiting the fields along with the participants – may be divided into 2-3 groups.

Section 1

Introductory section/setting the context

1. Brief exchange of pleasantries rapport building

- Self-Introduction by Asar and CMSR team members and welcoming the participants
- Self-introduction by farmers (name, village, size of land operated, crops grown in different seasons)
- Brief orientation by the progressive farmer/other resource person

2. Goals and plans of the listening session

- Overall goal is to understand the opportunities and challenges surrounding crop residue management. Specific goals - learning from farmers about the problems they face in crop residue management, origin of the problem, knowledge about incentives and disincentives offered by the government, knowledge and adoption of alternatives, way forward.
- Information captured will be used to determine what changes or actions are required to tackle the issue of stubble burning, without compromising on farmers' productivity/gain.

3. Listening session overview

- Moderator to describe the flow of the sessions and the overall time the discussion may take. Some of the questions might seem obvious or perhaps repetitive but we are keen to understand your perspective. As such we are seeking a lively and honest discussion with participation from everyone here. The discussion may take about 3 hours. Your participation in the discussion is voluntary. Your viewpoint will be valuable for us.

Section 2

Understanding the problem

Probe - (Punjab has been growing rice-wheat system since the Green Revolution. Since when did this become a major problem)

1. Cropping Pattern (ongoing agricultural year, June 2022 to May 2023)

- Main crop in Kharif (with approx. nursery raising, sowing and harvesting dates)
- Main crop in Rabi (with approx. nursery raising, sowing and harvesting dates)
- Main crop in Zaid (with approx. nursery raising, sowing and harvesting dates)
- Any intercrop with main crop?

2. Do you face any problem with respect to removal of stubble from the field after harvesting the main kharif crop and sowing the winter crop?

- If yes, which crop?
- What kind of problems do you face?
- What is the origin of the problem? Since when did this problem become a major issue?
- When did burning emerge as one of the major issues?

3. What do you do with the crop residue produced from the main kharif crop?

- Burning? (Probe for: factors that lead to stubble burning, awareness of the side effects and long-term health hazards associated with stubble burning, etc.)
- Left to stand in the field for mulch for the next crop and planting in the winter crop by using happy seeder?
- Left in the field to decompose and produce organic nutrient through using PUSA decomposer
- Sold as waste to energy factory
- Sold to factories that produce new products through recycling (e.g pellets, briquettes etc.)
- Store/sell straw for use as animal fodder

4. What are the alternative methods that were tried by the farmers in your area. What worked and what did not?

5. If any of the alternative method is adopted what is the approximate expenditure per acre? (Please include capital expenditure (one time machinery etc.) and operational expenditure estimates)

6. How many have happy seeder + tractor? How many own combine harvesters fitted with happy seeders?

- How much was invested? Was subsidy availed?
- What is the EMI?
- What is the interest part of the EMI?

7. What are the machineries used by the farmers on custom hiring basis for stubble management? Probe for each machinery used:

- Is the service available on time?
- What is the cost of hiring per acre?
- Problems in using machinery
- Advantages/disadvantages, Ease of Service provision, etc.

8. How may have purchased bailers? Probe for:

- How much was invested? Was subsidy availed?
- What is the EMI?
- What is the interest part of the EMI?
- Are the economics favorable for using bailers?

9. Awareness and usage of PUSA decomposer? Probe for:

- How many are aware?
- How many are using?
- Cost per acre.
- Is this affordable?
- Is it readily available and where?
- How may stopped using it after initially adopting and why?
- Any problems in use of decomposer?
- Why some farmers are not using decomposer?

10. How many are selling the crop residue to waste to energy or other purposes?

- The value chain of such sale
- Any cost incurred on it?
- Any price received for it?
- Why people are not selling /giving away crop residue?

11. Awareness and opinion about fines and other punitive measures for stubble burning

12. Awareness about alternative uses of crop residue

- Pellets
- Brickettes for construction purposes
- Biochar
- Animal feed/fodder
- Animal bedding
- Soil enrichment through mulching/ploughing back into soil

13. Challenges in expanding alternatives to current residue management practices and cropping patterns?

Section 3

Introductory section/setting the context

1. Awareness about initiatives taken by the government/ or any other agencies to resolve the problem of stubble burning in your area? Probe for: various initiatives that have been attempted?

2. Reason/s for rising stubble-burning cases in the region despite various interventions by the government to address the issue? Probe for: challenges faced by the farmers in adopting alternative solutions (For example: distribution of machines by the government to manage paddy stubble, pellet making, in-situ management etc.)

3. Information about whether farmers attended any awareness camps regarding stubble burning? If yes, probe for the details.

4. Support (knowledge, training, machines or financial support) receive from panchayat, local authorities or agricultural universities to tackle crop residue burning?

5. Ask the farmers to mention all the stakeholders that they can think of engaged in addressing the issue of stubble burning in their village. Also mention details of roles played in pursuit of solutions. (For example; panchayat, any local NGO, other govt agencies, agriculture universities etc.)

6. Acceptance towards low-cost alternative to stubble burning? Probe for: their interest and willingness to adopt the practices and what kind of sustainable intervention they seek to prevent the problem of stubble burning which is also in the best interest of farmers?

Section 4

Problems of agriculture in general and need for crop diversification

1. Which problems are experienced by farmer? (non-market related)

- Soil salinity
- Water stress
- Need for high doses of fertilizer due to decrease in soil fertility
- Need for increasing use of pesticides due to increasing pest and disease infestation

2. Awareness about issues associated with stubble burning?

- Awareness that residue burning results in soil carbon and nitrogen
- Awareness that crop residue is a good source of preserving soil fertility and soil moisture?
- Awareness of breathing problems caused by crop residue burning? How badly does it affect the communities?
- Awareness that burning crop residue causes air pollution in your own neighborhood? Awareness that the pollutants can be blown by the wind?
- Awareness that this pollution causes danger to public health?

3. Is farming also a reason for rise in cancer incidences in Punjab? If so, how?

4. Awareness that applying biochar can help in reducing soil salinity?

5. Awareness of crop diversification that can replace the rice – wheat rotation system?

6. Willingness to adopt crop diversification? If yes, what would be the ideal rotation? What support is required for this?

- From scientists
- From Government
- From non-profits
- From Panchayats

Consensus Building

Action Planning





“

Few years ago, we grew maize, sugarcane, lentils, mustard, black and white gram, millets, peanuts, etc. But we don't get MSP on these crops now, that is why we don't cultivate most of them.”



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**Clean Air
Punjab**

Asar Social Impact Advisors Pvt Ltd
No 16, 7th Temple Road, 15th Cross
Malleswaram, Bangalore,
Karnataka- 560003