



Cultivating Equality in Women and Farm Mechanization for an Inclusive Agricultural Future

Pallavi Deka

Krishi Vigyan Kendra, Assam Agricultural University, Lalpool, Udalguri, Assam, 784514

Email: pallavi.deka@gmail.com

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Abstract

Across the rural landscapes of India and other developing regions, women sustain the rhythm of agriculture. They plant, harvest, manage livestock and preserve food systems, yet their contributions are often unseen and undervalued. Mechanization offers a powerful pathway to ease their drudgery, enhance efficiency and promote gender equity in farming. For women, mechanization is not just about machines it is about dignity, safety and opportunity. When designed with empathy and ergonomic insight, agricultural tools can transform women's daily lives and reshape the social fabric of rural economies.

Keywords: Women in agriculture, Farm mechanization, Ergonomics, Gender empowerment, Inclusive development

Introduction

In the heart of India's villages, the story of agriculture is largely written by women. From dawn to dusk, they carry out tasks that ensure food reaches every household. They sow seeds, transplant rice, weed fields and thresh grains yet their labour often remains invisible in agricultural statistics. Despite forming nearly half of the agricultural workforce, women have limited control over land, credit and mechanized tools (Doomra *et al.*, 2007).

Mechanization has long been celebrated for transforming productivity, but its benefits have not reached everyone equally. Machines have often been designed with a one size fits all approach assuming a male operator. For women, this mismatch between design and physical capability translates into fatigue, injuries and exclusion from technological progress (Singh *et al.*, 2019).

Recognizing women as equal participants in agriculture requires more than policy acknowledgment. It demands rethinking how technologies are imagined, built and shared. When mechanization aligns with women's needs and abilities, it becomes a catalyst for empowerment and wellbeing.

Women in agriculture the unseen strength

Across India, women perform almost every task in crop production, animal husbandry and post-harvest management. Their responsibilities often include sowing, transplanting, weeding,

harvesting, winnowing and seed cleaning. Most of these activities are carried out manually using simple hand tools that were never designed with women's ergonomics in mind.

Doomra *et al.*, (2007) observed that the lack of gender appropriate equipment not only increases physical stress but also limits women's ability to scale up their productivity. Many women continue to work in stooping postures for hours, leading to chronic back pain and fatigue. Yet, their resilience sustains food systems and rural livelihoods.

While technology has the potential to ease this burden, cultural and institutional barriers often stand in the way. Women rarely receive training in machinery operation or maintenance and in many communities, it is still considered inappropriate for women to operate large equipment. These social taboos restrict their access to innovation and deepen the gender divide in mechanization (Mehta *et al.*, 2018).

Gaps in mechanization and gender inclusion

Mechanization should make farming easier, safer and more productive, yet for many women, it remains out of reach. The reasons are complex. Ownership of land is a key determinant of access to machinery and since few women legally own farmland, they often cannot justify or finance equipment purchases. Even when tools are available, their designs are frequently unsuitable for women's body dimensions, strength and endurance levels. (Singh *et al.*, 2019)

highlighted that most agricultural implements in India are built around male body dimensions, resulting in unsafe and uncomfortable working conditions for women. For example, handles of weeders and hoes are often too long or too heavy, requiring excessive energy expenditure.

Social norms compound these barriers. Many training programs on mechanization are conducted in male dominated spaces, where women's participation is minimal. Without training, their confidence to operate or maintain machinery remains low, reinforcing a cycle of dependency and exclusion.

Bridging this gap calls for an inclusive approach that places women at the center of design, training and policy initiatives. Mechanization must be redefined not only as a technical solution but as a social innovation.

The role of ergonomics in creating gender friendly tools

A major stride toward empowering women in agriculture begins with understanding how they interact with tools. Ergonomics bridges this understanding by designing equipment that aligns with human capability and comfort. When farm tools are ergonomically designed for women, they help reduce strain, improve precision and enhance work satisfaction (Singh *et al.*, 2019).

Doomra *et al.*, (2007) emphasized that most tools currently in use disregard the physiological differences between men and women. For instance, traditional sickles often have inappropriate curvature and weight, causing wrist strain. Ergonomic redesigns such as lighter handles, adjustable grips and balanced centers of gravity can drastically reduce physical effort and improve performance.

Institutions such as the Indian Council of Agricultural Research ICAR and the Central Institute of Agricultural Engineering CIAE have developed gender friendly tools including hand weeders, seed dribblers, pedal operated threshers and lightweight transplanters (Mehta *et al.*, 2018). These innovations are not mere conveniences; they represent a shift in how agricultural science perceives women as active, capable users of technology rather than peripheral helpers.

Mechanization as a pathway to empowerment

Mechanization, when thoughtfully implemented, can be a tool of empowerment in every sense economic, social and personal.

Economic Empowerment

Access to machinery allows women to save time, expand cultivated areas and take on

entrepreneurial roles such as machinery hiring or maintenance services. When women's productivity rises, so does their income and bargaining power within households and communities. Mehta *et al.*, (2018) observed that women led custom hiring centers have become successful models of collective economic empowerment, allowing groups of women to lease and manage farm machinery as a business venture.

Social Empowerment

Mechanization offers women more than efficiency it offers agency. As women gain confidence in using and managing equipment, they challenge traditional gender roles. Training programs that teach machinery operation or repair create new spaces of leadership and visibility for women in rural economies (Doomra *et al.*, 2007).

Health and Safety Empowerment

Physical wellbeing is a critical dimension of empowerment. Gender appropriate mechanization reduces exposure to hazardous chemicals, awkward postures and repetitive motions that lead to chronic pain or injury. Singh *et al.*, (2019) noted that ergonomically designed tools reduce fatigue by nearly 30 to 40 percent, helping women sustain their productivity without compromising health.

Policy and Institutional Support

For gender inclusive mechanization to thrive, supportive policy frameworks are essential. India's Sub Mission on Agricultural Mechanization SMAM includes special provisions for women farmers, promoting financial assistance and training. Yet, challenges remain in implementation.

Training centers, especially Krishi Vigyan Kendras (KVKs), play a crucial role in bridging the knowledge gap. Many KVKs now conduct gender focused mechanization training where women learn not just to operate tools but to maintain and adapt them to their specific needs. Mehta *et al.*, (2018) highlighted the importance of such localized capacity building efforts in sustaining long term adoption.

Financial inclusion is equally vital. Women's access to credit determines their ability to invest in mechanized solutions. Self Help Groups (SHGs) and Farmer Producer Organizations (FPOs) have proven to be effective platforms for collective ownership of tools. These institutions foster both economic empowerment and social solidarity, helping women move from individual labourers to cooperative entrepreneurs.

Policy must also recognize the importance of research and participatory design. As Singh *et al.*,

(2019) observed, women's involvement in the design and testing of agricultural tools ensures that technologies evolve in step with their realities and aspirations.

Toward a safer, smarter and inclusive agricultural future

The future of agriculture lies not only in advanced machinery but in how that machinery uplifts every person who works the land. For women, the promise of a safer and smarter agricultural future rests on technologies that understand their daily struggles and transform them into opportunities.

Smart mechanization, digital literacy and community centered innovation can make this future possible. As rural landscapes evolve with precision agriculture, artificial intelligence and automation, women must be part of this transformation not as passive recipients but as innovators, trainers and entrepreneurs.

Doomra *et al.*, (2007) reminds us that empowerment is not a singular moment but a continuous process of access, skill and recognition. When women have the tools that suit their strength and the knowledge to wield them, they become architects of a new rural

order, one that values equity, safety and dignity as much as productivity.

Conclusion

The story of agricultural progress will remain incomplete without women at its core. Mechanization designed with empathy and inclusivity can transform not just how women work, but how they live. From reducing drudgery and improving health to creating new pathways for income and leadership, gender friendly mechanization represents a quiet revolution in rural empowerment. The vision of a safer, smarter and inclusive agricultural future is one where every woman in the field holds not just a tool, but the power to shape her destiny.

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