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Profile Characteristics of Tribal Millet Growers in Madhya Pradesh, India

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Millets play a crucial role in the livelihoods and food systems of tribal and mountainous areas, especially among farmers with limited resources in Madhya Pradesh. This research sought to evaluate the socio-economic characteristics and knowledge levels of tribal millet farmers concerning the processing and value addition of minor millets. A total of 734 participants (367 men

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and 367 women) were surveyed from eight strategically chosen villages in the Mandla and Dindori districts. Most participants, 63.22% of men and 61.31% of women, were in the middle-age (36-50 years), with primary education being the most prevalent among women (27.52%) and men (20.16%). A majority, 63.76%, had medium-sized families and were mainly involved in agriculture and labour (42.51%). Regarding land ownership, 39.51% were small-scale farmers, and 71.66% had a medium-sized area (0.7-2.5 ha) dedicated to millet cultivation. An annual income classified as medium (₹39,521–₹91,195) was reported by 70.03% of the respondents. Kodo and Kutki were jointly cultivated by 69.48% of the farmers. In terms of awareness, 66.76% of men and 64.31% of women demonstrated a moderate level of awareness about processing and value addition, although traditional methods were prevalent among 92.37%. Knowledge levels were also moderate for the majority, with 68.39% of men and 67.03% of women.

Keywords: Tribal farmers; millets; profile characteristics; livelihoods; food systems.

1. INTRODUCTION

Tribal populations are scattered all over the hilly and forest regions of the country, majority of them inhabitants in Central India, high concentration of tribal's live in Madhya Pradesh, Chhattisgarh, Orissa, Andhra Pradesh, Jharkhand (Rajan *et al.*,2015). With a population of 72.60 million, Madhya Pradesh is the sixth-most populous state in the country. Out of the total population in India, about 72.40 percent live in rural areas and living in and around forest areas (Payasi et al., 2023). KVK working in tribal districts of Madhya Pradesh are actively engaged in dissemination of location-specific technologies related to agriculture (Rajan et al. 2016). Technological demonstration viz., On-farm testing (OFT), Front line demonstration (FLD) can help to accelerate the adoption of idea also farmers can learn new ways of doing things without having to do it on their farms(Rajan et al., 2020). Livelihoods mission (NRLM) is one such government initiative to uplift the rural women by making them self-reliant and helps them in earning their livelihoods (Goswami et al, 2021).

Millets are considered one of the earliest domesticated cereal grains used for household purposes and play a vital role in the traditional healthy food systems of tribal communities across India. These small-seeded, nutrient-rich grains are well-adapted to harsh climatic conditions and low-input agriculture, making them essential for ensuring food and livelihood security in rainfed and resource-poor regions (Dar et al., 2018, More et al., 2025). India is the world's largest millet producer, accounting for nearly 41% of global production, with major contributions from states such as Rajasthan, Karnataka and Madhya Pradesh (APEDA, 2023).

In tribal-dominated districts like Mandla and Dindori in Madhya Pradesh, millets especially Kodo and Kutki are widely cultivated using indigenous knowledge systems passed down through oral traditions. These crops serve both subsistence and income-generating purposes and form a critical component of local diets and cultural practices (Ambre et al., 2020). The role of tribal women in this system is profound, as they are primarily responsible for processing, storing, and value addition of millets. This post-harvest losses can be reduced to certain extent by value addition. Value addition is the process of achieving a high price for the same volume of a primary product through processing, packaging, quality improvement, or other means. One of the most important aspects of nutritional security is value addition (Srivani et. al., 2022b).

The government of India has approved 2023 as an international year of millets to boost production of the nutrient-rich millets and agro-industry involved in its production as well as to boost local farmers for production of this neglected but important group of cereal. India is the world's largest millet producer country and is majorly cultivated in Rajasthan, Uttar Pradesh, Gujarat, Madhya Pradesh, Haryana, Maharashtra, and Karnataka. Millets have been an integral part of diet in the population of Odisha, Madhya Pradesh, Jharkhand, Rajasthan, Karnataka, and Uttarakhand. (*E- Catalogue for Export of Millets and Value-Added Products (M.P.) APEDA).* **In World** total production 30,064,360 tons *(world Population Review) https://www.worldatlas.com> Economics.* **In India** total area under millets 38.08 lakh ha.

production 48.12 lakh tonnes and Productivity 1110 Kg/ha. *(2021-22) (Directorate of millets development, Jaipur)*. India is considered as the world's leading producer of different types of millets with Karnataka being the leading producer. Millets are considered as equally important source of starch and other dietary carbohydrates both of which play an important role as they are rich in meeting the daily energy requirements of humans as well as nutrient uptake (Chandra et al., 2018).

In M.P. total area under millets 83500 hac production 74800 tonnes and productivity 778 Kg/hac *(2019-20)* (*E- Catalogue for Export of Millets and Value-Added Products (M.P.) APEDA)*. Due to government's policy of promoting the production of cereals like rice and wheat, millet production is declining gradually, in spite of being termed as smart food that is beneficial for all the stakeholders, farmers, consumers and the mother Earth (Kane-Potaka *et al*., 2021).

This study therefore aims to assess the socio-economic profile of tribal millet growers in Mandla and Dindori districts, generating baseline information for policy-makers, development agencies, and researchers to design inclusive and sustainable millet development strategies that are sensitive to tribal realities and gender dynamics.

2. MATERIALS AND METHODS

The present study was conducted to assess the profile characteristics of tribal farmers in selected districts of Madhya Pradesh.

The study followed an Ex-post-facto research design. Within Madhya Pradesh, Mandla and Dindori districts were purposively chosen as the research location because these districts report the highest area under minor millet cultivation and are inhabited predominantly by tribal communities. Minor millets, particularly kodo (*Paspalum scrobiculatum*) and kutki (*Panicum sumatrense*), are traditionally grown in these regions on drylands that are unsuitable for major crops. For the present study, two blocks from each of the selected districts were purposively chosen based on the extent of area under millet cultivation. Accordingly, Bajag and Dindori blocks were selected from Dindori district, while Mawai and Niwas blocks were selected from Mandla district. According to data obtained from the Department of Agriculture, Government of Madhya Pradesh, these blocks recorded the highest production of minor millets. Within each of the four selected blocks, two villages were purposively chosen based on their active engagement in millet cultivation and the predominance of tribal farming communities. Consequently, eight villages were selected: Chanda and Tantar from Bajag block, Kudwari and Madhopur from Dindori block, Parsatola and Anjani Mal from Mawai block, and Gundlai Mal and Masoor Ghughari from Niwas block. In each selected village, separate lists of tribal millet farmers were compiled for male and female respondents.

2.1 Selection of Respondents

A list of total number of tribal farmers will be prepared from selected villages. According to Yamane (1967), if the population is known, the following formula is used to compute the ideal sample size that is adequate for drawing conclusions about the entire population.

$$n = \frac{N}{1 + N(e)^2}$$

The variables in this formula are, 'n' is the sample size, 'N' is the population of the study and 'e' is the margin error in the calculation.

Female population

n= 4509/ {1+4509 (0.05)2}
n=367.40
n=367

Male population

n= 4419/ {1+4419 (0.05)2}
n=366.79
n=367

Total sample size- 734

Based on this formula, a total of 734 respondents were selected for the study comprising 367 male and 367 female tribal farmers.

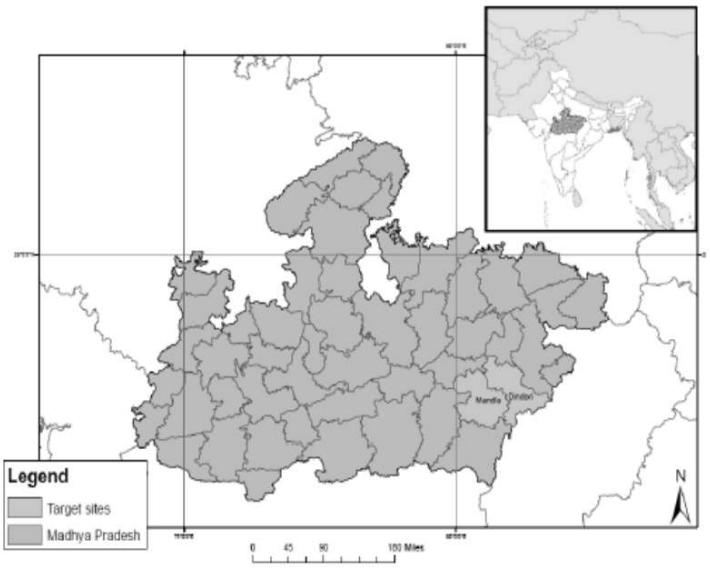

Fig. 1. Map of Madhya Pradesh

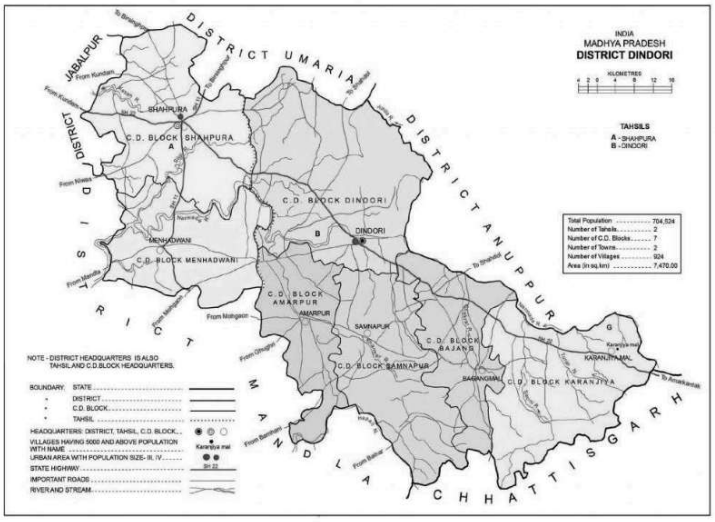

Fig. 2. Map of Dindori District

List 1. Sampling of males and females' tribal farmers

District	Blocks	Villages	Total Male Farmer	Proportional stratified sampling in each male farmer n=(N*S)/N	Sample size in each village male Farmer	Total Female Farmer	Proportional stratified sampling in each female farmer n=(N*S)/N	Sample size in each village Female Farmer
Dindori	Bajag (92 villages)	Chanda	463	(463*367)/4419	38	488	(488*367)/4509	40
		Tantar	468	(468*367)/4419	39	486	(486*367)/4509	40
	Dindori (194 villages)	Kudwari	537	(537*367)/4419	45	523	(523*367)/4509	43
		Madhopur Mal.	366	(366*367)/4419	30	367	(367*367)/4509	30
Mandla	Mawai (146 Villages)	Parsatola	863	(863*367)/4419	72	862	(862*367)/4509	70
		Anjani Mal.	658	(658*367)/4419	55	666	(666*367)/4509	54
	Niwas(106 Villages)	Gundlai Mal.	616	(616*367)/4419	51	669	(669*367)/4509	54
		Masoor Ghughari Mal.	448	(448*367)/4419	37	448	(448*367)/4509	36
			4419		**367**	**4509**		**367**

Table 1. Distribution of the respondents according to their profile characteristics (n = 734, comprising 367 men and 367 women)

S. No.	Profile Characteristics	Category	Men (frequency & percentage)	Women (frequency & percentage)
1	Age (Years)	Young (Up to 35)	59 (16.08%)	79 (21.53%)
		Middle (36–50)	232 (63.22%)	225 (61.31%)
		Old (Above 50)	76 (20.71%)	63 (17.17%)
2	Education	Illiterate	43 (11.72%)	66 (17.98%)
		Read and write	76 (20.71%)	88 (23.98%)
		Primary Level	74 (20.16%)	101 (27.52%)
		Middle School	80 (21.80%)	69 (18.80%)
		High School	63 (17.17%)	28 (7.63%)
		Higher Secondary	23 (6.27%)	12 (3.27%)
		Graduate and above	8 (2.18%)	3 (0.82%)
3	Occupation	Agriculture	73 (19.89)	112 (30.52)
		Agriculture + Labour	156(42.51)	120 (32.70)
		Agriculture + Forestry	48 (13.08)	37 (10.08)
		Agriculture + Animal Husbandry	34 (9.26)	16 (4.36)
		Agriculture + Others	56 (15.26)	82 (22.34)

S. No.	Profile Characteristics	Category	Men (frequency & percentage)	Women (frequency & percentage)
4	Annual Income (Rs.)	Low (< Rs.39,520)	52 (14.17)	4 (1.09)
		Medium (Rs. 39,521–91,195)	257 (70.03)	310 (84.47)
		High (> Rs. 91,196)	58 (15.80)	53 (14.44)
5	Awareness on Processing & Value Addition	Low	52 (14.17%)	66 (17.98%)
		Medium	245 (66.76%)	236 (64.31%)
		High	70 (19.07%)	65 (17.71%)
6	Decision-Making Ability	Low	38 (10.35%)	53 (14.44%)
		Medium	265 (72.21%)	259 (70.57%)
		High	64 (17.44%)	55 (14.99%)
7	Market Orientation	Low	54 (14.71%)	79 (21.53%)
		Medium	249 (67.85%)	231 (62.94%)
		High	64 (17.44%)	57 (15.53%)
8	Risk Bearing Ability	Low	60 (16.35%)	80 (21.80%)
		Medium	228 (62.13%)	247 (67.30%)
		High	79 (21.53%)	40 (10.90%)
		Low	45 (12.26%)	68 (18.53%)

S. No.	Profile Characteristics	Category	Men (frequency & percentage)	Women (frequency & percentage)
9	Information Seeking Behavior	Medium	252 (68.66%)	260 (70.84%)
		High	70 (19.07%)	39 (10.63%)
10	Social Participation	Low	45 (12.26%)	73 (19.89%)
		Medium	252 (68.66%)	228 (62.13%)
		High	70 (19.07%)	66 (17.98%)
11	Training on Processing & Value Addition	No Training	98 (26.70%)	42 (11.44%)
		One Training	155 (42.23%)	169 (46.05%)
		Two to Four Trainings	86 (23.43%)	120 (32.70%)
		More than Four Trainings	28 (7.63%)	36 (9.81%)

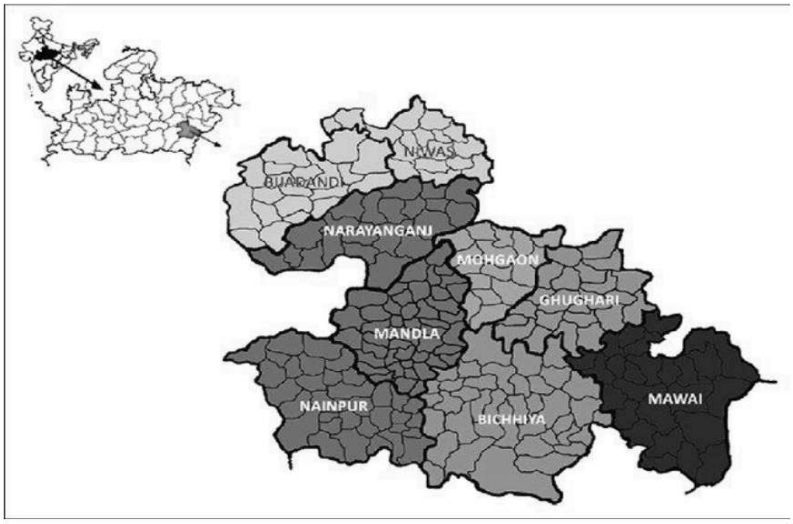

Fig. 3. Map of Mandla District

Data for the present study were collected during the agricultural year 2024 through a well-structured and pre-tested interview schedule administered personally to the selected respondents. Both quantitative and qualitative data were gathered to capture a comprehensive understanding of the research problem. The quantitative data included socio-economic characteristics (age, education, family size, occupation, landholding, area under millet cultivation, annual income, millet crops grown), gender roles in millet processing and value addition, knowledge levels regarding processing and value addition, participation in training programmes, extension contact, information-seeking behaviour, and access to processing facilities. Qualitative data were obtained through open-ended questions focusing on traditional processing practices, indigenous knowledge, cultural significance, perceived constraints, and suggestions for improvement.

Collected data underwent a rigorous process of scrutiny and cleaning, which involved verifying field entries, checking for consistency, coding responses, and categorizing qualitative narratives into thematic areas. Descriptive statistics such as frequencies, percentages, means, and standard deviations were used for summarizing quantitative data.

3. RESULTS AND DISCUSSION

The socio-personal, economic, psychological and communication characteristics of tribal millet growers were analysed to understand their profile and engagement in millet cultivation and value addition. Each variable has been discussed below with interpretations and supported by previous studies:

4. SOCIO-PERSONAL AND ECONOMIC CHARACTERISTICS

4.1 Age

Age was operationalized as respondents' chronological age in years at the time of investigation. Table 1 shows that most male respondents 63.22 per cent belonged to the middle age group (36 to 50 years), followed by the old age group (above 50 years) with 20.71 per cent and young age group (up to 35 years) with 16.08 per cent. For female respondents, 61.31 per cent were in the middle-aged group, followed by young age group at 21.53 per cent and old age group at 17.17 per cent. This distribution indicates that middle-aged farmers dominate millet cultivation among tribal communities. This could be attributed to their active engagement in agriculture, physical

capabilities and involvement in ancestral farming practices. The lower percentage of young respondents may be due to migration to urban areas for education and employment, while the older age group is less involved due to declining physical capacity and interest in field activities. These findings were consistent with the research of Chapke et al. (2022) and Sangappa et al. (2023).

4.2 Education

Education refers to formal schooling attained by respondents at the time of investigation. Data reveals that among male respondents, 21.80 per cent had education up to middle school, followed by primary level 20.16 per cent and read and write without formal schooling 20.71 per cent. A considerable percentage completed high school 17.17 per cent, while 11.72 per cent were illiterate. Only 6.27 per cent had attained higher secondary education and 2.18 per cent had education up to graduation or above. For female respondents, most had primary level education 27.52 per cent, followed by read and write 23.98 per cent and illiterate 17.98 per cent. About 18.80 per cent had education up to middle school, while 7.63 per cent completed high school. Only 3.27 per cent completed higher secondary and 0.82 per cent had attained graduation or above. The analysis shows most male respondents were educated up to middle school, while female respondents had lower educational attainment, mainly up to primary school or basic literacy. The gender gap in higher education may be attributed to socio-cultural factors, including limited access for girls, early home responsibilities, and lack of awareness about higher education's importance for women in tribal areas. These findings align with those reported by Chapke et al. (2022) and Sangappa et al. (2023)

4.3 Family Size

Family size refers to members in the respondent's household. As shown in Table 2, among 367 respondents, 63.76 per cent belonged to medium sized families (4 to 6 members). In addition, 23.43 per cent were large families (more than 7 members), while 12.81 per cent had small families (up to 3 members). This suggests medium-sized families dominate among tribal millet growers, due to traditional joint family structure in rural tribal communities, which supports shared agricultural labour. Larger families may indicate dependence on family labour, especially where external labour is limited or unaffordable.

4.4 Occupation

Occupation refers to primary and secondary livelihood activities of respondents. Table 1 shows that among males, 42.51 per cent engaged in agriculture with labour. About 19.89 per cent depended solely on agriculture, while 15.26 per cent combined agriculture with other occupations. Smaller groups combined agriculture with forestry 13.08 per cent and agriculture with animal husbandry 9.26 per cent, showing moderate occupational diversification. Among females, 32.70 per cent practiced agriculture with labour, followed by 30.52 per cent in agriculture alone. About 22.34 per cent engaged in agriculture with other activities, while smaller percentages combined agriculture with forestry 10.08 per cent and agriculture with animal husbandry 4.36 per cent. These findings highlight diversified livelihood strategies among tribal communities, particularly agriculture-labour combinations, resulting from economic necessity, seasonal employment, and uncertain agricultural income. These results are corroborated by Sangappa et al. (2023) and Rafi et al. (2024).

4.5 Landholding

Land holding refers to agricultural land possessed by respondents. Data in table 2 shows that 39.51 per cent respondents had small land holding, followed by 33.24 per cent with semi-medium land holding, 18.80 per cent with marginal size land holding and 8.45 per cent with medium size land holding. The data indicates that small and semi-medium farmers comprise 73 per cent of tribal millet growers, suggesting predominant small-scale subsistence farming in the tribal belt. This links to land fragmentation, inherited property division, and limited access to land resources. These findings align with those of Chapke et al. (2022).

4.6 Area under Millet Cultivation

This variable represents the portion of land allocated to millet crops. Data in Table 2 shows that 71.66 per cent had medium area under millet cultivation, followed by 16.35 per cent with large area and 11.99 per cent with less area. This indicates that millets are grown as important but not exclusive crops, often intercropped or rotated with other food staples. It reflects both the nutritional and cultural value of millets and the

resource constraints of small-scale tribal farmers. These findings are supported by Devi et al. (2024).

4.7 Annual Income

Annual income includes all earnings of respondents. Table 1 indicates that most male respondents (70.03 per cent) belonged to the medium income group Rs.39,521 to 91,195, followed by high-income group 15.80 per cent and low-income group 14.17 per cent. Among female respondents, 84.47 per cent were in the medium income group Rs. 6,974 to 33,384, while 14.44 per cent fell in the high-income group and 1.09 per cent were in the low-income group (below Rs. 6,973). This suggests tribal millet growers have moderate income levels, due to mixed livelihood strategies like combining agriculture with labour, forest products or livestock. The low percentage of high-income respondents suggests limited market access, productivity constraints and lack of value chain integration. Similar trends were noted by Chapke et al. (2022) and Srivani, 2022a.

4.8 Millet Crop Grown

This variable identifies millet crops cultivated by respondents. Data in Table 2 shows that 69.48 per cent reported growing Kodo and Kutki together, indicating a preference for these two types. Additionally, 23.16 per cent grow Kodo, Kutki with other minor millets. Only 4.09 per cent cultivate kodo alone and 3.27 per cent grow kutki alone. This reflects indigenous cropping patterns among tribal farmers, where intercropping is preferred for nutritional security and risk minimization. Growing multiple millets may reflect traditional ecological knowledge and adaptation to rainfed, low-input systems. Supporting findings from Rafi et al. (2024).

4.9 Awareness Regarding Processing and Value Addition

Awareness refers to respondents' understanding of techniques, benefits and practices in processing and value addition of minor millets. Table 1 reveals that among male respondents, 66.76 per cent exhibited medium awareness followed by high awareness 19.07 per cent and low awareness 14.17 per cent regarding minor millet processing and value addition. Similarly, among female respondents, 64.31 per cent had medium awareness while 17.98 per cent showed low awareness and 17.71 per cent had high awareness regarding minor millet processing and value addition. This finding reveals moderate familiarity among tribal farmers, suggesting traditional knowledge exists, but technical knowledge of modern value addition practices is limited. This gap in awareness may affect market linkages and income enhancement.

Table 2. Distribution of the respondents according to household profile characteristics

S. No.	Profile Characteristics	Category	Household (frequency)	(percentage)
1	Family Size	Small (Up to 3 members)	47	12.81
		Medium (4 to 6 members)	234	63.76
		Large (More than 7 members)	86	23.43
2	Land Holding	Marginal (Up to 1 ha)	69	18.80
		Small (1.01-2 ha)	145	39.51
		Semi- Medium (2.01-4ha)	122	33.24
		Medium (4.01-10 ha)	31	8.45
3	Area under millet crop	Less (<0.69 ha.)	44	11.99
		Medium (0.70-2.5 ha.)	263	71.66
		Large (>2.5 hac.)	60	16.35
4	Millet crop grown	Kodo	15	4.09
		Kutki	12	3.27
		Kodo+ kutki	255	69.48
		Kodo+ Kutki + other minor millets	85	23.16
5	Practices regarding processing and value addition of minor millet	Traditional practices	339	92.37
		Modern practices	28	7.63

4.10 Practices Regarding Processing and Value Addition

This variable examines farmers' practices during millet post-harvest handling. Table 2 shows that 92.37 per cent followed traditional practises, while only 7.63 per cent used modern practices for processing and value addition of minor millets. Most respondents used traditional methods for harvesting, drying, de-husking, storage, roasting, packaging and marketing. Modern techniques were mainly used in milling, storage and fermentation. This dominance of traditional practices reflects cultural familiarity, lack of infrastructure or inaccessibility of modern tools. However, it restricts efficiency, product diversification and marketability.

5. PSYCHOLOGICAL CHARACTERISTICS

5.1 Decision-Making Ability

Decision making ability refers to respondents' capability to make informed choices regarding millet cultivation, processing and value addition. Data shows that among male respondents, 72.21 per cent had medium decision-making ability, followed by high 17.44 per cent and low 10.35 per cent. Among female respondents, 70.57 per cent had medium decision-making ability, followed by high 14.99 per cent and low 14.44 per cent.

This distribution suggests tribal farmers, particularly women, are moderately involved in agricultural decisions but lack autonomous authority in strategic or financial matters. Cultural norms and gender roles limit female participation in key decisions. These findings align with Chapke et al. (2022).

5.2 Market Orientation

Market orientation refers to farmers' intention for market participation in crop production. Data in Table 1 shows that among male respondents, 67.85 per cent had medium market orientation, 17.44 per cent high and 14.71 per cent low orientation. For female respondents, 43.87 per cent had medium orientation, 40.60 per cent low and 15.53 per cent high orientation. These figures indicate most tribal millet growers, especially males, are somewhat market-oriented, while many females remain at lower participation levels. This may be due to limited market access, price uncertainty or lack of organized marketing channels. Gender disparity is evident, with females showing lower market engagement, possibly due to mobility restrictions. These observations align with Sangappa et al. (2023).

5.3 Risk-Bearing Ability

Risk bearing ability refers to farmers' capacity to handle farming uncertainties like crop failure, price volatility or weather risks. Data shows that among male respondents, 62.13 per cent had medium risk bearing ability, 21.53 per cent high and 16.35 per cent low. Among female respondents, 67.30 per cent had medium risk bearing ability, 21.80 per cent low, and 10.90 per cent high. This distribution shows most tribal farmers have moderate risk-taking willingness, typical in subsistence farming systems due to low income and assets. Female respondents showed lower risk tolerance, possibly due to social roles and resource limitations. These findings are supported by Sangappa et al. (2023).

6. COMMUNICATIONAL CHARACTERISTICS

6.1 Information-Seeking Behaviour

Information seeking behaviour refers to how respondent’s access knowledge related to millet processing and value addition. Table 1 shows that among male respondents, 68.66 per cent had medium information seeking behaviour, followed by 19.07 per cent with high and 12.26 per cent with low behaviour. Among female respondents, 70.84 per cent had medium information seeking behaviour, with 18.53 per cent low and 10.63 per cent high behaviour. This indicates moderate effort among tribal farmers to acquire agricultural information, with men showing slightly more active behaviour than women due to greater social mobility. These findings are supported by Chapke et al. (2022).

6.2 Social Participation

Social participation refers to respondents' involvement in social organizations, self-help groups, farmer clubs or community events. Table 1 shows that among male respondents, 68.66 per cent had medium level of social participation, followed by high 19.07 per cent, and low 12.26 per cent. Among female respondents, 62.13 per cent were in the medium category, while 19.89 per cent had low and 17.98 per cent had high

participation. This indicates tribal millet growers have moderate engagement with social institutions, helping them share knowledge and build community networks. However, the higher proportion of women with low participation suggests social restrictions may limit their involvement. These findings are indirectly supported by Bhuneshwari (2022).

6.3 Training Received on Processing and Value Addition of Minor Millet

Training exposure is critical for adopting improved practices. Among male respondents, 42.23 per cent attended one training, 23.43 per cent attended two to four trainings, while 26.70 per cent had no training. Only 7.63 per cent received more than four trainings on minor millet processing. For female respondents, 46.05 per cent attended one training, 32.70 per cent attended two to four trainings, while 11.44 per cent had no training and 9.81 per cent received more than four trainings. These results show most tribal farmers, particularly females, had at least one training exposure. However, the low proportion with multiple trainings indicates the need for repeated skill-based capacity building.

7. CONCLUSION

The current research on the profile characteristics of tribal millet farmers in the Mandla and Dindori districts of Madhya Pradesh offers an in-depth look at their socio-personal, economic, psychological and communication traits. The study found that millet farming in these tribal regions is mainly conducted by farmers who are middle-aged. The education levels, especially among women, were found to be quite low, highlighting a notable gender disparity in formal education and the necessity for inclusive literacy initiatives. Most tribal farmers were part of medium-sized families and owned small to semi-medium plots of land, emphasizing the subsistence nature of their agricultural practices. Many farmers combined millet cultivation with labour or other jobs, indicating economic diversification due to low and unpredictable agricultural earnings. Although most participants had a moderate annual income and cultivated millet on medium-sized plots, their knowledge and application of value addition and processing techniques were limited. Traditional post-harvest methods were prevalent, with only a few adopting modern techniques, which limited their market potential and participation in the value chain. Market orientation and risk-taking abilities were moderate, with men scoring slightly higher than women, reflecting gender-based differences in exposure, mobility and decision-making roles. Psychological and communication traits such as decision-making skills, information-seeking behaviour, and social participation were at medium levels, indicating room for improvement through targeted capacity-building efforts. While most farmers had attended only one training session on processing and value addition, the frequency and depth of these trainings were limited, especially among men. Overall, the findings indicate that while tribal millet farmers have strong traditional knowledge and are moderately involved in millet-based livelihoods, there are significant gaps in education, adoption of modern practices, market connections and institutional support. Addressing these gaps through gender-sensitive extension services, regular skill-based training, access to credit and market development initiatives is crucial for improving the livelihoods of tribal farmers and unlocking the full potential of minor millet cultivation.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of this manuscript.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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