

Empowering Women Through Farm Mechanization for a Safer, Smarter, Inclusive Future

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ABSTRACT

Mechanization needs to be encouraged among farm women as in the coming future they will play a significant role in the agriculture sector in India. Currently they are involved in vital but labour-intensive activities in agri-food system of the country. They face myriads of challenges like gender stereotypes, non-availability of ergo-fit tools, lack of awareness, lower skill set, like limited access to land ownership, credit etc. They are also limited by their low mobility and familial responsibilities. Focused research on developing gender friendly tools, increasing awareness, skill upgradation and mitigation of cultural stereotype can enhance women's involvement in mechanized agriculture. mechanization will not only technologically upgrade but also empower women as leaders in agriculture, by bridging gender disparities, enhancing agricultural productivity, and supporting sustainable rural development.

INTRODUCTION

India's agriculture sector employs 263 million people, with women comprising 37% of the workforce, a number expected

to rise due to the feminization of agriculture (Mehta *et al.*, 2018). By 2023-24, skilled roles for rural women increased from 48% to

59.4%, while physically demanding tasks declined due to mechanization. With 120 million agricultural machines and over 400 million hand tools, mechanization is boosting productivity and cost efficiency, especially in states with higher adoption. By reducing labour-intensive work, mechanization is making farming more accessible for women, enhancing their participation in agriculture while improving overall efficiency and output.

NEED OF INCLUSIVE FARM MECHANIZATION FOR WOMEN:

Between 2001 and 2011, the growth of women labourers in agriculture lagged behind men, leading to a declining share of women in the workforce. Mechanization, often perceived as male-dominated, has displaced women from traditional tasks, limiting their roles to low-paid, labour-intensive jobs like weeding and harvesting. As skill requirements change, many women's traditional expertise becomes obsolete, reducing employment opportunities in areas like rice mills and papad-making. The exclusion of women from mechanized farming deepens gender disparities, lowering their income and job prospects. To address this, inclusive mechanization strategies must focus on gender equity, providing training and access to advanced agricultural technology for rural women.

WOMEN IN AGRICULTURE AND ALLIED SECTOR

Women in agriculture and allied sectors contribute significantly through diverse roles, spanning crop production, agro-processing, commercial agriculture, and animal husbandry. Their contributions are integral to the agricultural economy, though often undervalued.

1. Field Operations in Crop Production:

Women are actively involved in tasks such as sowing seeds, transplanting (e.g., rice paddy), weeding, interculture, harvesting,

and threshing. These labour-intensive operations demand meticulousness and patience, traits that women bring to these tasks. Studies highlight that women in rural India contribute over 60-70% of the labour required in rice cultivation, especially in transplanting and weeding activities.

2. Agro-Processing Activities: Women play a crucial role in post-harvest processes, including cleaning, grading, drying, parboiling, milling, grinding, decortication, and storage. They manage sun-drying grains, moisture control, and small-scale processing like milling pulses and grinding spices. Though these tasks are labour-intensive and vital for quality preservation, mechanization is reducing drudgery. However, equitable access to agro-processing technologies remains limited, restricting women's opportunities in modernized agriculture.

3. Commercial Agriculture: Women play a crucial role in high-value, labour-intensive crops like tea, tobacco, and lac cultivation. In tea plantations, they form the majority of workers, ensuring quality leaf harvesting despite tough conditions. In tobacco farming, women handle manual plucking and sorting, valued for their precision. In lac cultivation, especially in Jharkhand and Chhattisgarh, women are deeply involved in lac collection and processing, providing a significant source of income. Despite their contributions, their work often remains underrecognized and underpaid, highlighting the need for better wages, skill development, and mechanization access to improve their livelihoods.

4. Animal Husbandry and Dairy Farming:

Women play a vital role in livestock management, handling feeding, cleaning, milking, and animal healthcare, along with small-scale dairy processing to produce ghee and paneer for household use or sale.

In India, 75% of the dairy farming workforce consists of women, who also manage fodder preparation and utilize manure for composting. Their contributions are essential to livestock productivity and rural economies, yet they often lack recognition, access to technology, and financial support, highlighting the need for better training, resources, and gender-inclusive policies in the dairy sector.

NEED FOR MECHANIZATION AMONG WOMEN IN AGRICULTURE

Currently, women constitute about 37% of the agricultural workforce in India, and this proportion is predicted to increase due to significant male migration to urban areas in search of higher-paying jobs. This shift leaves women as primary caretakers of farms, responsible for both managerial and labour-intensive tasks. In rural areas, the Female Labour Force Participation Rate (FLFPR) rose from 24.6% in 2017-18 to 41.5% in 2022-23, reflecting their increasing role in agriculture.

CHALLENGES FACED BY WOMEN IN AGRICULTURE

Women agricultural workers face numerous challenges that hinder their efficiency and growth. Limited access to mechanized tools forces them to rely on manual labour, increasing physical strain and reducing productivity. Despite their critical role in farming and agro-processing, they are often excluded from mechanization initiatives, making tasks like harvesting, processing, and livestock care more labour-intensive (Agarwal, 2009). Additionally, traditional societal norms restrict women's participation in formal skill development programs, preventing them from learning modern farming techniques and machine operation. Though women possess strong decision-making abilities and adaptability to new technologies, they remain underutilized in mechanization strategies.

Addressing these gaps requires gender-inclusive policies, training programs, and improved access to technology, empowering women to enhance productivity and economic independence.

MITIGATION THROUGH MECHANIZATION

Mechanization presents a powerful solution to the challenges faced by women in agriculture, transforming their work and improving overall efficiency. By introducing mechanized tools for tasks like transplanting, harvesting, and post-harvest processing, physical strain is significantly reduced, allowing women to work more efficiently with less fatigue. Improved access to technology ensures that farming operations are conducted in a timely and precise manner, leading to higher crop yields and better-quality produce. Beyond productivity, training women in machine operation can empower them to move beyond manual labour, giving them greater control over technology, decision-making, and financial independence. This shift enhances their confidence, social standing, and economic opportunities, making mechanization a key driver of gender-inclusive agricultural development.

ISSUES AND MITIGATION IN TECHNOLOGY ADOPTION

The challenges women face in adopting technology in agriculture can be broadly categorized into three domains: research and development (R&D), extension services, and social/general issues.

- 1. Research and Development:** Women in rural agriculture are often excluded from research focus, with technologies primarily designed for male users, ignoring women's physical differences, preferences, and needs. This results in ergonomic incompatibility, where tools are too heavy, unsafe, or inefficient for women to use

comfortably. Safety concerns further limit adoption, as traditional attire like sarees and dupattas increases the risk of accidents with machinery. Additionally, many tools lack clear safety instructions, and cautionary measures are poorly communicated, discouraging women from embracing modern technology

Women's physiological and anthropometric characteristics must guide the design of agricultural tools and machines. Key differences in anthropometry, muscular strength, aerobic capacity, physiological costs, postural preferences, load carrying and safety measures must be accounted for while designing tools for women (Singh *et al.*, 2019). It may be noted that farm women's clearance, reach, posture, and strength are 6–21% lower than men. Women's strength is 11–153% lower compared to men. Women possess 65–75% of men's aerobic capacity (Mehta *et al.*, 2018). Average oxygen consumption for women is 0.6 l/min versus 0.7 l/min for men, with heart rates of 105 bpm and 110 bpm, respectively. Women prefer sitting or standing positions, over squatting or bending. Women's load-carrying capacity is 21% less than men's. Personal protective equipment (Gloves, mask, suits) designed for women, must be provided and moving parts of machinery must be covered to reduce risks.

2. Extension Issues: Women in agriculture often face unintentional exclusion from training, as extension services and technical programs primarily target male farmers, creating a significant knowledge gap. Their limited access to land, credit, and agricultural resources further restricts participation in extension initiatives (Agarwal, 2009). Deep-rooted cultural stereotypes—such as the belief that women are confined to household duties or resistant to innovation—reinforce their marginalization. As a result, only 5% of

global extension services are tailored to women, according to the FAO.

Effective awareness and training programs are essential to empower women in agriculture with modern tools and techniques. Counselling and awareness campaigns should be organized to educate women about available technologies and their benefits, ensuring wider adoption. Safe handling training must be provided to equip women with proper equipment usage and safety precautions, reducing risks. A comprehensive database should document women's agricultural roles, available women-specific tools, and success stories to inspire more participation. Encouraging progressive women farmers as trainers can further promote knowledge-sharing. Additionally, specialized skill upgradation programs should be conducted to enhance productivity, reduce drudgery, and increase women's role in mechanized farming.

3. Social and General Issues: Women in agriculture face multiple challenges that hinder their access to modern tools and technologies. Traditional gender roles restrict their resource access, confining them to specific tasks while excluding them from decision-making and mechanization opportunities. Economic constraints further limit their ability to purchase advanced equipment, reinforcing their dependence on manual labour. Additionally, lack of awareness and accessibility challenges—including limited knowledge of available technologies and inadequate maintenance and repair facilities—prevent widespread adoption. Compounding these issues, manufacturers show little interest in designing women-friendly equipment, citing low demand and favouring minor modifications rather than comprehensive solutions. Addressing these barriers requires policy support, financial assistance, awareness programs, and

industry engagement to promote gender-responsive mechanization.

To ensure gender equity in agriculture, societal attitudes must shift by challenging perceptions and advocating for women's equal participation in machinery operation. Awareness campaigns targeting male farmers and communities can foster inclusivity. Organizing women's groups for custom hiring centres ensures access to tools without individual financial burdens. Policy advocacy should promote women-friendly tool designs, offering subsidies and incentives for gender-specific agricultural equipment. Additionally, mobile maintenance services can provide on-the-spot support to keep tools functional. Recognizing innovations and efforts through awards for manufacturers, extension workers, and women adopters will further drive engagement. Implementing these strategies enhances women's productivity, empowerment, and well-being, fostering gender equity and overall agricultural progress

FUTURE PROJECTIONS AND RECOMMENDATIONS

Currently, women are engaged as labourers in 99.99% of cases, with only 0.01% involved in controlling machines. This imbalance must be addressed through targeted initiatives. Projections suggest that by 2030, the share of women in mechanization could rise significantly with proper policy interventions, including:

- Subsidized access to mechanized tools for women farmers.
- Skill development programs tailored to women's needs.
- Awareness campaigns to break societal perceptions of "machines for men."

In conclusion, mechanization is not merely a technological upgrade but a pathway to empower women in agriculture. By ensuring their access to and control over mechanized tools, we can bridge gender disparities, enhance agricultural productivity, and support sustainable rural development

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