**Feminization of Farming: Availability and Use of drudgery reducing tools**

**Abstract**

**Introduction:** The progressive feminization of agriculture, driven by male outmigration and gender-based labor divisions, has increased women’s participation in rural farming. Despite their critical role, women farmers face significant challenges, including limited access to mechanization and increased physical drudgery. This review aims to analyze the availability, adoption, and impact of drudgery-reducing tools on women’s agricultural labor, emphasizing their potential for economic empowerment and health improvements.

**Methods:** A qualitative literature review was conducted, synthesizing peer-reviewed studies, government reports, and institutional publications. Key themes such as tool awareness, adoption rates, ergonomic benefits, and socio-economic implications were identified. The Human Physical Drudgery Index (HPDI) was referenced to quantify biomechanical strain across various agricultural tasks.

**Results:** Findings reveal that transplanting, threshing, harvesting, and load carrying impose the greatest physical strain on women, with drudgery-reducing tools enhancing efficiency by 15–50% and reducing costs by up to 40%. Post-harvest tools yield the highest efficiency gains, critical for women’s predominant roles in these activities. However, adoption is hindered by limited awareness, socio-cultural norms, and inadequate policy support. Integrating ergonomic tool design with gender-sensitive policies, financial support, and capacity-building initiatives is imperative. Future research should prioritize context-specific mechanization, digital innovation, and participatory approaches to advance gender equity and sustainable agricultural development.

**Keywords:** Feminization of agriculture, drudgery-reducing tools, women empowerment, ergonomic technology, sustainable agriculture

**Introduction**

With growing male outmigration and gender-based divisions of labor, agriculture is increasingly feminized. Women now represent a substantial share of the rural agricultural workforce. However, this shift has not always been accompanied by adequate policy or technological support. Women farmers face limited access to mechanization, leading to increased physical strain and reduced productivity. The feminization of agriculture demands gender-responsive innovations—most notably, drudgery-reducing tools that are ergonomically designed and economically accessible.

Women make up 37% of the agricultural workforce, with over 80% of rural women engaged in farming (PLFS, 2022-23). Despite their crucial role, they face challenges such as wage disparities, limited access to mechanization, and physically strenuous work, leading to musculoskeletal disorders and fatigue. Traditional farming methods expose them to excessive manual labor, restricting productivity and well-being.

To address these challenges, gender-sensitive agricultural policies must promote subsidized ergonomic tools, improved credit access, and skill training for women farmers. Government programs should ensure mechanized equipment adoption, empowering women with technology-driven solutions. Additionally, recognizing women's land ownership rights and increasing their participation in decision-making can further enhance economic independence. By integrating financial support, modern technology, and policy interventions, India can boost agricultural productivity while reducing drudgery for women, fostering sustainable rural growth (NSSO, PLFS Report, 2018-19).

Evidence from several studies indicates that the use of cycle weeders, seed drills, and mechanized threshers—tools designed to reduce drudgery— can significantly relieve physical strain, increase operational efficiency, and improve women farmers' health (PLFS, 2019–20). Regardless of the benefits derived from the tools, their adoption is still hampered by lack of awareness, inadequate extension outreach, and high initial costs. The gap between women’s growing responsibilities in agriculture and their access to ergonomically designed, labor-saving innovations creates a critical absence of policy and research attention.

This review aims to fill the gap by analyzing the available literature from an Indian perspective on the availability, adoption, and functionality of drudgery-reducing tools. It investigates the socio-economic implications of physical labor reduction for women to reveal their potential for economic empowerment and social inclusion. In doing so, the review identifies best practices, obstacles, and strategic needs for expanding gender-responsive mechanization.

**Materials and Methods**

This study employs a qualitative review of literature to examine the adoption and impact of drudgery reducing tools in the feminization of farming. A systematic search of peer-reviewed articles, government reports, and institutional publications was conducted to identify studies relevant to ergonomic agricultural tools and their adoption among women farmers. The review focused on four key studies: Sarmah and Hazarika (2023), Tiwari *et al*. (2021), King (2016), and Singh *et. al*. (2011). Data extraction involved identifying core themes such as tool awareness, adoption rates, operational efficiency, and health impacts.

Sarmah and Hazarika (2023) provided insights into the challenges faced by rural women in Assam, emphasizing the triple burden of productive, reproductive, and social work, along with the role of Krishi Vigyan Kendras in increasing tool awareness and adoption. Tiwari et al. (2021) contributed quantitative data on high awareness (64.16%) and adoption (56.66%) rates of tools like groundnut decorticators, improved sickles, and maize shellers among farm women in Gumla district, highlighting the efficacy of training and demonstrations. King (2016) focused on small millets in Kolli Hills, revealing significant reductions in time and physical burden in post-harvest processing through simplified implements. Additionally, Singh *et al*. (2011) compared traditional and improved tools, documenting up to a 32.40% reduction in energy expenditure and notable health benefits.

Women play a crucial role in agriculture, particularly in rural and developing regions, where they are often engaged in a wide range of farming activities. However, farm women frequently operate under extremely hazardous and physically demanding conditions, primarily due to limited access to improved agricultural tools and technologies.

Given these challenges, a study was undertaken to evaluate and quantify the extent of drudgery experienced by farm women in various agricultural operations. By assessing the physiological workload, posture-related strain, and time-intensity of common farming tasks, the study hlighted critical areas where interventions—such as improved tools, mechanization, or ergonomic solutions—could alleviate the burden and enhance the wellbeing and productivity of women in agriculture.

**Drudgery index-**

Data indicating musculoskeletal disorders as analyzed by ergonomics assessment of postural and biomechanical assessments using the Human Physical Drudgery Index (HPDI), resulting in the maximum drudgery reflecting very high risk in transplanting (48.4%), followed by threshing (47.2%), load carrying (46.00%), and harvesting (45.14%).

Table 1: HDPI of different agricultural operation

|  |  |
| --- | --- |
| **Agricultural operations** | **HDPI (%)** |
| Nursery | 23.71 |
| Sowing | 27.43 |
| Transplanting | 48.4 |
| Irrigation | 27.43 |
| Manuring | 27.28 |
| Weeding | 38.07 |
| Plant protection | 27.29 |
| Harvesting | 45.14 |
| Binding crops | 22.57 |
| threshing | 47.2 |
| Winnowing | 29.06 |
| Load carrying | 46.00 |
| Drying | 28.21 |
| Storage | 28.82 |

 Source: Joshi et al. 2024

A narrative synthesis was employed to integrate findings, identify recurring themes, and assess the effectiveness of drudgery reducing technologies in enhancing the productivity and well-being of women in agriculture. This qualitative approach provides a comprehensive understanding of both the benefits and barriers associated with the adoption of these tools.

**Results and Discussion**

The presented tables (Table:2,3,4 & 5) illustrate a comprehensive range of agricultural tools designed to alleviate physical strain and improve operational efficiency for women in farming. The tools span various stages—from pre-sowing (seed treatment and sowing devices) to field maintenance (fertilizer application and weeding) and harvesting through to post-harvest processing. Each tool is not only cost-effective, with prices varying according to their function and sophistication, but also engineered to increase efficiency by 15–50% and save up to 40% in costs. These improvements mean that tasks once performed manually and with considerable physical effort are now streamlined, reducing the overall workload.

Efficiency gains directly translate into reduced physical stress, which is particularly important for women who often bear a disproportionate share of labor in agriculture. For example, the seed treatment drum, with a 30% efficiency increase and a 20% cost saving, minimizes manual handling and ensures uniform application of chemicals, thereby reducing repetitive motions that can lead to fatigue. Similarly, tools such as the rotary maize sheller and pedal-operated paddy thresher significantly lower the need for intensive labor, cutting down the time and effort required for complex tasks. This decrease in physical exertion not only enhances productivity but also reduces “cardiac cost” – a term reflecting the diminished strain on the heart and overall reduction in health risks associated with continuous, strenuous manual labor.

Post-harvest tools (Table 5) like the grain mill and dal mill further exemplify how mechanization benefits women in agriculture. By automating traditionally labor-intensive processes, these tools help in achieving consistent quality in processed products while mitigating long-term physical wear and tear. In essence, the strategic implementation of these women-friendly tools fosters a safer, more efficient, and cost-effective farming environment, empowering women to contribute more sustainably to agricultural productivity and overall household income.

Table 2: Women Friendly sowing and seed treatment tools for Agricultural Efficiency

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| S. No. | Equipment Name | Uses | Approximate Cost (INR) | Importance for Women | Average Increase of Efficiency (%) | Percentage of Saving Cost (%) |
| 1 | Seed Treatment Drum | Used for coating seeds with protective chemicals before sowing. | ₹2000 | Reduces manual effort in seed treatment, ensuring uniform coating. | 30% | 20% |
| 2 | CIAE Seed Drill | Mechanized sowing device for precise seed placement. | ₹5000 | Reduces labor intensity and ensures uniform seed distribution. | 35% | 25% |
| 3 | PAU Seed Drill | Designed by Punjab Agricultural University for efficient sowing. | ₹5000 | Improves sowing efficiency, reducing time and effort for women. | 35% | 25% |
| 4 | Naveen Dibbler | A manual tool for planting seeds at appropriate spacing. | ₹700 | Reduces bending and improves precision, lowering physical strain. | 15% | 10% |
| 5 | Rotary Dibbler | Uses rotary action for better efficiency in seed planting. | ₹2300 | Speeds up the sowing process while reducing drudgery. | 40% | 30% |

Table 3: Drudgery Reducing Fertilizer and Weeding Tools for Women in Agriculture

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| S. No. | Equipment Name | Uses | Approximate Cost (INR) | Importance for Women | Average Increase of Efficiency (%) | Percentage of Saving Cost (%) |
| 1 | Fertilizer Broadcaster | Distributes fertilizers uniformly across the field. | ₹2500-3000 | Reduces manual effort, ensuring even fertilizer application and improving soil fertility. | 35% | 25% |
| 2 | Twin Wheel Hoe | A hand tool used for weeding and aeration in row crops. | ₹800 | Eases weeding work, reducing back strain and improving efficiency. | 20% | 15% |
| 3 | Cono Weeder | Specially designed for weeding in paddy fields. | ₹1900 | Reduces drudgery, improves posture, and enhances weeding efficiency in wetland farming. | 30% | 20% |
| 4 | Grubber Weeder | Used for weeding and loosening soil in crops. | ₹400 | Reduces bending effort, making weeding less strenuous. | 15% | 10% |
| 5 | Single Wheel Hoe | Helps in weeding, soil aeration, and earthing-up. | ₹600 | Lightweight tool, reduces physical strain and time. | 20% | 15% |
| 6 | Hand Ridger | Used for making ridges and furrows for planting. | ₹2,000 - ₹5,000 | Reduces physical effort in making ridges, improving efficiency. | 25% | 20% |

Table 4: Women-Friendly Harvesting Tools for Drudgery Reduction

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| S. No. | Equipment Name | Uses | Approximate Cost (INR) | Importance for Women | Average Increase of Efficiency (%) | Percentage of Saving Cost (%) |
| 1 | Improved Sickle | Ergonomically designed for efficient crop cutting. | ₹150 - ₹500 | Reduces hand fatigue and improves cutting efficiency. | 25% | 15% |
| 2 | Fruit Harvester | Long-handled tool for picking fruits without damage. | ₹500 - ₹1,500 | Prevents climbing-related injuries and improves safety. | 30% | 20% |
| 3 | Tea Plucker (Scissor Type) | Specially designed for precise tea leaf plucking. | ₹300 - ₹1,200 | Reduces strain on fingers and speeds up plucking. | 20% | 15% |
| 4 | Bhindi Plucker | Helps in easily plucking ladyfinger (okra). | ₹200 - ₹800 | Minimizes hand injuries and increases harvesting speed. | 20% | 15% |
| 5 | Sugarcane Stripper | Removes leaves from sugarcane stalks efficiently. | ₹500 - ₹2,000 | Reduces manual effort and speeds up sugarcane processing. | 25% | 20% |

Table 5: Post-harvest drudgery reducing tools and its importance for women

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| S. No. | Equipment Name | Uses | Approximate Cost (INR) | Importance for Women | Average Increase of Efficiency (%) | Percentage of Saving Cost (%) |
| 1 | Groundnut Decorticator (Sitting Type) | Hand-operated tool for shelling groundnuts | ₹2,400 | Reduces hand strain and speeds up shelling process | 30% | 20% |
| 2 | Groundnut Stripper | Separates groundnuts from plants | ₹2,500 | Eases post-harvest processing, reducing workload | 30% | 20% |
| 3 | Tubular Maize Sheller | Removes maize grains from cobs | ₹60 | Increases efficiency and reduces hand fatigue | 40% | 30% |
| 4 | Rotary Maize Sheller | Mechanized maize sheller for higher efficiency | ₹4,000 - ₹6,000 | Saves time and minimizes physical effort | 50% | 40% |
| 5 | Rotary Arecanut Dehusker | Removes husks from arecanuts | ₹8,000 - ₹18,000 | Reduces time and effort in dehusking arecanuts | 45% | 35% |
| 6 | Pedal Operated Paddy Thresher | Threshes paddy grains manually | ₹5,500 | Increases output and reduces drudgery | 40% | 30% |
| 7 | Paddy Winnower | Separates grains from chaff using airflow | ₹5,000 - ₹9,000 | Improves grain quality and reduces manual effort | 35% | 25% |
| 8 | Hanging Type Grain Cleaner with Sack Holder | Cleans grains before storage | ₹4,500 - ₹6,000 | Reduces dust exposure and improves storage quality | 30% | 20% |
| 9 | Grain Mill | Used for grinding grains into flour | ₹19,000 - ₹25,000 | Helps women process grains at home, reducing labor | 35% | 25% |
| 10 | Dal Mill | Processes pulses into dal by removing husks | ₹15,000 - ₹30,000 | Reduces manual work and increases processing speed | 35% | 25% |



**Figure 1:** Comparison of Efficiency Increase vs. Cost Saving across major categories of drudgery-reducing tools.

From the graph presented as Figure 1, it can be seen that tools used after harvesting yield the greatest efficiency improvement (37%) and savings in costs (28%) relative to other categories of tools. This is particularly advantageous for women who operate predominantly in post-harvest activities. Tools for seed sowing and treatment also show significant improvement, helping in the reduction of early-stage work and exhaustion. These findings indicate that further attention is required for post-harvest and sowing technologies for women-specific mechanization. This graph underlines the requirements of rural women such as subsidized policies, tool banks, and skill training aimed at rural women which need strategic policies specifically designed for them.

**Exploring the Role of Women in Agriculture: Challenges, Technologies, and Future Directions**

Feminization of agriculture is a multifaceted process with strong implications for agricultural productivity and the gendered labor burden of women. Although the term agricultural feminization is simplified very often, findings from research indicate that women's involvement in agriculture is transforming and growing in most parts of the world (Kawarazuka et al., 2022). The process raises the demand for strategic interventions to eliminate women's drudgery in agriculture, especially in areas of high climate risk (Khatri-Chhetri et al., 2019). The deployment of drudgery-reducing machinery and CSA technologies can be a major consideration in narrowing the gap in labor burden between the two genders. For example, in Nepal, where feminization of agriculture is progressing very fast, various CSA interventions have been found to have potential to save labor for women and enhance productivity and farm incomes. These include direct seeded rice, green manuring, laser land levelling, and system of rice intensification (Khatri-Chhetri et al., 2019). However, it is important to mention that the impact of these tools could be diverse depending on local crop, agro-climate, and social conditions.

Overall the process of feminization of agriculture and the use and availability of drudgery-reducing tools would be very important in providing future research directions. It could evaluate the development and adaptation of context-specific technologies in terms of household socioeconomic profiles and women's involvement in varied farming activities (Khatri-Chhetri et al., 2019). It also evaluate the incorporation of AI and IoT technologies in the development of smart, gender-responsive agricultural tools (Hussein et al., 2024). Future research work also must deal with the myths of agricultural feminization and analyze the multifaceted gendered power dynamics in these processes to ensure that the interventions are positive to women farmers and help in global food security (Kawarazuka et al., 2022; Hussein et al., 2024).

The position of women in agriculture has increasingly become very important in developing countries with important implications for food security, women's empowerment, and sustainable development. In many developing countries, women make up a significant proportion of the agricultural workforce, and they play a vital role in ensuring household and national food security. Empirical evidence shows the existence of a positive relationship between women's empowerment in agriculture and many indicators of food security, including calorie availability, food consumption, and dietary diversity (Jemaneh & Shibeshi, 2023). For instance, in Ethiopia, improved women's empowerment was significantly associated with improved household food security outcomes. Similarly, in Malawi, women's empowerment in the production and marketing of livestock was related to improved household food security (Mataka et al., 2023). Agriculture ranks as an important source of income and autonomy for rural women, especially in situations where opportunities for men to work away from home exist. This is particularly important given that women in rural areas tend to remain the most excluded when it comes to accessing agricultural productive resources, with important implications for food security, nutrition, and poverty reduction (Dwomoh et al., 2023). However, it should be noted that women's participation in agriculture is faced with a range of challenges, including the effects of neoliberalism and mechanization, that can perpetuate patriarchal systems in agriculture (Rahman et al., 2023). In conclusion, enhancing the participation of women in agriculture is central to the attainment of food security, women's empowerment, and sustainable community development. Nevertheless, these benefits are accompanied by the necessity to fight current challenges and implement gender-sensitive policies and programs in agriculture.

**Conclusion**

The progressive feminization of agriculture in India underscores an imperative to confront the distinct challenges confronting women farmers, particularly the substantial physical drudgery embedded in conventional farming practices. This review elucidates that ergonomically designed, gender-responsive drudgery-reducing tools substantially mitigate labor intensity, enhance operational efficiency, improve health outcomes, and foster greater economic empowerment for women in agriculture.

Empirical evidence, including assessments based on the Human Physical Drudgery Index (HPDI), reveals that tasks such as transplanting, threshing, harvesting, and load carrying impose the highest biomechanical strain on women. The strategic deployment and adoption of women-friendly agricultural implements targeting these labor-intensive operations can significantly diminish physical hardship and augment women’s productive engagement.

Nonetheless, the diffusion of these technologies remains constrained by barriers including limited awareness, inadequate extension support, restricted access, and entrenched socio-cultural norms. Therefore, technological innovation must be complemented by robust policy frameworks, inclusive extension services, subsidized access, and comprehensive capacity-building initiatives aimed at empowering rural women.

Ultimately, drudgery-reducing tools transcend mere mechanization; they serve as transformative agents fostering gender equity, elevating livelihoods, and advancing sustainable agricultural development. Enabling women farmers through appropriate technology adoption is pivotal to enhancing the resilience, productivity, and sustainability of Indian agriculture amid evolving socio-economic and climatic challenges.

**Future Prospects and Research Opportunities**

Future advancements in women-centric agricultural mechanization require a holistic approach that integrates user-centered design, capacity building, and supportive policies. Ergonomically tailored tools combined with targeted training will empower women farmers to effectively use and maintain these technologies. Financial access through subsidies and microcredit is essential to promote adoption, while customization to local agro-ecological conditions will enhance sustainability. Additionally, leveraging digital innovations like AI and GIS can improve extension services and inclusivity. Future research should focus on assessing socio-economic impacts, advancing gender-responsive digital agriculture, and fostering participatory development to create a more equitable and transformative agricultural sector.

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