Participation, Hindrances and Contributing Factors of Tribal Women in Millet Cultivation: Case of Eastern Plateau and Hill Region Climatic Zone

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Abstract: Millet cultivation is integral to the socio-cultural and economic framework of tribal societies, serving as a cornerstone for their sustenance and identity preservation. Despite its critical importance, the role of tribal women in millet farming remains under explored and insufficiently recognized. This study examines the extent of tribal women's participation, the challenges they face, and contributing factors in millet cultivation through tabular analysis, statistical methods, binomial logistic regression, and Garrett ranking. The participation is negatively correlated with age, education, social motivation, and annual agricultural income, while economic motivation has a positive correlation. Lack of education is identified as the primary constraint, with the highest mean score of 72.70, followed by inadequate knowledge dissemination from developmental programs. Policy recommendations include targeted awareness campaigns on millet's nutritional benefits and culturally sensitive policies to empower tribal women in millet farming.

Keywords: Millets, Tribals woman, Participation, Binomial Logistic, Factors, Hinderances

The pivotal role of women in agriculture has been recognized throughout history, encompassing a diverse range of activities vital to agricultural production and household welfare. Highlighted by the Food and Agriculture Organization (FAO) in 2011, women's contributions in crop cultivation, animal husbandry, processing, and marketing of agricultural produce are indispensable for ensuring food security and overall well-being within households (FAO 2011). However, despite their significant contributions, women have faced systemic disparities rooted in gender-based discrimination, limiting their access to essential resources (Doss in 2018). These disparities have profound implications for food security and nutrition, underscoring the intricate link between women's roles in agriculture and household welfare (FAO 2011). Addressing and rectifying these inequalities is not only crucial for promoting gender equality but also imperative for advancing broader sustainable development goals, as emphasized by the FAO in 2020.Major millets such as sorghum and pearl millet, along with smaller grain millets like finger millet (Ragi), foxtail millet (Kangni), kodo millet (Kodo), proso millet (Cheena), barnyard millet (Sawan), and little millet (Kutki), offer numerous advantages. Additionally, millet cultivation serves as the cornerstone of rain-fed agriculture, upon which 60% of Indian farmers rely.

In Jharkhand, India, home to 32 distinct tribes, tribal communities are categorized into Hunter-Gatherer Types, Shifting Agriculturists, Simple Artisans, and Settled Agriculturists, each contributing to the rich diversity of tribal life. Agriculture in Hazaribagh is predominantly rainfed, with the kharif season (June–September) being the primary cropping period. Sorghum, bajra and finger millet are significant staple food crops, particularly among subsistence farming households in the rainfed uplands. These millets, alongside paddy, form the backbone of agricultural activities in the district. Tribal communities in the region predominantly cultivate local landraces of finger millet, including Birhor, Korwa, Hill Kharia, Sauria Paharia, Mahli, Lohra, Karmali, and Chik Baraik, among others. Traditional agronomic practices are employed for millet cultivation, primarily during the *kharif* season on marginal lands in upland and hilly regions. Millets are often grown in mixed cropping systems alongside pulses, legumes, and oilseeds, requiring minimal external inputs. In addition to serving as a nutritious food crop, finger millet significantly contributes to the income of rural households.   The participation of tribal women in millet cultivation is a vital yet often underexplored aspect of agricultural practices. Factors such as socio-cultural norms, land rights, access to resources, and the presence of support systems influence the involvement of tribal women in millet farming operations (Haque and Belwal 2017). The deeper examination of these factors is essential, as affect not only millet production but also gender equality and sustainable agriculture in India, as highlighted by Gupta et al (2017). This

research aims to address this gap by investigating the extent of tribal women's involvement and factors affecting in various aspects of millet cultivation and identifying the constraints they face.

MATERIAL AND METHODS

The study centred on the Jharkhand state in India, located in the northeastern region of the country, within Zone VII of the country, recognized as the Eastern Plateau and Hill Region (cite). Jharkhand shares its boundaries with Bihar to the north, West Bengal to the east, Odisha to the south, Chhattisgarh to the west, and Uttar Pradesh to the northwest. The capital city of Jharkhand is Ranchi. Agriculture stands as the primary economic activity, engaging approximately 63% of the rural population in the state.

For our research, because if tribal dominated state, study selected randomly North Chhota Nagpur division. From this region, we have purposively chosen the villages of Kundwa and Jitpur in the Barhi block of Hazaribagh district. A total of 60 households were selected from each villages using an unplanned approach to attain a total sample size of 120. A multistage sampling approach were utilized, encompassing both random and purposive selection of districts, blocks, and villages, to form the foundation for data collection in the state of Jharkhand. The specific focus of this research was on "Participation and the factors influencing tribal women's participation as well as what kinds of hindrances facing during the cultivation of millet cultivation in study area during the agriculture year 2022-23. Data collection was conducted through personal structured interviews with a carefully selected group of farmers. To identify suitable respondents for the study, a snowball sampling technique was employed.

Questionnaire design: Survey was designed to assess the knowledge levels about the nutritional aspects of millets among the local tribal population The preliminary study involving 30 participants was conducted to evaluate the questionnaire's reliability and validity. Out of the eight items in the satisfaction questionnaire, strong validity was observed, with values ranging from 0.632 to 0.824. The construct validity analysis, including Cronbach's alpha (CA) of 0.802, composite reliability (CR) of 0.923, and average variance extracted (AVE) of 0.862, met the established criteria of CA and CR ≥ 0.800 and AVE > 0.500 and CR > AVE, confirming the questionnaire's credibility. The questionnaire encompassed four demographic variables and the factors influencing the subsequently formulated through logical reasoning. Prior consent from participants was obtained by transparently stating the study's purpose. The questionnaire was supplemented with images of millets to facilitate easy identification and ensure unbiased responses.

Statistical analysis: The study employs a mixed-methods approach, combining qualitative and quantitative techniques to gather comprehensive data. Tabular analysis, totals and mean methods were employed to assess the extent of tribal women involvement and their contribution in various activities related to millet cultivation. The analysis focused on determining the number of days worked by individuals (where a work-day represents the productive work completed by a worker within an eight-hour day). Descriptive and inferential Analytical tools were used to analyse the data using Stata and SPSS Software. The binomial logistic regression method was employed to examine the determinants behind farmers' decisions regarding their involvement in different operations of millet cultivation. This statistical analysis was used to identify and understand the various factors that played a role in shaping these decisions.

The logistic regression model used typically follows this form:

$$\ln(p/1-p) = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \ldots + \beta_p x_p + u_i$$

where, p represents the probability of the dependent variable being 1 i.e., participation in different operations of millet cultivation

1-p represents the probability of the dependent variable being 0 i.e., non-participation in different operations of millet cultivation

β_0 is the intercept coefficient

β_1, β_2,…….. β_p are the coefficients of the independent variables x_1, x_2, x_3…..x_p

β_0= intercept coefficient

β_1…..β_p = coefficients of independent variables

x_1= Age (In years)

x_2= Education (Years of schooling)

x_3 = Economic motivation (Yes = 1, No = 0)

x_4 = Social Motivation (Yes = 1, No = 0)

x_5 = Farming Experience (in years)

x_6 = Area (ha)

x_7 = Annual income from agriculture (Rs/annum)

x_8 = Surplus family labour (Yes=1, No = 0)

u_i = Random Error Term

In a binomial logistic regression model, the odds ratio is a measure that quantifies how the odds of an event occurring change with a one-unit change in an independent variable while holding all other variables constant. It provides insight into the relationship between a specific predictor variable and the probability of the binary outcome (typically coded as 1 or 0) happening. Mathematically, the odds ratio for a predictor variable xi in a logistic regression model is calculated as follows:

Odds Ratio $= e^{\wedge} \beta_i$

where, β_i is the coefficient associated with the predictor

variable xi in the logistic regression model.

e represents Euler's number, approximately equal to 2.71828

Study focused on assessing the limitations experienced by tribal women in the research area, and this was accomplished using the Garrett Ranking method. The major advantage of this technique as compared to simple frequency distribution is that the constraints and advantages are arranged based on their importance from the point of view of respondents. Hence, the same number of respondents on two or more constraints may have been given different ranks.

By applying a specific formula, the factors were ordered and assigned ranks, allowing for a systematic evaluation of their significance.

Per cent position = 100(R_{ij}-0.50)/N_j

where, R_{ij} = Rank given for the ith reason by j^{th} respondent

N_j = Number of factors ranked by j^{th} respondent

This involves converting the percentile position of each factor into scores using Garrett's Ranking table. The scores for each labourer across the 10 factors are then aggregated and divided by the total number of respondents. The mean score obtained is used to rank the sources of problems in descending order of importance.

RESULTS AND DISCUSSION

Participation: Tribal women exhibited significant involvement in transplanting activities, with an average time spent per individual reaching 4.85 hours (Table 1). Chauhan et al (2006) also highlighted transplanting as a task garnering high participation from farm women. The prominence of women in transplanting tasks can be attributed to the meticulous attention and care required, where their patience and precision play pivotal roles, thereby underscoring their substantial contribution to this aspect of agricultural practice. Following transplanting, harvesting emerged as another operation where tribal women demonstrated participation, with an average time of 4.66 hours per individual. This finding underscores the integral role played by women in harvesting activities, reflecting their contribution to the successful culmination of the cultivation process. Furthermore, the study revealed that weeding, harvesting, and transplanting tasks were exclusively performed by females, highlighting their central role in these essential agricultural activities. Conversely, field preparation, a task characterized by its strenuous nature, was predominantly carried out by men, resulting in negligible participation from tribal women and restricting their involvement to seedbed preparation alone. Hussain et al (2011) and Kumari et al (2016), emphasized the division of labour based on gender roles in agricultural practices of work-days**.**

Constraints faced by women workers: The lack of education emerged as the foremost constraint, garnering the highest mean score of 72.70 (Table 2). This finding underscores the critical need for educational interventions targeting tribal women, as education serves as a foundational tool for enhancing their capacity, agency, and opportunities for socio-economic advancement. Slathia (2015) and Jaiswal (2018) also identified low levels of education as a primary obstacle hindering the empowerment and well-being of tribal women. Insufficient knowledge dissemination by developmental programs emerged as the second-highest constraint, reflecting the need for more effective communication and outreach strategies to ensure the accessibility and relevance of development initiatives for tribal women. Mareeswaran et al (2017), Jaiswal (2018) and

Table 1. Tribal women participation in different operations of millet cultivation in terms of work-days

Operations	Total hours	Total works-days	Total time spent by an individual farmer
Field preparation	287.5	35.4	0.3
Sowing	526.0	65.75	0.55
Transplanting	4654.0	581.75	4.85
Irrigation	231.5	28.94	0.24
Weeding	2690.5	336.31	2.8
Fertilizer application	477.2	59.65	0.5
Harvesting	4469.0	558.63	4.66
Threshing	697.0	87.13	0.73
Winnowing	348.5	43.56	0.36
Grading and packaging	161.5	20.19	0.17
Transportation and marketing	532.0	66.5	0.55
Total	15074.7	1883.81	15.71

Table 2. Constraints faced by tribal women

Constraints	Mean score	Rank
Lack of education	72.7	1
Insufficient knowledge about development programs	72.05	2
Less numeration	71.98	3
Lack of training	70.32	4
Lack of alternate employment	63.64	5
Health issue	62.24	6
Priority to male worker	61.1	7
Insufficient credit facility	48.73	8
Family restriction	44.53	9
Lack of freedom to take decision	34.96	10

Shamna et al (2018) underscored the importance of targeted interventions and capacity-building efforts to address knowledge gaps and enhance the effectiveness of developmental programs in empowering tribal women. Furthermore, the analysis identified several other notable constraints, including inadequate remuneration, lack of training opportunities, limited access to alternative employment, insufficient credit facilities, family restrictions, and health issues. These findings highlight the multifaceted nature of the challenges faced by tribal women, encompassing economic, social, and health-related dimensions. The recognition of these constraints underscores the urgency of adopting holistic approaches that address intersecting needs and vulnerabilities of tribal women, while also promoting their agency, autonomy, and well-being.

Factors influencing the participation: The logistic regression analysis revealed significant associations between several predictor variables and the odds ratio of a particular outcome (Table 4) by the p-values. Age (p = 0.03116) and economic motivation (p = 0.02481) were negatively and positively correlated with the participation of tribal women, respectively, with odds ratios of 0.96664 and 1.22646, suggesting that for each year increase in age, the odds of the participation of tribal women in different operations of millet decrease by 0.96664 times, and each unit increase in economic motivation results in 1.22646 times increase in the odds. Furthermore, social motivation (p = 0.04256) was also negatively associated with the participation, with an odds ratio of 0.9522, implying that increased social motivation is associated with 0.9522 times decrease in the odds of participation. These findings suggest that age, education, economic motivation, and social motivation have significant impacts on the outcome. However, other variables like farming experience, area, and surplus family labour, did not show significant associations with the outcome. The Cox and Snell R-squared value of 0.713 (Table 3) indicates that the model explains a substantial portion of the variance in the data. The variable 'age' exhibited a negative and significant relationship with participation, indicating that older tribal women tended to allocate less time to agricultural activities compared to their younger counterparts. Younger women in farming displayed a higher inclination towards embracing change, likely attributed to their greater physical strength, which enables them to engage in a wider range of agricultural tasks. This observation aligns with the research conducted by Choudhary and Singh (2003). However, it contradicts the

Table 3. Policy measures and suggestions to address the constraints faced by tribal women

Livelihood diversification	Introduce and support livelihood diversification programs that align with the local ecosystem and resources. This might involve promoting sustainable agriculture, non-timber forest products, and cottage industries to increase income opportunities.
Community-based training	Establish community-based training centres that offer practical skills relevant to the local economy. These centres can focus on agriculture, traditional crafts, and small-scale enterprises to enhance employability.
Health camps	Organize regular health camps within tribal communities, offering basic healthcare services and awareness programs on nutrition, hygiene, and preventive healthcare. Collaborate with local healthcare providers to ensure accessibility.
Microfinance initiatives	Facilitate the formation of women's self-help groups and provide them with access to microfinance services. This empowers women to start small businesses or invest in income-generating activities.
Tailored educational programs	Develop customized educational programs that consider the unique needs of tribal women. Ensure schools are located nearby, provide scholarships, and offer flexible timings to accommodate their responsibilities.
Women's cooperatives	Encourage the formation of women's cooperatives to collectively address issues and access resources. These cooperatives can engage in joint ventures, marketing, and advocacy.
Mobile information centres:	Establish mobile information centres that visit remote tribal areas regularly to disseminate information about government schemes, entitlements, and services available to them.
Inclusive governance	Promote the inclusion of tribal women in local governance structures and decision-making bodies. Ensure their voices are heard in matters affecting their communities.
Cultural sensitivity	Design policies and programs that respect and incorporate the cultural values and practices of tribal communities. This ensures greater acceptance and participation.
Monitoring and evaluation	Implement robust monitoring and evaluation mechanisms to assess the effectiveness of policies and programs. Adapt strategies based on real-time feedback and experiences on the ground.
Collaborative approach	Foster partnerships between government agencies, non-governmental organizations (NGOs), and local community leaders to jointly address the multifaceted challenges faced by tribal women.
Legal support	Establish legal aid centres in proximity to tribal communities, providing guidance and support to women dealing with legal issues, including family restrictions and property rights.
Infrastructure development	Prioritize infrastructure development in tribal areas, including road connectivity, electricity, and clean water supply, to improve accessibility and quality of life.

Table 4. Binary logistic results for analysis of factors influencing participation of tribal women in different operation of Millet production for whole sample

Variables	B	Standard error	p-Value	Exp(B)/ Odds Ratio
Intercept	4.338	1.27023	0.00013	-
Age	-0.03451	0.01384	0.03116	0.96664
Education	-0.002421	0.00243	0.00245	0.99758
Farming experience	0.50632	2.47245	0.8941	1.66058
Social motivation	-0.04861	0.59341	0.04256	0.9522
Economic motivation	0.20432	0.82457	0.02481	1.22646
Annual Income from agriculture	-0.01321	0.54839	0.00613	0.98694
Area	-0.12451	0.86986	0.89412	0.88245
Surplus family labour	0.00647	2.17485	0.91347	1.00647
Cox and Snell R-squared	0.713			

results reported by Fami (2006) and Chauhan (2011). The 'education' variable demonstrated a negative and significant relationship with the participation of tribal women in farming.

These findings are not consistent with the results of studies conducted by Singh et al (2015) and Chauhan (2011). The 'social participation' variable exhibited a notable negative and statistically significant relationship with the participation of tribal women in farming. This was attributed to their active involvement in community activities, which resulted in less time being allocated to farming. These findings are in contrast to those of Singotia (2014) and Patel et al (2016). On the other hand, 'economic motivation' displayed a positive and significant relationship with the participation of farm women in agricultural activities. Many tribal women want to assist the head of the family in income generation to meet the daily needs. Sharma (2008) and Bhairve (2013) reported similar findings. Annual income from agriculture has a negative and significant relationship with the participation index as millet cultivation is a minor crop which is basically done in the study area for their own consumption. Therefore, as their income increases from other major crops participation in millet cultivation decreases.

CONCLUSION

The transplanting is the most labour-intensive operation in millet cultivation, primarily undertaken by tribal women who also handle weeding and harvesting tasks. However, their involvement in field preparation is limited due to the physical demands of the work. The main challenges faced by tribal women include a lack of education and insufficient knowledge from developmental programs, which significantly impact their participation in millet farming. Factors such as age, education, social motivation, and agricultural income further influence their engagement

negatively. Based on these findings, the study suggests several policy measures, including the creation of nutritional awareness campaigns, the implementation of culturally-sensitive policies, the establishment of proper market facilities for output procurement, and the promotion of community-based organizations or cooperatives among tribal women.

AUTHOR CONTRIBUTION

The conceptualization of the paper, supervision of field research, and data collection were overseen by P.S. Badal. Kumari Megha contributed to data collection and entry. Sachin Rathour conducted data analysis and interpreted the findings.

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