

CROP RESIDUE BURNING: FARMERS' PERCEPTIONS AND ASSOCIATED FARMER CHARACTERISTICS

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ABSTRACT

Crop residue burning (CRB) or stubble burning is a persistent environmental and agronomic challenge in India, particularly within the rice–wheat system, where farmers rely on it as the quickest means of disposal despite its harmful impacts. This study was conducted in Jabalpur district of Madhya Pradesh, one of the state's highest CRB-affected regions, to evaluate farmers' perceptions of residue burning and analyse how their personal, socio-economic, communicational, and psychological profiles influence these perceptions. A total of 120 farmers from six villages in Patan block were selected using multistage purposive-random sampling. Primary data were collected through structured interviews and analysed using descriptive statistics and Pearson's correlation. Findings revealed that most farmers (69.17%) had medium-level perceptions, indicating awareness of the adverse effects of CRB such as soil nutrient loss, air pollution, and microbial degradation, but limited motivation or resources to adopt alternatives. Only 15 per cent demonstrated high perception, while 15.83 per cent showed low perception. Strong consensus was noted on the harmful impacts on soil health (85.33%) and the potential of eco-friendly options like biofuel plants and baling, yet traditional beliefs regarding pest and weed control persisted. Correlation analysis highlighted ecological consciousness ($r = 0.348$, $p < 0.01$), education ($r = 0.321$, $p < 0.01$), mass media exposure ($r = 0.284$, $p < 0.01$), economic motivation ($r = 0.275$, $p < 0.01$) and landholding size ($r = 0.253$, $p < 0.01$) as significant predictors of perception, whereas age ($r = 0.058$) and family size ($r = 0.041$) had negligible influence. The study concludes that enhancing awareness, providing affordable technologies, and creating economic incentives are crucial to reducing CRB and promoting sustainable residue management.

Keywords: crop residue burning, farmers' perception, sustainable residue management, rice-wheat system.

INTRODUCTION

Agriculture plays a vital role in food security and rural livelihoods in India, but agricultural waste management remains a major environmental concern. Crop residue burning (CRB), particularly in the rice-wheat system, is widely practiced due to short sowing windows, labour shortages, high operational costs, and lack of affordable residue management technologies (Gadde et al., 2009; Dutta et al., 2022). India produces nearly 500 million tonnes of crop residue annually, of which about 92 million tonnes are burned openly (Bhuvaneshwari et al., 2019). Although convenient, CRB contributes to greenhouse gas emissions, air pollution, soil nutrient depletion, and adverse health effects (Jain et al., 2014; Lan et al., 2022). Previous studies have highlighted that farmers' perceptions, ecological consciousness, education, mass media exposure, innovativeness, and economic motivation significantly influence their environmental

decision-making and adoption behaviour (Prajapati et al., 2018; Gamit & Kumar, 2022; Rana & Patel, 2022; Veni et al., 2022; Desai et al., 2024; Kumbhani et al., 2024; Gamit & Vinaya, 2024).

Despite policy interventions such as Happy Seeder technology, mulching, and bio-decomposers, CRB persists due to financial constraints and limited access to sustainable alternatives (Kaushal, 2020; Vinaya et al., 2013). Recent reports recorded 37,602 CRB incidents during 2024, with Madhya Pradesh reporting the highest number of cases (Anonymous, 2024a). Jabalpur district, one of the major CRB-affected districts in the state, provides an important context for studying farmers' perceptions toward CRB and their association with personal, socio-economic, communicational, and psychological characteristics. Understanding these factors is crucial for identifying barriers to the adoption of sustainable residue management practices and for designing

effective extension interventions, awareness programmes, and policy measures. The study is significant in providing location-specific insights that may help policymakers, researchers, and extension agencies promote eco-friendly alternatives and reduce the environmental and health impacts of CRB.

OBJECTIVES

- (1) To evaluate the perception of farmers towards crop residue burning
- (2) To analyse the relationship between the profile of farmers and their perception towards crop residue burning

METHODOLOGY

The study was based on a positivist research philosophy, assuming that farmers' perceptions and related socio-economic and psychological variables can be objectively measured. A deductive approach was adopted, wherein theoretically derived factors influencing perception were empirically tested. The research followed a quantitative methodology using a survey design with a cross-sectional time horizon, as data were collected at a single point in time during 2025.

The study was conducted in Jabalpur district of Madhya Pradesh, where the paddy-wheat cropping system predominates and crop residue burning has been highly prevalent in recent years (Anonymous, 2024a). Patan block was purposively selected due to the highest reported cases of residue burning (675) in 2024 (Anonymous, 2024b). Six villages reporting the highest incidence were selected, and an eligibility list of farmers owning at least one acre of land and cultivating rice and wheat continuously for five years was prepared. A mixed sampling design (multistage purposive-random sampling) was used, wherein the block and villages were selected purposively, followed by simple random selection of 20 eligible farmers from each village, resulting in a total sample of 120 respondents.

Primary data were collected through a structured and pre-tested interview schedule to ensure clarity and relevance to the study objectives. Personal interviews were conducted after explaining the purpose of the research to ensure reliability and encourage free interaction. Secondary data were obtained from the State Agriculture Department, the Office of the Deputy Director of Agriculture, and relevant reports and publications.

Farmers' perception of crop residue burning, the dependent variable, was measured using a Likert-type scale (Anuradha, 2020), covering aspects such as soil organic matter

decline, environmental pollution, and health hazards from smoke. Responses ranged from Strongly Agree to Strongly Disagree (scores 5 to 1), yielding scores between 16 and 80, which were categorized into three categories- low (<59), medium (59–69), and high (>69) using arbitrary method. Independent variables included personal, socio-economic, communicational, and psychological characteristics.

All variables were quantified using standard scoring procedures. Data were analyzed using descriptive statistics such as frequency, percentage, mean, standard deviation, and weighted mean. Karl Pearson's correlation coefficient was employed to examine relationships between farmers' characteristics and their perceptions. Statistical analysis was performed using Microsoft Excel and IBM SPSS Statistics version 30 to ensure accuracy and reliability.

RESULTS AND DISCUSSION

Perception of farmers towards crop residue burning

Perception was operationally defined as the manner in which respondents interpret the effects of crop residue burning based on their awareness and experiences. As shown in Table 1, majority (69.17 %) of the farmers were in the medium perception category (scores between 59 and 69), followed by 15.83 per cent in the low perception category (score less than 59) and 15 per cent in the high perception category (score above 69). The mean perception score was 63.85 with a standard deviation of 5.23. The predominance of medium-level perception among farmers is consistent with the findings of Choudhary et al. (2022), who reported that most farmers possessed moderate awareness regarding the environmental impacts of crop residue burning but continued the practice because of operational and economic constraints. Similar observations were also reported by Prajapati et al. (2018), where farmers demonstrated moderate perception towards environmental hazards caused by stubble burning.

Table 1: Distribution of Farmers according to their overall perception towards crop residue burning (n=120)

Sr. No.	Category	Respondents	
		Frequency	Percentage
1	Low (less than 59)	19	15.83
2	Medium (59 to 69)	83	69.17
3	High (Above 69)	18	15.00
Mean=63.85		SD= 5.23	

Table 2 highlights the varying levels of farmers' perceptions regarding crop residue management practices. The strongest consensus emerged around the negative impact of stubble burning on soil health, with 85.33 per cent

acknowledging its role in depleting vital nutrients. Closely linked, 83.50 per cent of respondents agreed that the use of Happy Seeder machines requires high-powered tractors, which are often unaffordable or inaccessible for small-scale farmers. Reflecting optimism toward sustainable alternatives, 82.00 per cent supported the potential of biofuel plants as eco-friendly solutions with economic benefits. Similarly, 81.33 per cent considered baling a practical and widely used method for straw disposal, while 80.50 per cent emphasized that services such as custom hiring centres and shared baler units could reduce operational costs by enabling resource-sharing for expensive machinery. These findings are in agreement with Choudhary et al. (2022), who observed that affordability and limited machinery access were major barriers influencing farmers' residue management decisions.

A considerable proportion of farmers also expressed moderate agreement on related issues. Around 79.50 per cent noted that use of paddy straw is limited to only a few uses. Around 79.00 per cent noted that leaving straw on fields could encourage pathogen growth, 79.33 per cent believed Panchayat involvement could strengthen compensation schemes, and 78.00 per cent recognized stubble burning as a cause of soil carbon loss. These findings are supported by Kumbhani et al. (2024) and Vanpariya et al. (2020), who reported that farmers with higher ecological consciousness exhibited better awareness regarding environmental degradation and sustainable agricultural practices. Interestingly, despite these scientific insights, traditional beliefs persisted: 78.50 per cent still saw burning as useful for pest control and 77.33 per cent for weed management, reflecting a coexistence of modern understanding with conventional practices. Similar findings were reported by Anuradha et al. (2020), who observed that farmers often continue residue burning due to traditional beliefs, time pressure, and lack of feasible alternatives despite being aware of its harmful effects. Around 73.67 per cent believed that intercropping is useful and effective for crop residue management showing the farmers' willingness

towards crop diversification.

On the other hand, some areas reflected lower awareness or weaker agreement. Only 68.17 per cent believed that additional income from stubble would increase farmers' economic condition and only 67.50 per cent recognized paddy straw's potential as an energy source. Economic and institutional doubts were also visible, as 64.83 per cent questioned the viability of composting straw, while only 67.83 per cent supported stronger action from State Pollution Control Boards signaling limited trust in regulatory mechanisms.

Overall, perception levels revealed a mixed picture. A majority of farmers (69.17 %) fell into the medium-perception category, indicating moderate awareness of harmful effects such as air pollution, soil degradation and microbial loss, but with limited drive to pursue alternatives. A smaller group (15.83 %) showed low perception, characterized by minimal awareness or concern, reflecting a higher likelihood of continuing residue burning due to convenience, lack of knowledge or limited access to alternatives. Only 15 per cent demonstrated high perception, combining strong awareness with readiness to adopt sustainable practices such as mulching, composting or mechanized solutions like the Happy Seeder. The overall mean perception score of 63.85 with a standard deviation of 5.23 underscores that while awareness exists, it remains moderate and relatively uniform among respondents, highlighting the need for stronger interventions in awareness, accessibility and institutional support. These results align with findings by Kumar et al. (2015), Singh et al. (2024), Gamit and Kumar (2022), Rana and Patel (2022), and Veni et al. (2022); Zala et al. (2025); Patel et al. (2025), who reported that while awareness regarding crop residue burning and environmental sustainability is increasing, behavioural change remains gradual due to knowledge gaps, socio-economic limitations, and practical barriers.

Table 2: Farmers' perceptions towards crop residue burning

(n=120)

Rank	Statement	Weighted Mean(%)
1	Burning of stubble eliminates vital soil nutrient	85.33
2	Happy Seeder requires high-capacity tractor, not feasible for every farmer	83.50
3	Biofuel plants are a sustainable option to solve stubble burning	82.00
4	Baling is the most common and effective method adopted by farmers	81.33
5	Custom hiring centres and straw baler units help recover operational costs	80.50
6	Use of paddy straw is limited to only a few uses	79.50
7	Involving panchayats for compensation claims can cover more areas	79.33
8	Straw lying in open creates micro-environment for pathogen growth	79.00
9	Pests and pathogens can be controlled by stubble burning	78.50
10	Burning stubble reduces organic carbon in soil	78.00

Rank	Statement	Weighted Mean(%)
11	Weeds can be controlled by open stubble burning	77.33
12	Intercropping is useful and effective for crop residue management	73.67
13	Additional income from stubble will improve farmers' economic condition	68.17
14	State Pollution Control Boards should be more stringent	67.83
15	Paddy straw can act as alternative energy source for local energy demand	67.50
16	Composting paddy straw is not economically viable	64.83

Relationship Between the Profile of Farmers and Their Perception Towards Crop Residue Burning

As shown in Table 3, relationship analysis further revealed that several farmer characteristics had significant associations with perception towards crop residue burning. Ecological consciousness showed the highest positive and significant correlation ($r = 0.348$, $p < 0.01$), indicating that farmers with greater environmental concern possessed more favourable perceptions towards sustainable residue

management practices. Similar findings were reported by Kumbhani et al. (2024) and Vanpariya et al. (2020), who observed that environmentally conscious farmers demonstrated better awareness and positive orientation towards eco-friendly agricultural practices. Comparable observations were also reported by Reimer et al. (2012), who found that environmental concern significantly influenced farmers' adoption of conservation-oriented agricultural practices.

Table 3: Relationship Between the Profile of Farmers and Their Perception Towards Crop Residue Burning

(n=120)

S. No.	Independent Variable	Correlation Coefficient (r)
X ₁	Age	0.058 (NS)
X ₂	Education	0.321 **
X ₃	Family Size	0.041 (NS)
X ₄	Annual Income	0.199 *
X ₅	Cropping patten	0.267*
X ₆	Land Holding	0.253 **
X ₇	Mass Media Exposure	0.284 **
X ₈	Extension Contact	0.186 *
X ₉	Innovativeness	0.230 *
X ₁₀	Risk Preference	0.186 *
X ₁₁	Economic Motivation	0.275**
X ₁₂	Ecological Consciousness	0.348 **
X ₁₃	Awareness about socio-ecological issues related to crop residual burning	0.212 *

*Significant at 0.05 per cent level ($p < 0.05$), **Significant at 0.01 per cent level ($p < 0.01$), NS=Non-Significant

Education ($r = 0.321$, $p < 0.01$) and mass media exposure ($r = 0.284$, $p < 0.01$) were positively associated with perception, suggesting that educated farmers and those with greater exposure to information sources were more aware of the harmful effects of residue burning and more willing to adopt improved alternatives. Similar results were reported by Gamit and Kumar (2022) and Veni et al. (2022), who found that education and media exposure significantly influenced farmers' environmental perceptions and adoption behaviour. Likewise, Kumar et al. (2015) observed that farmers with better educational backgrounds and access to agricultural information demonstrated greater awareness regarding the adverse environmental impacts of residue burning and were more inclined toward alternative residue management

practices.

Economic motivation ($r = 0.275$, $p < 0.01$) and landholding size ($r = 0.253$, $p < 0.01$) also showed significant positive relationships, implying that economically motivated and resource-rich farmers were more inclined toward sustainable residue management options. Choudhary et al. (2022) similarly reported that income and landholding positively influenced farmers' awareness and attitudes towards residue management practices. Grover et al. (2015) further reported that large farmers possessing better economic resources were more likely to adopt residue management technologies due to their greater financial capacity and machinery access.

Cropping pattern ($r = 0.267$, $p < 0.05$) was positively associated with perception, indicating that farmers practicing diversified cropping systems exhibited greater acceptance of sustainable alternatives. Innovativeness ($r = 0.230$, $p < 0.05$) and awareness of socio-ecological issues ($r = 0.212$, $p < 0.05$) also contributed positively, which aligns with the findings of Rana and Patel (2022), who reported that progressive and innovative farmers possessed more favourable perceptions towards eco-friendly agricultural practices.

Further, annual income ($r = 0.199$, $p < 0.05$), extension contact ($r = 0.186$, $p < 0.05$), and risk preference ($r = 0.186$, $p < 0.05$) exhibited positive and significant associations with perception towards CRB. Farmers having better extension exposure, higher income, and greater willingness to take risks were more likely to adopt sustainable residue management practices. Similar observations were made by Prajapati et al. (2018), who highlighted the positive influence of extension participation and awareness on farmers' perceptions regarding environmental hazards caused by stubble burning. Likewise, Sidhu et al. (2007) reported that extension services and institutional support significantly enhanced the adoption of conservation agriculture practices among farmers.

In contrast, age ($r = 0.058$, NS) and family size ($r = 0.041$, NS) showed non-significant relationships, suggesting that demographic variables had limited influence on shaping farmers' perceptions towards crop residue burning. Similar non-significant associations of age with environmental perception were also observed by Desai et al. (2024), indicating that behavioural orientation towards sustainable residue management depends more on awareness, resource access, and environmental sensitivity than on demographic characteristics alone.

CONCLUSION

The study revealed that most farmers in Jabalpur district possessed medium-level perceptions towards crop residue burning, indicating awareness of its harmful environmental effects but limited capacity to adopt sustainable alternatives. Farmers recognized the benefits of eco-friendly practices such as biofuel production, baling, and shared machinery services, yet traditional beliefs regarding pest and weed control continued to influence burning practices. Perception towards CRB was significantly influenced by factors such as ecological consciousness, education, landholding, mass media exposure, and economic motivation. The findings emphasize the need for awareness programmes, stronger extension support, affordable technologies, and incentive-based interventions to promote sustainable residue

management and reduce crop residue burning.

POLICY IMPLICATIONS

The findings suggest that policies aimed at reducing crop residue burning should prioritize awareness-based and incentive-driven approaches alongside regulatory measures. Strengthening environmental education, mass media campaigns, and extension services through demonstrations and farmer trainings can improve farmers' perceptions and adoption of sustainable residue management practices. Financial support and subsidies, particularly for small and marginal farmers, are essential to enhance access to residue management technologies. Expansion of Custom Hiring Centres (CHCs) and shared machinery services can further improve affordability and accessibility of equipment. Additionally, promoting market-linked uses of paddy straw such as bioenergy, baling, and biomass-based enterprises may provide economic incentives for farmers to adopt eco-friendly alternatives to residue burning.

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CONFLICT OF INTEREST

The authors declare 'no conflict of interest'.

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