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Mann-Whitney U test assessment of gender based participation in rice farming

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Abstract

This study explored gender based participation in rice farming in Tripura, revealing distinct roles undertaken by farm men and farm women throughout various stages of the rice farming. A total of 160 male and 160 female farmers were included in the study to examine and compare the participation of farm men and women in various rice farming activities. The objectives of the study were accomplished using the Mann-Whitney U test for statistical analysis. The study revealed a statistically significant gender based difference in participation in rice farming activities. The Mann-Whitney U test confirmed that farm men had a significantly higher extent of participation compared to farm women, with a very large effect size, indicating a practically meaningful gap. Farm men were predominantly involved in tasks related to land preparation, input application, irrigation, spraying, and mechanized harvesting, while farm women were more engaged in labour intensive and post-harvest activities such as hand weeding, winnowing, and drying. Participation patterns varied widely between activities, with some showing a clear male or female dominance. Furthermore, the distribution of participation levels demonstrated that farm men mostly fell within medium to high participation categories, whereas the majority of farm women were in the low participation group. The findings reveal a continued inequality in how agricultural roles are shared between men and women, emphasizing the importance of adopting gender inclusive measures in extension programs and agricultural policies.

Keywords: Participation, Mann-Whitney U test, labour intensive, rice farming, agricultural policies

Introduction

A gender-disaggregated approach in agriculture provides a valuable perspective for understanding the differences in resource access and labour participation between male and female farmers. Recognizing the distinct roles and responsibilities men and women undertake in agricultural, allied, and household activities is essential for effectively identifying and addressing gender disparities (Rudrapal *et al*., 2025) [6]. Tripura has a cultivable area of 2.72 lakh hectares (26% of the total geographical area) and a net cropped area of 2.55 lakh hectares (24%). The state produces approximately 8,04,516 metric tonnes of rice, with an average productivity of 2.8 tonnes per hectare. The cropping intensity in Tripura is 191%, significantly higher than the national average of 142% (Directorate of Agriculture, Government of Tripura 2022). A gender-inclusive Integrated Farming System (IFS) promotes sustainable livelihoods for small and marginal farmers by ensuring equitable participation of men and women in agriculture, especially on marginal lands. Bridging gender gaps in labour and access to resources enhances productivity and fosters stronger cooperation within farming households (Sahu *et al*., 2024) [8]. India's overall growth is closely tied to agricultural advancement, with extension services acting as a vital link between researchers, policymakers, and farmers to enhance practices and livelihoods. Since pre-independence, public institutions have been actively delivering these services to boost agriculture and allied sectors in rural areas (Parashar and Tyagi, 2025) [3]. Women play a vital role in national development, and their potential in this context is increasingly recognized. Despite facing numerous challenges, many women have achieved success in the entrepreneurial sector, demonstrating resilience and determination (Rudrapal *et al*., 2024) [5]. Tribal women play a pivotal role in agricultural development by managing household economies and making key decisions on land use and resource allocation. Their elevated social status stems from their control over resources, shaping their influence within the tribal economy (Moharana *et al*., 2025) [2]. Dairy farming plays a crucial role in boosting rural livelihoods by improving milch animal productivity and creating income opportunities. According to the 20th Livestock Census, India's livestock population rose by 4.6% to 535.78 million, with Tripura accounting for 13.18 lakh. (Rudrapal *et al*.,

2023) [7]. Timely and reliable agricultural information plays a vital role in enhancing farm productivity, informed decision-making, and sustainable practices. Gaining insight into how paddy farmers seek, access, and use this information is fundamental for developing efficient extension approaches and effective information delivery systems (Rakesh *et al*., 2024) [4].

Objective

To assess the extent of participation of farm men and farm women in rice farming

Materials and Methods

The research is carried out in Sepahijala and South Tripura districts of Tripura, identified for their relatively greater contribution to rice production. Target respondents were identified using a simple random sampling method. A total of 160 farm men and 160 farm women were selected for participation in the study. The respondents selected for this study were engaged in rice farming. Primary data were collected through face-to-face interviews using a pre-tested and structured questionnaire to ensure reliability and validity. The study identifies 25 key activities involved in rice farming, each assessed using a four-point scale to capture the pattern of participation. The scale ranges from activities carried out alone by farm men or farm women (4), jointly (3), jointly undertaken with family members (2), jointly performed with the help of family members, labourers, machinery & contractual support (partial involvement) (1). To evaluate the distribution of the data, the Shapiro-Wilk test was conducted to test for normality. In this study, the resulting p-values were found to be less than the conventional significance threshold of 0.05, leading to the rejection of the null hypothesis of normality. This outcome confirmed that the data did not follow a normal distribution. Given this non-normality, the Mann-Whitney U test, a non-parametric alternative to the independent samples t-test, was employed to analyze the data. This test is particularly appropriate for ordinal data or continuous data that deviate from normality, and it is used to compare whether there are statistically significant differences between two independent groups. In the context of this study, the Mann-Whitney U test was applied to examine gender-based differences in key variables between male and female respondents. A significance level (α) of 0.05 was established to determine statistical relevance. Any result with a p-value below this threshold was considered statistically significant. All statistical computations and analyses were carried out using the Jamovi statistical software, which offers a user friendly interface and robust statistical capabilities.

Results and Discussion

Table 1 presents the mean participation scores and corresponding ranks of farm men and farm women across different rice farming activities. Farm men exhibit a significantly higher mean score of 3.92 (Rank 1) in seed selection and treatment than farm women, who have a mean score of 1.80 (Rank 14). Farm men have a mean score of 3.27 (Rank 13) for preparation of the seedbed, while women show a slightly lower mean of 2.58 (Rank 8). sowing of pre-germinated seeds, men have a mean of 3.38 (Rank 12), and women have a higher mean of 2.73 (Rank 6). Across most land preparation activities, men demonstrate higher involvement in ploughing, mean of 3.56 (Rank 8) compared to women's 1.51 (Rank 19). Similarly, in harrowing, men's mean is 2.93 (Rank 16) versus women's 1.91 (Rank 11). Puddling shows a mean of 3.13 (Rank 15) for men and 1.86 (Rank 13) for women. Levelling follows a similar trend with men at 3.26 (Rank 14) and women at 1.57 (Rank 18). However, in cleaning field boundaries, women have a slightly higher mean of 2.36 (Rank 10) compared to men's 2.33 (Rank 19). Transplanting shows a notable difference, with women having a higher mean score of 2.77 (Rank 5) compared to men's 2.25 (Rank 20). In applying FYM/Green manure, men have a mean of 3.56 (Rank 8), while women have a lower mean of 1.60 (Rank 15). Applying chemical fertilizers/NPK follows a similar pattern, with men at 3.55 (Rank 9) and women at 1.58 (Rank 17). Hand weeding (6_a) has a very low mean for men at 1.23 (Rank 24) but a high mean for women at 3.18 (Rank 2), indicating it is a predominantly female task. Conversely, spraying herbicide shows a high mean for men at 3.70 (Rank 5) and a low mean for women at 1.32 (Rank 22). The use of a rotavator for weed management also shows higher male involvement (Mean 3.61, Rank 7) compared to women (Mean 1.25, Rank 23). Irrigating the main field has a mean of 3.49 (Rank 10) for men and 1.59 (Rank 16) for women, indicating higher male involvement. However, cleaning channels shows a higher mean for women at 2.91 (Rank 3) compared to men's 2.64 (Rank 18). Similar to herbicide spraying, spraying other plant protection chemicals shows a high mean for men at 3.78 (Rank 3) and a very low mean for women at 1.21 (Rank 24). Harvesting using a sickle has a mean of 2.13 (Rank 21) for men and 2.61 (Rank 7) for women. In contrast, the use of a machine operated harvester shows a higher mean for men at 3.65 (Rank 6) compared to women's 1.36 (Rank 21). Threshing has relatively similar means for both genders (Men: 2.90, Rank 17; Women: 2.84, Rank 4). Winnowing and drying show very low means for men (1.50, Rank 23 and 1.53, Rank 22, respectively) and high means for women (3.35, Rank 1 for both), indicating these are predominantly female tasks. Milling has a higher mean for men at 3.71 (Rank 4) compared to women's 1.88 (Rank 12). Bagging also shows higher male involvement with a mean of 3.82 (Rank 2) versus women's 2.44 (Rank 9). Finally, transportation has a mean of 3.45 (Rank 11) for men and 1.44 (Rank 20) for women, indicating a greater male role. This finding supports the report by Kavyashree *et al*. (2022) [1], which highlighted that farm women predominantly engaged in tasks such as transplanting, manual weeding, and value addition.

Table 1: Mean value of rice farming activities of farm men and farm women (n=320) Farm men=160, Farm women=160

Rice farming activities	Farm Men		Farm Women	
	Mean	Rank	Mean	Rank
Seed selection and treatment	3.92	1	1.80	14
Nursery preparation				
Preparation of seedbed	3.27	13	2.58	8
Sowing of pre-germinated seed	3.38	12	2.73	6
Land preparation				
Ploughing	3.56	8	1.51	19
Cleaning of field boundaries	2.33	19	2.36	10
harrowing	2.93	16	1.91	11
Puddling	3.13	15	1.86	13
Levelling	3.26	14	1.57	18
Transplanting	2.25	20	2.77	5
Manuring				
Applying FYM/Green manure	3.56	8	1.60	15
Applying chemical fertilizers/NPK	3.55	9	1.58	17
Weed management				
Hand weeding	1.23	24	3.18	2
Spraying herbicide	3.70	5	1.32	22
Rotavator for weed management	3.61	7	1.25	23
Irrigation				
Irrigating main field	3.49	10	1.59	16
Cleaning channels	2.64	18	2.91	3
Spraying plant protection chemicals for pest and disease management/ Plant protection	3.78	3	1.21	24
Harvesting				
Harvesting by using sickle	2.13	21	2.61	7
Machine operated/harvester	3.65	6	1.36	21
Post harvesting				
Threshing	2.90	17	2.84	4
Winnowing	1.50	23	3.35	1
Drying	1.53	22	3.35	1
Milling	3.71	4	1.88	12
Bagging	3.82	2	2.44	9
Transportation	3.45	11	1.44	20

Table 2 presents a comparative distribution of farm men and farm women based on their level of participation (High, Medium, and Low) in rice farming. Farm men are more likely to have medium to high levels of participation. A significant majority (63.7%) have medium participation, and over a (36.3%) have high participation. Farm women show a different pattern where majority (56.9%) have low participation, while a smaller percentage (43.1%) have medium participation.

Table 2: Distribution of farm men and farm women according to their level of participation in rice farming (n=320) Farm men=160, Farm women=160

Participation in rice farming	Category	Farm men		Farm women	
		Frequency	Percentage	Frequency	Percentage
	High	58	36.3	0	0
	Medium	102	63.7	69	43.1
	Low	0	0	91	56.9

Hypothesis testing

H_{01}: There is no significant difference in the extent of participation of farm men and farm women in rice farming

H_{11}: There is a significant difference in the extent of participation of farm men and farm women in rice farming

According to the Mann-Whitney U test, the mean and median difference presented in Figure 1 revealed that farm men have a higher mean and median value in extent of participation in rice farming as compared to farm women, and the tall box indicated more variability among farm men.

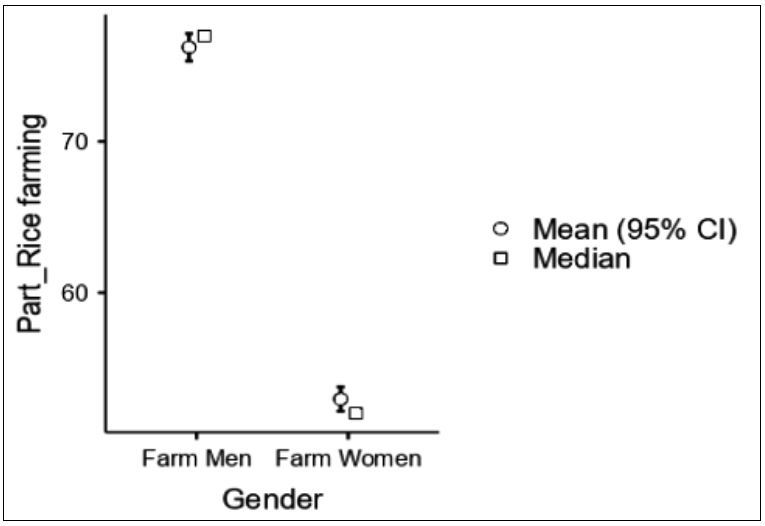

Fig 1: Mean and median difference between rice farming of farm men and farm women

Table 3 revealed that the median score of rice farming of farm men is 77.0 and mean score is 76.3 where median score of farm women is 52.0 and mean score is 53.0. Farm men exhibit considerably higher involvement compared to farm women. The standard deviation for male farmers was 5.88, and for female farmers 5.17, indicating moderate variability in participation levels within each group and farm men participation scores are slightly more spread out than those of farm women. The standard errors values (0.464 for males and 0.408 for females) suggest that the sample means are reliable estimates of the population means, as the variability is low. Calculated Mann-Whitney U value 42.5, which helps determine the distributions of participation scores differ between groups. *P*-value (< 0.001) this is highly significant, Therefore, we reject the null hypothesis and there is a significant difference in the extent of participation between farm men and farm women in rice farming. Effect size 0.997 indicates a very large effect size, showing that the difference between male and female participation is practically meaningful.

Table 3: Mann-Whitney U test analysis on rice farming of farm men and farm women

Participation	Group	N	Mean	Median	SD	SE
Rice farming	Farm men	160	76.3	77.0	5.88	0.464
	Farm women	160	53.0	52.0	5.17	0.408
	Statistics	*p*-value			Effect size	
	42.5	<0.001	Rank biserial correlation		0.997	

Conclusion

The study aimed to assess gender-disaggregated participation in rice farming in Tripura, revealing a statistically significant difference in the extent of involvement between farm men and farm women. The Mann-Whitney U test results firmly reject the null hypothesis (H_{01}), confirming that male and female participation differs considerably ($U = 42.5$, $p < 0.001$). Farm men demonstrated a higher mean participation score (76.3) compared to farm women (53.0), with corresponding median values of 77.0 and 52.0, respectively. The effect size of 0.997 further indicates a substantial and practically meaningful difference in participation levels. Activity-wise analysis revealed that men predominantly participate in physically intensive and mechanized operations such as seed selection and treatment (mean 3.92), ploughing (3.56), spraying herbicides (3.70), and bagging (3.82). Conversely, farm women showed higher involvement in labour intensive and post-harvest tasks like hand weeding (3.18), winnowing and drying (3.35), and cleaning channels (2.91). Transplanting and threshing were among the few activities with relatively balanced participation, with women slightly outpacing men in transplanting (2.77 vs. 2.25). 36.3% of farm men had high participation and 63.7% had medium participation, with none in the low category. In contrast, 56.9% of farm women fell into the low participation group, and the remaining 43.1% had medium involvement. These findings emphasize the gender-based division of labour in rice farming, reflecting entrenched social norms and role expectations. To foster gender equity and enhance agricultural productivity, extension services and policy interventions should be tailored to address the distinct needs of men and women, while actively empowering and engaging women in the technical dimensions of rice farming. Traditional roles assign field based and mechanised tasks to farm men, while farm women focus on manual and post-harvest activities. Farm men typically hold land titles, credit access and machinery enabling them to lead resource intensive activities. Since farm men typically oversee decisions on crop selection and input use, they become more deeply involved in all farming activities. Conversely, farm women simultaneous obligations to fieldwork and household chores reduce their capacity to engage in demanding agricultural tasks.

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