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Empowering Farm Women: The Role of Drudgery-Reducing Technologies in Promoting Gender Equity

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ABSTRACT

The transition of Indian agriculture from animal-driven to machine-driven practices has introduced various tools and implements aimed at increasing efficiency and reducing physical labour. Ergonomics, the science of tailoring equipment and workstations to the capabilities and limitations of the human body, plays an important role in reducing physical stress and health risks associated with agricultural work, especially for female workers who face repetitive and difficult tasks.

This study explored the introduction and impact of ten drudgery-reducing farm technologies for farm women. The primary goal was to evaluate the effectiveness of these technologies in enhancing productivity and reducing physical labour through a capacity-building training program. A capacity-building training program was conducted in Kaveliguda village, targeting 50 farm women. The training focused on ten drudgery-reducing farm technologies, which included sapling transplanters, improved sickles, long-handle weeders, Head load managers, Seed placement tubes, Finger guards, Ring cutters, different types of Cotton harvest bags, Knitted gloves, and Seed cum fertilizer bag. Pre and post-training evaluations were carried out to assess changes in awareness and adoption rates. Socio-economic constraints, including low income and limited contact with extension services, create significant barriers to training participation and technology uptake.

The pre- and post-training evaluations revealed significant increase in awareness of the drudgery-reducing technologies. There was a moderate adoption rate of these technologies among the participants. The findings underscore the importance of accessible training and technology in enhancing productivity and occupational comfort for women in agriculture. By emphasizing ergonomics and user-centered design principles, this study highlighted the importance of active participation of women in the design process to ensure that the equipment meets their specific needs and preferences. This participatory approach not only increased the usefulness and acceptance of the equipment among women farmers but also created a sense of ownership. Prioritizing ergonomics in tool design and implementation can create a more equitable and sustainable agricultural sector that supports the health and empowerment of women farmers.

Keywords: *Drudgery reducing technologies, Farm women, Awareness, Gender Equity, Occupational Comfort, User centered Design, Ergonomics, Physical load, Manual tools.*

1. Introduction

Agricultural activities in India, once dominated by animal-driven practices, are increasingly transitioning to mechanized systems aimed at enhancing productivity and reducing labour [8]. The agricultural sector in India relies heavily on the contributions of women, who are involved in a wide range of tasks from sowing to harvesting. However, farm women—who form a crucial part of the agricultural workforce—continue to experience significant drudgery due to repetitive, labour-intensive tasks [3]. The shift towards mechanization in agriculture has introduced tools aimed at increasing efficiency, yet many of these tools are not ergonomically suited to the needs of women farmers, thereby underscoring the need for gender-sensitive technological interventions.

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This drudgery not only affects their physical well-being but also limits their overall productivity. In this context, ergonomics, the science of designing tools and equipment that align with human capabilities, plays a critical role in reducing occupational stress and enhancing comfort.

Ergonomics, the science of designing tools and processes to fit human capabilities, offers a promising solution by reducing occupational stress and improving comfort. The introduction of gender-friendly, drudgery-reducing technologies provides a practical solution to alleviate the physical strain on women farmers. Tools such as sapling transplanters, long-handle weeders, sickles, and cotton harvest bags are designed to make agricultural tasks less burdensome. However, the success of these interventions depends on the extent to which they align with the needs and preferences of farm women and whether appropriate training programs accompany their distribution [13].

This study evaluates the impact of ten drudgery-reducing technologies provided to farm women, focusing on changes in awareness, adoption rates, and improvements in occupational comfort.

A participatory approach involving the farm women in the design and feedback process ensures that the tools meet user-specific needs, fostering ownership and long-term adoption.
By analyzing the effectiveness of capacity-building programs and identifying factors that influence technology adoption, this research highlights the importance of targeted interventions [24]. It also underscores the need for robust extension services to bridge the gap between innovation and on-field application. The insights from this study contribute to the broader goal of achieving gender equity in agriculture by empowering women through ergonomically designed technologies that foster both productivity and well-being. The objectives include evaluating changes in awareness and adoption rates of these technologies before and after training and determining how effectively these tools improve occupational comfort and productivity.

2. Methodology

Ex-post facto research design was selected for the study. A total sample of 50 farm women was selected from the village of Kaveliguda, Shamshabad mandal, Rangareddy district, Telangana. Capacity building training programs on different types of gender friendly drudgery-reducing farm tools i.e. sapling transplanter, sickle/kurpi, long handle weeders, ring cutter, finger guards, knitted gloves, three types of harvest bags, head load manager, sapling transplanter, seed placement tube and seed cum fertilizer bag were introduced. The independent variables are socio-economic and communication factors and the dependent variables are awareness and adoption levels of drudgery-reducing tools among farm women.An interview schedule was developed on gender friendly drudgery reducing farm technologies. The developed schedule included both closed and open-ended questions to assess the awareness and adoption levels. Data were collected from the selected women farmers as per developed schedule before and after the capacity building training programmes. After one season of crop, data was collected and analyzed to understand the adoption level of given technologies. Descriptive statistics and correlation were used for analyzing the data.

3.Results and Discussion

3.1Demographic Distribution of Respondents

3.1.1 Age Distribution

The majority of respondents were middle-aged women (46%), suggesting that this age group may have a more substantial role in agricultural activities and decision-making within their households, followed by older women (34%). The 20 percent of younger participants (18-35 years) indicated an opportunity to engage this group more actively in agricultural practices and technology adoption[2], [37].

3.1.2 Educational Profile

A significant proportion of respondents (46%) were illiterate, highlighting the need for targeted educational interventions to enhance literacy and numeracy skills among farm women. Additionally, 30 percent had primary education and 24 percent had secondary education, suggesting a potential for improving awareness and understanding of drudgery-reducing technologies through tailored training programs [18].

3.1.3 Work Experience in Agriculture

The majority of respondents (30%) had 11-20 years of experience in farming, indicating a relatively experienced cohort. However, the lower representation in higher experience brackets (only 8% with 21-30 years) suggests challenges in retaining women in agriculture as they age or progress in their occupation [28].

Table-1 Distribution of respondents according to the demographic profile (N=50)

Personal and Social Variables	Frequency	Percentage (%)
Age		
Young (18-35 years)	10	20.0
Middle (36-55 years)	23	46.0
Old (Above 55 years)	17	34.0
Education		
Illiterate	23	46.0
Primary school education (up to 7th standard)	15	30.0
Secondary school education (8th to 10th standard)	12	24.0
Work experience		
Below 10 years	12	24.0
Between 11-20 years	15	30.0
Between 21-30 years	4	8.0
Between 31-40 years	7	14.0
Above 41 years	12	24.0
Type of Family		
Joint family	28	56.0
Nuclear family	22	44.0
Size of family		
Small (up to 4 members)	22	44.0
Medium (5 to 8 members)	17	34.0
Large (Above 8 members)	11	22.0
Caste		
General	10	20.0
OBC	32	64.0
SC / ST	8	16.0

3.1.4 Family Structure and Size

The majority of respondents belonged to joint families (56%), which might have provided a support network for sharing responsibilities while 44% were from nuclear families which could have influenced their availability for training and adoption of new technologies.

3.1.5 Caste Distribution

The caste distribution revealed that 64 percent of respondents belonged to Other Backward Classes (OBC), while only 16 percent were from Scheduled Castes/Scheduled Tribes (SC/ST). This demographic insight was critical, as it highlighted the need for inclusive policies that address the unique challenges faced by women from different caste backgrounds [20].

3.2 Economic Profile of Respondents

The economic variables from this study provided critical insights into the financial circumstances and agricultural status of the respondents.

Table-2 Distribution of respondents according to the economic variables (N=50)

Economic Variables	Frequency	Percentage (%)
Annual family income (Rs.)		
Low (< 1,50,000)	37	74.0
Medium (1,50,000 to 3,00,000)	9	18.0
High (> 3,00,000)	4	8.0
Type of farmers		
Marginal farmer (< 1.00 ha)	9	18.0
Small farmer (≥ 1.00 to 1.99 ha)	15	30.0
Medium farmer (2.00 to 9.99 ha)	22	44.0
Big farmer (> 10.00 ha)	4	8.0
Type of house		
Kutcha	8	16.0
Semi Pucca	22	44.0
Pucca	20	40.0

3.2.1 Annual Family Income

The majority of respondents (74%) had low annual incomes (less than ₹1,50,000), indicating economic constraints that could limit their ability to invest in new technologies. Only 18 percent and 8 percent were in the medium and high-income categories, respectively. Addressing these economic constraints was crucial for promoting technology adoption; financial assistance or subsidized access to drudgery-reducing tools might have been necessary to empower these women economically [1], [4], [14].

3.2.2 Classification of Farmers by Landholding Size

The majority of respondents were medium (44%) and small (30%) landholding farmers, with only 18 percent and 8 percent being marginal and big farmers, respectively. The predominance of medium and small landholding farmers suggested that a substantial portion of the respondents might have faced challenges related to resource allocation and access to markets. These challenges could have directly influenced their willingness and ability to adopt new technologies. Programs aimed at enhancing productivity needed to consider the specific needs and constraints of medium and small farmers landholding, ensuring that interventions were tailored accordingly.

3.2.3Type of House

The majority of respondents lived in semi-pucca (44%) and pucca (40%) houses, with only 16 percent living in kutcha houses.The prevalence of semi-pucca housing suggested a transition towards more stable living conditions but also indicated that many families might still have lacked adequate infrastructure and resources.

3.3 Communication Profile of Respondents

3.3.1 Mass Media Exposure Level

The majority of respondents (40%) had low exposure to mass media, with only 16 percent having high exposure. This suggests a need for targeted media campaigns to reach women farmers effectively and improve their access to agricultural information [7].

Table-3 Distribution of respondents according to the communication profile (N=50)

Communication Variables	Frequency	Percentage (%)
Mass media exposure level		
Low exposure (< 10)	20	40.0
Medium exposure (10 to 13)	22	44.0
High exposure (> 13)	8	16.0
Contact with extension personnel's/agents		
Low contact (< 9)	41	82.0
Medium contact (9 to 11)	7	14.0
High contact (> 11)	2	4.0
Contact level with extension Institutes		
Low contact (< 7)	41	82.0
Medium contact (7 to 9)	7	14.0
High contact (> 9)	2	4.0

3.3.2 Contact with Extension Personnel/Agents

A significant proportion of respondents (82%) had low contact with extension personnel. Only 14 percent had medium contact, and a mere 4 percent reported high contact with extension agents. This lack of interaction raised concerns about the accessibility and effectiveness of extension services in reaching women farmers. Extension personnel play a crucial role in disseminating knowledge, providing training, and facilitating technology adoption [15].

3.3.3 Contact Level with Extension Institutes

Similar to contact with extension personnel, 82 percent of respondents had low contact with extension institutes. Enhancing collaboration between extension institutes and local communities was essential to bridge this gap. Initiatives could include organizing community workshops, field demonstrations, and participatory training sessions that actively involve women farmers [6].

3.4 Drudgery Levels Perceived by Farm Women During Farming Activities

The data presented in Table-4 illustrated the perceived levels of drudgery associated with various farming activities among farm women, highlighting the physical and psychological challenges they faced in their agricultural practices. Farm women perceive certain farming activities as significantly more labour-intensive than others.

Manual harvesting and weeding were identified as the most drudgery-prone activities, with 28 percent and 26 percent of respondents, respectively, categorizing them as such. This highlights the physical strain associated with these tasks.This aligned with existing literature that emphasizing the physical strain involved in harvesting crops manually, which often required prolonged periods of bending and lifting, leading to musculoskeletal issues [9], [23]. The identification of high-drudgery activities underscored the urgent need for developing and promoting ergonomic tools and technologies tailored to these specific tasks [19], [29], [35].

Other activities, such as sowing and threshing, were also perceived as moderately drudgery-prone, with 22 percent and 24 percent of respondents, respectively, indicating this level of intensity [13], [30]. In contrast, activities like cleaning and drying of farm produce were perceived as less strenuous, with 14 percent and 30 percent of respondents, respectively, categorizing them as least drudgery-prone [10].

Table-4 Perceived drudgery levels in farming activities by farm women (N = 50)

Farming activities	Level of drudgery					
	Most drudgery Prone		Moderately drudgery prone		Least drudgery prone	
	Frequency	Percentage (%)	Frequency	Percentage (%)	Frequency	Percentage (%)
Clod breaking	-	-	6	12.0	2	4.0
Digging	-	-	6	12.0	5	10.0
Seed treatment	-	-	5	10.0	9	18.0
Sowing	11	22.0	5	10.0	-	-
Irrigation	-	-	2	4.0	6	12.0
Weeding	13	26.0	6	12.0	-	-
Manual Harvesting	14	28.0	5	10.0	-	-

Machine Harvesting	-	-	6	12.0	-	-
Threshing	12	24.0	-	-	-	-
Cleaning of farm produce	-	-	7	14.0	8	16.0
Drying of farm produce	-	-	-	-	15	30.0
Storage of farm produce	-	-	2	4.0	5	10.0

3.5 Awareness of weeding tools

The findings on the awareness of various weeding tools among farm women before and after a capacity-building training program highlighted a significant shift in knowledge levels.

Before the training, awareness of weeding tools was limited. Only 10 percent of respondents were aware of sickles, and none were aware of long-handle weeders. While 64 percent knew about khurpis, their full potential might not have been recognized.This substantial improvement underscored the effectiveness of the training program in disseminating knowledge about traditional tools that could aid in weeding [23].

Table- 5 Distribution of the respondents according to awareness about weeding tools (N=50)

Tools	Crops	Pre-evaluation	Post-evaluation
Sickle	Brinjal, Tomato, Gourds, Okra, Fodder Crops, Flowers	5 (10.0%)	25 (50.0%)
Khurpi	Vegetable and horticulture	32 (64.0%)	39 (78.0%)
Long handle weeder	Soybean, SunflowerMaize, Okra, Brinjal, Tomato, Chilli,	--	45 (90.0%)
All	--	15 (30.0%)	44 (88.0%)

After the training, awareness increased significantly. Knowledge of sickles increased to 50 percent, and awareness of long-handle weeders reached 90 percent of respondents who recognized this tool's relevance for multiple crops, including maize, okra, brinjal, tomato and chilli. Awareness of khurpis also increased to 78 percent. Overall, awareness of all weeding tools rose from 30 percent to 88 percent.

This significant improvement in awareness highlights the effectiveness of the training program in empowering farm women with knowledge about tools that can reduce physical strain and improve efficiency in weeding practices [32]. The increase reflected not only improved awareness but also a potential shift in attitudes towards adopting these tools in daily farming practices [19], [29].

3.6 Awareness of harvesting tools

The findings on the awareness of various harvesting tools among farm women before and after a capacity-building training program revealed significant changes. Before the training, awareness of various harvesting tools was limited. Only 30 percent of respondents were aware of ring cutters, 4 percent knew about finger guards, and 10 percent were aware of knitted gloves. Awareness of front load and back load harvest bags was 20 percent and 34 percent, respectively, while only 16 percent were aware of wing-type cotton harvest bags.

Table- 6 Distribution of the respondents according to awareness about harvesting tools (N=50)

Types of harvesting tools	Pre-evaluation	Post-evaluation
Ring cutter	15 (30.0%)	50 (100.0%)
Finger guards	2 (4.0%)	46 (92.0%)
Knitted gloves	5 (10.0 %)	50 (100.0%)
Front load harvest bag	10 (20.0%)	46 (92.0%)
Back load harvest bag	17 (34.0%)	40 (80.0%)
Wing type cotton harvest bag	8 (16.0%)	37 (74.0%)
All	17 (34.0%)	35 (70.0%)

After the training, awareness of all harvesting tools significantly increased. All respondents (100%) were aware of ring cutters and knitted gloves, while 92 percent were aware of finger guards and front load harvest bags. Awareness of back load and wing-type cotton harvest bags increased to 80 percent and 74 percent, respectively.

This dramatic improvement indicated that the training effectively introduced this tool, which is essential for efficient and safe harvesting, particularly in crops like cotton [17], [21], [36].The finger guards showed a notable increase in awareness, the training program effectively highlighted their utility in preventing injuries during harvesting tasks [30], [31].

3.7 Awareness about sowing tools

Before the capacity-building training program, the awareness level of sowing tools among farm women was extremely low. Only 6 percent were aware of sapling transplanters, 4 percent knew about seed placement tubes, and none had heard of seed cum fertilizer bags. Majority of the respondents (94%) indicated no awareness of any sowing tool.

Table- 7 Distribution of the respondents by awareness of sowing tools(N=50)

	Pre-evaluation	Post-evaluation
Sapling Transplanter	3(6.0%)	50 (1000%)
Seed placement tube	2 (4.0%)	48 (96.0%)
Seed cum fertilizer bag	-	46 (92.0%)
None of the above	47 (94.0%)	-

The post-training evaluation revealed a significant increase in awareness. All participants (100%) were aware of sapling transplanters and their benefits. Awareness of seed placement tubes and seed cum fertilizer bags also increased to 96 percent and 92 percent, respectively. This remarkable transformation highlights the effectiveness of the training program in disseminating crucial knowledge and empowering farm women with information on modern agricultural tools and techniques.

3.8 Awareness about the use of Head Load Manager

This improvement reflected the effectiveness of the training program in expanding participants' knowledge of essential harvesting tools. The rise in awareness suggested a positive shift toward adopting technologies that can enhance efficiency and safety, contributing to reduced drudgery and better agricultural outcomes for women farmers [25], [26].

Table-8 Distribution of the respondents on the use ofHead load manager (N=50)

	Pre-evaluation	Post-evaluation
Light in weight	15 (30.0%)	-
Made with cane	8 (16.0%)	
Easy to handle	15 (30.0%)	-
Stress of weight to be supported by back muscles and relieves strain on head and shoulder	4(8.0%)	-
All	2(4.0%)	50 (100.0%)

3.9 Awareness levels of drudgery reducing tools

A significant majority of respondents (74%) exhibited low awareness of drudgery-reducing tools and equipment. This lack of knowledge could hinder the adoption of these tools and limit their impact on agricultural practices. A smaller proportion, 20 percent, displayed a medium level of awareness, indicating a potential for improvement through targeted education and awareness campaigns. Only 6 percent of respondents demonstrated high awareness, highlighting the need for increased efforts to disseminate information and promote the benefits of these tools.

The limited number of highly aware individuals suggested that while some may have access to information, it is not widespread enough to influence broader adoption [27], [34].

Table-9 Distribution of the respondents according to awareness level of drudgery reducing tools (N=50)

Awareness level	Frequency	Percentage (%)
Low (<18)	37	74.0
Medium (18 to 21)	10	20.0
High (>22)	3	6.0

3.10 Evaluation of field validation of technology on drudgery of farm women

The use of a long-handle weeder resulted in a decrease in the drudgery score from 25 to 23.7, reflecting a reduction in physical strain during these labour-intensive tasks. The t-value of 8.26 indicated a highly significant improvement, suggesting that this technology is effective in making weeding less strenuous. The introduction of the sapling transplanter led to a decrease in the drudgery score from 23 to 22.06. Although this reduction is smaller compared to weeding, the t-value of 3.76 still signifies an improvement in the experience of farm women during sowing activities. The most notable improvement was observed in harvesting, where the combination of a cotton harvest bag and knitted gloves reduced the drudgery score from 29 to 24.4. The t-value of 11.5 indicated a significant reduction in physical strain, highlighting the effectiveness of these tools in alleviating discomfort and enhancing efficiency during harvesting [5].

Table-10 Evaluation of field validation of technology on drudgery of farm women (N=50)

Identified drudgery prone Activities	Technology used for Intervention	Pre-test drudgery Score	Post-test drudgery Score	t' values
Weeding and inter-culturing	Long handle weeder	25 +/- 2.07	23.7 +/- 1.75	8.26**
Sowing	Sapling transplanter	23 +/- 2.32	22.06 +/- 1.90	3.76**
Harvesting	Cotton harvest bag, Knitted Gloves	29 +/- 0.84	24.4 +/-1.40	11.5**

*** Significant at 5 % level of significance*

3.11 Technology adoption preferences for drudgery reduction tools

The adoption levels of various gender-friendly drudgery-reducing tools among farm women, categorized by their decision-making preferences regarding tool selection, revealed notable insights into their acceptance and preferences. The data highlighted the varying degrees of acceptance and preference for both conventional and improved technologies, as well as the willingness to suggest modifications or try new innovations.

Table-11 Distribution of the respondents by technology adoption preferences for drudgery reduction tools(N=50)

Drudgery Reducing Tools	Decision making on technology selection of farmers							
	Farmers preferring conventional method only		Farmers preferring improved technology		Farmers suggesting modification on technology		New innovations tried by farmers	
	Frequency	Percentage (%)	Frequency	Percentage (%)	Frequency	Percentage (%)	Frequency	Percentage (%)
Sickle/khurpi	28	56.0	22	44.0	-	-	-	-
Long handle weeders	15	30.0	35	70.0	6	12.0	9	18.0
Ring cutter	10	20.0	40	80.0	-	-	-	-
Finger guards	50	100.0	-	-	5	10.0	-	-
Knitted gloves	8	16.0	42	84.0	-	-	-	-
Front load harvest bag	38	76.0	12	24.0	-	-	-	-
Back load harvest bag	50	100.0	-	-	-	-	-	-
Wing type cotton harvest bag	43	86.0	7	14.0	-	-	-	-
Headload manager	20	40.0	30	60.0	-	-	-	-
Sapling transplanter	13	26.0	37	74.0	10	20.0	-	-
Seed placement tube	40	80.0	10	20.0	6	12.0	-	-
Seed cum fertilizer bag	44	88.0	4	8.0	-	-	-	-

Traditional Tools: While traditional tools like sickles and khurpis were widely used, a substantial portion of farmers (44%) expressed a preference for improved versions of these tools.

Weed Control Tools:A positive trend was observed in the adoption of improved long-handle weeders. While 30 percent of farmers still used traditional method, 70 percent preferred improved design. Furthermore, 12 percent suggested modifications, and 18 percent had even experimented with new innovations.

Protective Gear: Despite the potential benefits of improved finger guards, all farmers relied on the traditional method of harvesting. While 84 percent of farmers adopted improved knitted gloves.However, the absence of suggestions for modifications indicated that the current design may meet users' needs effectively.

Harvesting Tools:A significant gap was observed in the adoption of improved harvesting tools. Only 24 percent of farmers opted for improved front-load harvest bags, while none adopted modern backload bags. For wing-type cotton harvest bags, only 14 percent used improved technology. However, 80 percent of farmers adopted improved ring cutters.

Planting Tools: While 74 percent of farmers adopted sapling transplanters, there was a significant gap in the adoption of seed placement tubes (20%) and seed cum fertilizer bags (12%), with most farmers relying on traditional methods.

Head Load Manager: Forty percent of farmers still relied on the traditional method of carrying loads. However, 60 percent preferred improved technology, highlighting the need for increased awareness about its ergonomic benefits.
While some tools like long handle weeders and sapling transplanters showed promising adoption rates, others indicated strong adherence to traditional practices.The high percentage of farmers suggesting modifications for certain tools highlighted an opportunity for manufacturers and developers to engage with users in refining product designs based on users' feedback [33].

3.12 Awareness and knowledge of farm women on drudgery-reducing tools in agriculture

The results indicated that the intervention significantly enhanced both awareness and knowledge among the participants, with t-values far exceeding the critical value for significance. The increase in knowledge scores from pre-test to post-test reflected an enhanced capacity among these women to implement new techniques effectively, thereby contributing to their empowerment within both agricultural and household contexts [22], [38].

Table-12 Awareness and knowledge of drudgery reducing tools among farm women (N = 50)

	Pre-test score +/- SD	Post-test Score +/- SD	Gain in awareness score	t-values
Awareness	4.5 +/- 2.73	7.3 +/- 1.43	2.9	9.12**
Knowledge	6.7+/- 5.8	12.5 +/- 3.6	5.5	15.36**

*** Significant at 5 % level of significance*

3.13 Adoption levels of drudgery-reducing tools

The distribution of respondents according to their adoption levels of drudgery-reducing tools and equipment is summarized in Table 13. A significant 84 percent of respondents belonged to the low adoption category. This indicated a significant barrier to the integration of drudgery-reducing tools in their farming activities. The high percentage suggested that despite some awareness, many farm women may have faced challenges such as financial constraints, lack of access to tools or insufficient training on how to use them effectively [16].
Twelve percent of respondents exhibited a medium level of adoption. This group demonstrated a willingness to use drudgery-reducing tools but likely does not utilize them consistently or effectively. The presence of this segment indicated potential for growth; targeted interventions could help these women transition to higher levels of adoption. Only 4 percent of respondents were categorized as having high adoption levels. This small percentage highlighted that very few farm women are fully integrating drudgery-reducing tools into their agricultural practices.

Table-13 Distribution of the respondents according to adoption levels of drudgery reducing tools (N = 50)

Adoption level	Frequency	Percentage (%)
Low (< 48)	42	84.0
Medium (48 to 50)	6	12.0
High (> 50)	2	4.0

3.14 Adoption of gender friendly drudgery reducingtools

The distribution of respondents by their extent of use and adoption levels of various tools is illustrated in Table 14. Knitted Gloves (88.10%) and Ring Cutter (80%) showed the highest adoption indices, indicating that these technologies were widely accepted and frequently used by the respondents.The Front Load Harvest Bag also demonstrated a strong adoption index of 83.33 percent, reflecting its effectiveness in reducing drudgery during harvesting.The high adoption rates may be attributed to their ease of use, immediate benefits in reducing physical strain and positive feedback from users [11].

Table-14 Distribution of the respondents by their adoption of drudgery reduction tools (N=50)

Name of the technology	Extent of use						Adoption Index (%)
	Always		Sometimes		Never		
	Frequency	Percentage (%)	Frequency	Percentage (%)	Frequency	Percentage (%)	
Sickle/khurpi	9	40.90	11	50.00	2	9.09	54.55
Long handle weeders	4	11.43	19	54.29	12	34.28	27.14
Ring cutter	32	80.00	8	20.00	-	-	80.00
Knitted gloves	37	88.09	5	11.90	-	-	88.10
Front load harvest bag	10	83.33	2	16.67	-	-	83.33
Wing type cotton harvest bag	5	71.43	2	28.57	-	-	71.43
Headload manager	3	10.00	18	60.00	9	30.00	30.00
Sapling transplanter	2	5.41	18	48.65	17	45.94	25.00
Seed placement tube	4	40.00	4	40.00	2	20.00	40.00
Seed cum fertilizer bag	1	25.00	2	50.00	1	25.00	25.00

Moderate adoption rates were seen for the Wing Type Cotton Harvest Bag which had an adoption index of 71.43 percent, suggesting a good level of acceptance but with scope for improvement.The Sickle/Khurpi technology had an adoption index of 54.55 percent, indicating that while it is used, there were still a significant number of respondents who either used it sometimes or not at all.Technologies like the Sapling Transplanter (25%), Headload Manager (30%) and Seed Cum Fertilizer Bag (25%) had relatively low adoption indices, suggesting barriers to their consistent use among farm women.The Long Handle Weeders also showed a low adoption index of 27.14 percent, which may have indicated a need for further training or modifications to make this technology more appealing or accessible.For tools with lower adoption rates, factors such as lack of awareness, perceived complexity, or insufficient training could have hindered consistent use among farm women.

3.15 Correlation of socio-economic and communication variables with awareness and adoption levels of drudgeryreducing tools

The correlation coefficients wereused to identify the relationship between various independent variables (socio-economic and communication factors) and the dependent variables (awareness and adoption levels) of drudgery-reducing tools among farm women. These correlations were essential for identifying factors that influence awareness and adoption, which can inform targeted interventions.

Table-15 Correlation of personal socio-economic, communication variables with the awareness and adoption level of drudgery reducing tools and equipment

Independent variable	Dependent variables	
	Awareness level	Adoption level
	Correlation coefficient ('r' value)	
Age **(X_1)**	0.190*	0.163*
Education **(X_2)**	0.464**	0.374**
Type of family **(X_3)**	0.228**	0.166NS
Size of family **(X_4)**	-0.236**	-0.172*
Caste **(X_5)**	0.055NS	-0.015NS
Annul Income **(X_6)**	0.306**	0.292**
Size of land holding **(X_7)**	0.232**	0.192*
Type of house **(X_9)**	0.374**	0.234**
Mass media **(X_{10})**	0.565**	0.299**
Contact with extension personnel's **(X_{11})**	0.200*	0.155*
Contact with institution **(X_{12})**	0.190*	0.157*

Education: Education emerged as a strong positive correlate of both awareness and adoption. Higher levels of education were significantly associated with increased awareness and adoption of drudgery-reducing technologies. This suggests that education plays a crucial role in facilitating access to information and promoting the adoption of innovative practices.

Family Structure: Family structure, particularly the size of the family, showed a negative correlation with awareness and adoption. Larger families may be associated with lower awareness and adoption levels due to resource constraints and competing priorities.

Socioeconomic Factors: Higher annual income and larger landholdings were positively correlated with awareness and adoption. This suggests that economic factors can influence the ability to access and adopt new technologies.

Communication Factors: Mass media exposure, contact with extension personnel, and contact with institutions were all positively correlated with awareness and adoption. This highlights the importance of effective communication channels in disseminating information and promoting the adoption of drudgery-reducing tools.

4. Conclusion

The study demonstrated that introducing drudgery-reducing technologies tailored for farm women significantly improved awareness, reduced physical strain and encouraged technology adoption. The results highlighted the importance of ergonomically designed tools to address the specific needs of women in agriculture, ensuring both occupational comfort and enhanced productivity. Capacity-building initiatives proved effective, as shown by the significant increase in post-training awareness for various tools such as sapling transplanters, long-handle weeders, and cotton harvest bags. However, despite these improvements, the adoption levels varied. Technologies like knitted gloves and ring cutters showed high acceptance due to their ease of use, whereas others—such as sapling transplanters and seed placement tubes—faced barriers to consistent adoption, indicating the need for ongoing support and iterative improvements in design.

The findings emphasized that demographic factors, such as education and income, positively influenced both awareness and adoption of drudgery-reducing tools, whereas larger family size presents a potential barrier. Limited contact with extension agents and institutions also hampered broader technology adoption, underlining the importance of targeted outreach programs and media exposure.

The reduction in drudgery scores for key agricultural tasks, including weeding, sowing, and harvesting, validated the effectiveness of the introduced technologies. Ergonomic interventions like the long-handle weeder and cotton harvest bags led to significant reductions in physical strain, promoting sustainable participation of women in agricultural activities. The study concludes that participatory approaches involving farm women in the tool design process fostered greater acceptance and long-term use. For sustained impact, efforts had to focus on improving access to these tools, providing financial support, and strengthening extension services. Prioritizing ergonomic design and accessibility in agricultural technologies can pave the way for a more equitable, efficient, and inclusive agricultural sector that supports the well-being and productivity of women farmers.

Future Scope of study

Exploring financial models such as microcredit or subsidies, could enhance the adoption of these technologies among economically disadvantaged farmwomen. The research could be extended to test and refine drudgery-reducing technologies for diverse cropping systems across various agro-climatic zones.

Conflict of Interest

All the authors declare that they have no conflicts of interest.

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