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# Factors Associated with Perception and Knowledge of Punjab's Farm Youth about Stubble Management

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## HIGHLIGHTS

- A statistically significant association between caste and land holding were associated with perception of farm youth towards stubble management.
- Families owning medium and particularly large tracts of land displayed substantially higher involvement in burning, likely due to greater residue volume requiring quick clearance.
- Findings highlight need for targeted awareness and knowledge enhancement programme

ARTICLE INFO

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## ABSTRACT

The study, conducted in 2025, examined how socio-personal variables were associated with the perception and knowledge of farm youth toward stubble management, and how family and farming-related characteristics were associated with families' involvement in stubble burning. A structured questionnaire was administered to 720 respondents selected through multistage purposive and random sampling from five agro-climatic zones of Punjab. Data were analysed using chi-square and Fisher's exact tests to determine associations between variables. Gender and caste showed significant associations with both perception and knowledge. School type and medium of education showed no significant association with either variable. Family type was significantly associated with knowledge but not with perception. Among family and farming variables, caste and landholding size were significantly associated with the family's involvement in stubble burning, while family size, family educational status, and number of earning members showed no significant relationship. Overall, the results indicated that a combination of socio-personal characteristics and structural agricultural factors shaped stubble management behaviour. The study concluded that enhancing perception and knowledge among rural youth, particularly youth enrolled in Punjabi-medium and government schools, and those belonging to the general caste and large landholding families are essential for fostering long-term behavioural change.

## INTRODUCTION

The Indo-Gangetic Plain remains one of the most productive agricultural regions of the world, where the Green Revolution through improved crop varieties and synthesized fertilizers continues to support national food security (Pingali, 2012). India is currently the leading global producer of rice, with an average annual output of 151 million metric tonnes (Anonymous, 2025). Such high levels of production naturally generate vast quantities of crop residue, and the widespread practice of burning this residue

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in open fields has emerged as a major environmental and agricultural challenge (Choudhary et al., 2021). Stubble burning adversely affects air quality, soil health, and human well-being, contributing to the severe smog episodes that disrupt the social, economic, and cultural fabric of northern India each October–November (Chawla & Sandhu, 2020). Although long-term environmental improvement requires community participation and personal responsibility (Mukherjee, 2017), political misalignment across central, state, and local governments often limits effective coordination and enforcement (Khundrakpam & Sarmah, 2023; Kumar et al., 2015).

The present study is theoretically anchored in the framework of Social and Behavior Change (SBC), which recognizes that behavior related to environmental practices are shaped by an interaction of cognitive, emotional, and contextual factors rather than information alone (Lee & Davis, 2019). At the core is formative research: understanding the target audience's beliefs, practices, social norms, barriers, facilitators, and context, so that the interventions are tailored, relevant, and culturally appropriate. Monitoring, feedback, and participatory involvement are essential to ensure that changes are adopted and sustained over time. SBC also functions at multiple levels: individual (knowledge, attitude and skill), interpersonal (family and peers), community (norms, social networks and cultural practices), and structural/institutional (policies, facilities and system). The scale of change is often greater when interventions address not only individuals but also the social and environmental context in which people live. Since stubble burning is not merely an agricultural practice but a socially embedded behavior, the perception and knowledge of the younger generation particularly school students from farming families are critical to understand future behavioral trends in residue management.

In this context, the role of rural youth becomes increasingly critical. With growing technological aptitude and entrepreneurial potential, youth are key agents in shaping future sustainability efforts. Sensitizing them early to issues of climate change and sustainable agriculture is therefore essential. Current national initiatives, including those under the *Rashtriya Krishi Vikas Yojana* (RKVY), actively involve schools, colleges, *Krishi Vigyan Kendras* (KVKs), social organizations, and NGOs in awareness campaigns on stubble management. These efforts engage students through essay writing, debates, painting competitions, technical lectures, and other activities approved by the State Level Executive Committee (SLEC) and ICAR (Department of Agriculture & Farmers Welfare, 2023).

Given this backdrop, examining how socio-personal, family, and farming variables shape youth perception and knowledge related to stubble management and how these factors relate to families' stubble-burning behaviour becomes essential for designing more targeted and effective interventions.

## METHODOLOGY

The area for present investigation was conducted in five agro-climatic zones of Punjab state of India. Following the probability proportional to size sampling, eight districts out of twenty three districts spread over five agro-climatic zones (ACZ) were selected. Care was taken not to select adjoining districts of the same agro-climatic zones. From ACZ-I, ACZ-II and ACZ-IV Gurdaspur, Rupnagar and Fazilka districts were selected respectively. From ACZ III, being the largest zone three districts were selected, i.e. Sangrur, Jalandhar and Amritsar. From ACZ V, total two districts were selected i.e. Moga and Sri Muktsar Sahib. Three rural blocks from each selected districts were randomly selected. Thus, a total of 24 blocks were selected. From each block, two senior secondary co-educational schools were randomly selected thus making total of 48 schools. Five students belonging to farming families from each class i.e. class $10^{th}$, $11^{th}$ and $12^{th}$ were selected from each senior secondary, co-educational school. Total number of 720 students was taken as the sample from selected schools. The study was conducted in the year 2025 and data was collected by using a self-made questionnaire. The questionnaire was pre-tested on 60 non-sampled students from farming families of two senior secondary schools of Sidhwan bet block of Ludhiana district to ascertain the clarity and nature of responses among the respondents before proceeding with the research. The knowledge test and the perception scale yielded a Cronbach's alpha of 0.90 and 0.72, indicating acceptable reliability of the research instrument (Ray et al., 2021). The objectives of study were explicitly explained to respondents in their vernacular language, ensuring that they perceived the questions correctly. Perception was operationalized as the belief or opinion of student regarding stubble burning and its effects for the present study. The responses of students for twenty seven statements were sought on 5-point Likert scale. The knowledge was operationalized as the understanding of effects of stubble burning on health and environment as well as knowledge about stubble management technologies/practices to stop stubble burning. Score 1 was given to each correct answer and 0 for incorrect answer. Accordingly, knowledge score for each respondent was calculated and further categorized as low, medium and high knowledge level. In order to assess the association between the selected dependent and the independent variables, the data was subjected to chi square test and Fisher's exact test. Fisher's exact test was used when the cell had expected frequency less than five. A p-value less than 0.05 were considered statistically significant.

## RESULTS

The data presented in Table 1 reveals the association between socio-personal variables and the perception of respondents regarding stubble management. Among male respondents 1.50 per cent had a negative perception, 62.70 per cent had neutral, and 35.80 per cent had a positive perception about stubble management. In contrast, among females no respondents reported negative perception, 46.90 per cent had neutral perception. A little more than half of the female respondents (53.10%) reported positive perception. This shows a clear divergence, with females demonstrating stronger positive perception compared to males. Further, Fisher's exact test (24.393; $p = 0.000$) confirmed that there was statistically significant association between gender and perception of respondents at 5 per cent level of significance.

Among private school respondents 2.60 per cent had negative, 64.10 per cent neutral, and 33.30 per cent had positive perception towards stubble management. In government schools, 0.2 per cent respondents showed negative, 53.00 per cent neutral, and 46.90 per cent positive perception towards stubble management. A

**Table 1.** Association of socio-personal variables and perception of respondents regarding stubble management

| Variables | | Perception | | | Total | Fisher's exact test | p-value |
|---|---|---|---|---|---|---|---|
| | | Negative | Neutral | Positive | | | |
| Gender | Male | 6 | 259 | 148 | 413 | 24.393* | .000 |
| | Female | 0 | 144 | 163 | 307 | | |
| Total | | 6 | 403 | 311 | 720 | | |
| Type of school | Private | 5 | 125 | 65 | 195 | 17.434* | .000 |
| | Government | 1 | 278 | 246 | 525 | | |
| Total | | 6 | 403 | 311 | 720 | | |
| Medium of education | English | 5 | 158 | 92 | 255 | 12.720* | .001 |
| | Punjabi | 1 | 245 | 219 | 465 | | |
| Total | | 6 | 403 | 311 | 720 | | |
| School affiliation | PSEB | 6 | 384 | 296 | 686 | .093$^{NS}$ | 1.00 |
| | CBSE | 0 | 19 | 15 | 34 | | |
| Total | | 6 | 403 | 311 | 720 | | |
| Type of family | Nuclear | 4 | 196 | 161 | 361 | 1.342 $^{NS}$ | .499 |
| | Joint | 2 | 207 | 150 | 359 | | |
| Total | | 6 | 403 | 311 | 720 | | |
| Caste | General | 6 | 218 | 126 | 350 | 21.493* | .000 |
| | Backward caste | 0 | 88 | 70 | 158 | | |
| | Scheduled Caste | 0 | 97 | 115 | 212 | | |
| Total | | 6 | 403 | 311 | 720 | | |

*($p < 0.05$), NS (non- significant)

noticeable trend emerged in which government school respondents expressed more positive perception toward stubble management as compared to private school respondents. Fisher's exact test (17.434; p = 0.000) indicated that the association between type of school and respondents perception was statistically significant at 5 per cent level of significance.

Among the respondents studying in English-medium schools, 2.00 per cent respondents had negative, 62.00 per cent of respondents had neutral, and 36.10 per cent respondents had positive perception. Whereas data from respondents studying in Punjabi-medium school revealed that 0.20 per cent respondents had negative, 52.70 per cent of respondents had neutral, and 47.10 per cent respondents had positive perception. Thus, respondents from Punjabi-medium school demonstrated a higher overall positive perception. The association between medium of education and perception of respondents was statistically significant (Fisher's exact test = 12.720; p = 0.001) at 5 per cent level of significance.

Among respondents studying in schools affiliated with PSEB, 0.90 per cent respondents had negative, 56.00 per cent respondents had neutral perception, and 43.10 per cent respondents had positive perception. Almost similar distribution of respondents was noted in CBSE affiliated schools, where zero respondents reported negative, 55.90 per cent respondents had neutral, and 44.10 per cent respondents had positive perception. Fisher's exact test (0.093; p = 1.00) confirmed that there was no significant association between school affiliation and perception towards stubble management.

Data in Table 1 also shows that 1.1 per cent respondents from nuclear families reported negative, 54.30 per cent respondents had neutral, and 44.60 per cent respondents had positive perception. In joint families, 0.60 per cent respondents had negative, 57.70 per cent respondents had neutral perception, and 41.80 per cent respondents had positive perception. The percentage differences were minimal, supported by a non-significant Fisher's exact value (1.342; p = 0.499) suggesting no significant association between family type and perception of respondents.

When looking at the social stratification distribution from the lens of caste the data reveals that 62.30 per cent respondents from General category had neutral perception, 36.0 per cent respondents had positive, and 1.70 per cent respondents had negative perception. Among Backward Caste, 55.70 per cent respondents had neutral, and 44.30 per cent respondents had positive perception. Less than half of the respondents (45.80%) from Scheduled Caste had neutral, and 54.20 per cent had positive perception towards stubble management. No respondents from Backward caste and scheduled caste reported negative perception. Positive perception increased progressively from General to Backward Caste to Scheduled Caste respondents. Fisher's exact test (21.493; p = 0.000) confirmed a statistically significant association between caste and perception of farm youth towards stubble management at 5 per cent level of significance.

### Association of socio-personal variables and knowledge of respondents regarding effects of stubble burning and management of stubble

Data in Table 2 presents the association between socio-personal variables and the knowledge levels of respondents regarding the effects of stubble burning and the management of stubble. Among male respondents almost equal half of the respondents had low and medium level of knowledge i.e. 49.40 per cent and 49.90 per cent respectively. A very small fraction of respondents i.e. 0.70 per cent had high knowledge level. In contrast, majority (68.1%) female respondents reported low knowledge level, 31.90 per cent medium

**Table 2.** Association of socio-personal variables and knowledge of respondents regarding effects of stubble burning and management of stubble

| Variables | | Knowledge | | | Total | Fisher's exact test | p-value |
|---|---|---|---|---|---|---|---|
| | | Low | Medium | High | | | |
| Gender | Male | 204 | 206 | 3 | 413 | 26.159* | .000 |
| | Female | 209 | 98 | 0 | 307 | | |
| Total | | 413 | 304 | 3 | 720 | | |
| Type of school | Private | 100 | 93 | 2 | 195 | 5.958$^{NS}$ | .045 |
| | Government | 313 | 211 | 1 | 525 | | |
| Total | | 413 | 304 | 3 | 720 | | |
| Medium of education | English | 149 | 103 | 3 | 255 | 5.150$^{NS}$ | .062 |
| | Punjabi | 264 | 201 | 0 | 465 | | |
| Total | | 413 | 304 | 3 | 720 | | |
| School affiliation | PSEB | 392 | 291 | 3 | 686 | 0.703$^{NS}$ | .761 |
| | CBSE | 21 | 13 | 0 | 34 | | |
| Total | | 413 | 304 | 3 | 720 | | |
| Type of family | Nuclear | 231 | 129 | 1 | 361 | 13.185* | .001 |
| | Joint | 182 | 175 | 2 | 359 | | |
| Total | | 413 | 304 | 3 | 720 | | |
| Caste | General | 181 | 166 | 3 | 350 | 11.684* | .009 |
| | Backward caste | 105 | 53 | 0 | 158 | | |
| | Scheduled Caste | 127 | 85 | 0 | 212 | | |
| Total | | 413 | 304 | 3 | 720 | | |

*($p < 0.05$), NS (non- significant)

knowledge level, and no respondent had high knowledge level. This clearly shows that low knowledge level was more concentrated among females, whereas males had a relatively balanced distribution across low and medium knowledge levels. The Fisher's exact test value (26.159; $p = 0.000$) confirmed a statistically significant association between gender and knowledge level.

Slightly more than half of the respondents (51.30%) from Private school reported low level of knowledge followed by 47.70 per cent respondents with medium level of knowledge, and only 1.0 per cent respondents had high level of knowledge. Among government school respondents, 59.60 per cent respondents had low level of knowledge, 40.20 per cent respondents had medium, and 0.20 per cent had high knowledge level. Although both groups had a majority in the low-knowledge category, private school respondents demonstrated a slightly higher proportion of medium and high knowledge levels. Fisher's exact test (5.958; $p = 0.045$) indicated that the association between school type and knowledge was statistically significant.

Knowledge levels among respondents varied slightly by medium of education. Majority of respondents (58.40%) from English-medium school showed low knowledge level followed by 40.40 per cent respondents with medium knowledge level and merely 1.20 per cent respondents had high knowledge level. Whereas from Punjabi-medium schools 56.80 per cent respondents had low level of knowledge, 43.20 per cent medium, and no respondents had high knowledge level. While English-medium students showed a marginally higher proportion in the high-knowledge category, the overall distribution was very similar. This was confirmed by a non-significant Fisher's exact test value (5.150; $p = 0.062$), indicating no meaningful relationship between medium of education and knowledge levels.

Among respondents from schools affiliated with PSEB, 57.1 per cent respondents had low knowledge level followed by 42.40 per cent respondents having medium knowledge level and 0.40 per cent at high knowledge level. The majority (61.80%) of CBSE respondents reported low knowledge level followed by 38.20 per cent respondents who had medium knowledge level and there was no respondent in the high knowledge level category. No association was found out between school affiliation and respondents' knowledge level as statistically validated by a non-significant Fisher's exact test result (0.703; $p = 0.761$).

The majority (64.00%) respondents from nuclear families showed low knowledge level followed by 35.70 per cent respondents with medium knowledge level and just 0.30 per cent respondents having high knowledge level. Half of the respondents (50.70%) from joint families had low knowledge level followed by 48.70 per cent respondents having medium knowledge level and only 0.60 per cent respondents at high knowledge level. Joint family respondents demonstrated a visibly higher proportion of medium knowledge level when compared to nuclear families. The Fisher's exact test value (13.185; $p = 0.001$) confirmed a statistically significant association between family type and knowledge level.

In terms of caste, 51.70 per cent respondents from general category had low knowledge level and a little less than half (47.40%) respondents had medium knowledge level and merely 0.90 per cent respondents had high knowledge level. The distribution of Backward Caste shows that 66.50 per cent respondents showed low knowledge level and 33.50 per cent medium knowledge level. In Scheduled Caste 59.90 per cent respondents reported low knowledge level and 40.10 per cent respondents had medium knowledge level. No respondent in backward and schedule caste had high knowledge level. Although high knowledge was reported

**Table 3.** Association of family variables and stubble burning

| Variables | | Family burns stubble | | Total | $\chi^2$ | p-value |
|---|---|---|---|---|---|---|
| | | No | Yes | | | |
| Caste | General | 218 | 132 | 350 | 7.743* | 0.021 |
| | Backward caste | 118 | 40 | 158 | | |
| | Scheduled Caste | 144 | 68 | 212 | | |
| Total | | 480 | 240 | 720 | | |
| The minimum expected count is 52.67. | | | | | | |
| Family size | Small | 165 | 69 | 234 | 2.571$^{NS}$ | 0.276 |
| | Medium | 277 | 153 | 430 | | |
| | Big | 38 | 18 | 56 | | |
| Total | | 480 | 240 | 720 | | |
| The minimum expected count is 18.67. | | | | | | |
| Family Educational status | Low | 114 | 63 | 177 | 0.997$^{NS}$ | 0.607 |
| | Medium | 349 | 171 | 520 | | |
| | High | 17 | 6 | 23 | | |
| Total | | 480 | 240 | 720 | | |
| The minimum expected count is 7.67 | | | | | | |
| Number of earning members | One | 354 | 165 | 519 | 2.112$^{NS}$ | 0.348 |
| | Two-three | 116 | 68 | 184 | | |
| | Four and above | 10 | 7 | 17 | | |
| Total | | 480 | 240 | 720 | | |
| The minimum expected count is 5.67 | | | | | | |

*($p < 0.05$), NS (non- significant)

only within the General category, the broader pattern shows differing proportions of low and medium knowledge across caste groups. Fisher's exact test (11.684; p = 0.009) indicated a statistically significant association between caste and knowledge level.

**Association of family variables and families' involvement in stubble burning**

The perusal of Table 3 reveals the association between family variables and families' involvement in stubble burning. The respondents were asked whether their family was involved in stubble burning or not. Score 1 was given to respondents whose families engaged in stubble burning and score 2 was given to respondents whose families did not engage in stubble burning. The data shows a statistically significant association between caste and the practice of stubble burning among respondents' families ($\chi^2$ = 7.743; p = 0.021). Among respondents belonging to the General category 37.70 per cent of the respondents reported that their family burns stubble, whereas 62.30 per cent respondent reported that their family did not burn stubble. In the Backward Caste category 25.3 per cent respondents revealed that their family burned stubble, while 74.70 per cent respondents reported their family refrained from it. Among Scheduled Caste respondents 32.10 per cent respondents reported that their family blaze stubble and 67.90 per cent respondents' families did not burn stubble. A comparison of proportions indicates that the incidence of stubble burning was highest among General category respondents, followed by Scheduled Caste respondents, and lowest among those in the Backward Caste category. The statistically significant chi-square value supports that caste background had a meaningful influence on the likelihood of stubble burning.

Family size did not show a statistically significant association with stubble burning ($\chi^2$ = 2.571; p = 0.276). Among respondents belonging to small families 70.5 per cent respondents reported no participation in stubble burning whereas, 29.5 per cent respondents reported family participation in practiced stubble burning. The majority (64.4%) of respondents from medium-sized families reported that their family did not burn stubble while 35.6 per cent respondents revealed their family involvement in stubble burning. Similarly, 67.9 per cent respondents from big families said their family refrained from the practice followed by 2.1 per cent respondents whose family burned stubble. Although medium-sized families showed a slightly higher proportion of stubble-burning households, the overall distribution across all three categories remained similar. The non-significant chi-square test indicates that family size did not meaningfully influence stubble burning behaviour.

Family educational status also did not exhibit any significant association with stubble burning ($\chi^2$ = 0.997; p = 0.607). Among families with low educational status 64.4% families did not burned stubble while35.6 per cent respondents said their family burned stubble. In a similar fashion the 67.1% respondents with medium family educational status reported their families did not engage in stubble burning and 32.9 per cent families engaged in stubble burning. For families with high educational status majority (73.9%) of respondents said their family did not set their fields on fire compared to 26.1 per cent respondents who said their families burned stubble. The percentages across the three family educational status categories remained largely comparable. The non-significant chi-square value suggests that the educational status of the family did not substantially affect their stubble-burning practices.

The number of earning members in the family also showed no statistically significant association with stubble burning ($\chi^2$ = 2.112;

**Table 4.** Association of land ownership and stubble burning

| Variables | | Family burns stubble | | Total | Fisher's exact test | p-value |
|---|---|---|---|---|---|---|
| | | No | Yes | | | |
| Land owned | Marginal | 140 | 47 | 187 | 13.110* | 0.010 |
| | Small | 137 | 70 | 207 | | |
| | Semi-medium | 125 | 70 | 195 | | |
| | Medium | 75 | 46 | 121 | | |
| | Large | 3 | 7 | 10 | | |
| Total | | 480 | 240 | 720 | | |

*($p < 0.05$)

p = 0.348). Among families with a single earning member, 68.2 per cent respondents said their families did not practiced stubble burning whereas 31.8 per cent respondents said their families practiced stubble burning. Families with two to three earning members reported that 63.0 per cent families did not burned stubble and 37.0 per cent families who did burn stubble. In households with four or more earning members, 58.8 per cent respondents said their families did not burn stubble, while 41.2% respondents said their families burned stubble. Although an increasing trend is visible with more earning members, the chi-square test revealed no significant relationship. This indicates that the number of earning members does not meaningfully influence whether a family engages in stubble burning.

**Association of land ownership and stubble burning**

Table 4 examines the relationship between landholding size and the practice of stubble burning among respondents' families. A clear gradient was observed when proportions were compared across land ownership categories. Among marginal landholdings, 74.9 per cent respondents said their families did not burn stubble, while 25.1 per cent respondents reported that their families burned stubble. In the case of small landholder families, 66.2 per cent respondents reported their families did not burn stubble compared to 33.8 per cent respondents whose families burned stubble. Similarly, among semi-medium landowners, 64.1 per cent abstained and 35.9 per cent practiced stubble burning. For medium landowners, 62.0 per cent respondents said their families did not engaged in stubble burning, while nearly 38.0 per cent respondents reported their families engaged in stubble burning. The highest proportion was observed among large landowners, where 70.0 per cent respondents reported families burning stubble, compared to 30.0 per cent respondents who did not.

The percentage pattern indicates that the likelihood of stubble burning increased progressively with landholding size. Families owning medium and particularly large tracts of land displayed substantially higher involvement in burning, likely due to greater residue volume requiring quick clearance. The Fisher's exact test value (13.110; p = 0.010) confirmed that land ownership and stubble burning were significantly associated. Therefore, the results demonstrate that larger landowners were considerably more likely to engage in stubble burning, and this association was not due to random variation.

## DISCUSSION

The association of gender with both perception and knowledge reflects a meaningful divide in stubble management, suggesting that males, particularly in agrarian states, tend to have greater exposure to farm operations, crop residue handling, and informal agricultural learning. Huria et al. (2021), in a study conducted in the Malwa region of Punjab, reported that most agricultural activities are carried out by men, while women are primarily engaged in household and other non-farm activities. Female respondents, although equally affected by the consequences of stubble burning, may have limited interaction with farm-level decision-making, which could restrict knowledge acquisition. Bora et al. (2023) also highlighted that women's participation in agricultural decision-making is constrained by limited knowledge of advanced farming techniques, mobility restrictions, and reduced exposure to the outside world. This gendered divergence emphasizes the need for school-based and community-level sensitization efforts that intentionally include girls in agricultural and environmental education.

The lack of significant association between school affiliation (PSEB/CBSE) and both perception and knowledge suggests that board-level curricular differences may not be as influential as school-level implementation and resource availability. Interestingly, family type did not significantly influence perception but was significantly associated with knowledge. Findings from a study conducted by Nain et al. (2019) and Bisht (2023) also highlighted the role of family size, media exposure, and participation in activities organized by schools in shaping perception.

The role of caste emerged strongly, being significantly associated with perception, knowledge, and family involvement in stubble burning. Khurana et al. (2024) reported that social factors such as gender (female), religion (non-Hindu), and caste (marginalized groups) inversely influence the likelihood of crop residue burning. Among the family variables, family size, families' educational status, and number of earning members showed no significant association with stubble burning behaviour, indicating that household socio-economic capacity may not directly determine residue management choices. Whereas, Jambagi et al. (2025) revealed that, the higher rural male literacy rate was associated with an increase in the area of burning. This indicated that as literacy rates increased, individuals sought to capitalize on the economic benefits of the paddy–wheat cropping system by reducing the turnaround time through stubble burning. In contrast, land size was significantly associated with family involvement in stubble burning, with larger landholding families more likely to burn stubble, Parthiban et al. (2019) and Khurana et al. (2024) reported that total landholding and the share of cultivated area show mixed effects on behaviour. According to Kumar et al. (2024), smaller farmers are often more inclined to diversify their cropping patterns possibly to enhance

soil health, implement crop rotation, or respond to market conditions behaviour that aligns with sustainable agricultural practices and long-term resilience.

## CONCLUSION

Stubble management behaviour is influenced by a complex interplay of individual attributes, household factors, and broader structural constraints within the agricultural system. Enhancing perception and knowledge among rural youth particularly youth enrolled in Punjabi-medium and government schools, and those belonging to general caste and large land holdings are essential for fostering long-term behavioural change. Youth having larger landholdings should be encouraged to motivate their families to prioritize sustainable resource utilization by adopting practices that convert stubble into economic or on-farm assets, such as fodder, bedding, or soil amendments. At the same time, addressing systemic barriers, including limited access to machinery, the cost of alternative practices, and pressures from tight crop cycles, remains critical for reducing the prevalence of stubble burning. Taken together, the results underscore the need for targeted, inclusive, and context-sensitive interventions that account for both social inequities and the practical realities of Punjab's farming landscape.

## DECLARATIONS

Ethics approval and informed consent: The study adhered to established ethical principles of social science research. Informed consent was sought from the respondents for the study.

Competing Interest: The Authors have no competing interests.

Conflict of interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

The authors declare that during the preparation of this work, they thoroughly reviewed, revised, and edited the content as needed. The authors take full responsibility for the final content of this publication.

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