

Artificial Intelligence for Women Empowerment in Agriculture

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ABSTRACT

Women constitute a significant proportion of India's agricultural workforce, contributing extensively to farming and allied sectors such as livestock and fisheries. National labour statistics indicate that women account for between 42% and 64% of agricultural workers, including unpaid family labour, while in rural Assam nearly 76% of women's employment is concentrated in agriculture and fishing. Despite their substantial contribution, women continue to face gender disparities in land ownership, wages, access to credit, technology, and decision-making roles. Artificial Intelligence (AI) offers transformative potential to address these gaps and promote women's empowerment in agriculture. AI-enabled tools such as mobile advisory applications, chatbots, image-based crop diagnostics, fintech platforms, and digital market linkages can improve access to information, enhance farm productivity, facilitate financial inclusion, and strengthen entrepreneurial opportunities. AI-driven e-learning and personalized advisory systems can further support skill development and bridge gender gaps in extension services. However, challenges including digital illiteracy, limited smartphone ownership, poor connectivity, socio-cultural barriers, and data privacy concerns restrict AI adoption among women farmers. Targeted strategies—such as digital literacy training, development of local-language AI tools, affordable digital infrastructure, promotion of women-led agri-tech enterprises, and gender-sensitive policy frameworks—are essential for inclusive implementation. Overall, AI has significant potential to enhance women's productivity, income, and decision-making power, contributing to sustainable agricultural development and gender equality, particularly in rural regions like Assam.

Keywords: Artificial Intelligence, Women Empowerment, Agriculture, Gender Gap

INTRODUCTION

Women contribute a very large portion of the agricultural workforce in India. According to labour data, around 63% of workers in the agriculture sector are female at the national level.

Recent reports indicate women constitute about 64.4 % of agricultural workers (including unpaid family helpers), though only a small share are in leadership roles. These women are especially in rural areas, limiting their economic recognition and access to credit, inputs, and technology. Another survey (PLFS) suggests that over 42 % of India's agricultural workforce is women, showing increasing participation.

In rural Assam a substantial share of women work in agriculture and allied activities—about 76 % of rural

women's employment is in agriculture and fishing. For urban women in Assam, around 33 % are engaged in agricultural and allied work.

Some estimates suggest that over 74 % of women in Assam's agricultural sector participate in cultivation activities, showing growth compared with earlier periods.

Women play a critical role in India's agricultural economy, providing most of the labour on farms and in allied sectors like livestock and fisheries. However, data clearly shows persistent gender gaps in ownership, wages, access to technologies and decision-making—both nationally and in Assam.

This quantitative understanding helps in designing targeted policies, credit access, skill training, land rights support, extension services, and technology adoption programs, particularly use of AI in agriculture aimed at

empowering women farmers and agricultural workers, especially in Assam and other rural regions. Artificial Intelligence (AI) is transforming agriculture by improving productivity, efficiency, and decision-making. For women—who form a large share of the agricultural workforce in countries like India—AI can be a powerful tool for economic empowerment, skill development, and social inclusion. AI can help in women empowerment through their involvement in agriculture in following ways.

Improving Access to Information:

Artificial Intelligence (AI) significantly improves women farmers' access to timely and reliable agricultural information through mobile applications and chatbot-based advisory systems. These AI-powered tools provide real-time weather forecasts, early warnings about pest and disease outbreaks through image recognition, customized crop advisory services based on soil and climate conditions, and up-to-date market price information to help farmers make informed selling decisions. Platforms such as Digital Green and Microsoft AI for Earth offer localized and data-driven advisory support tailored to specific regions and crops. For women farmers—who often have limited direct interaction with traditional extension services—smartphones equipped with voice-based AI tools in local languages can bridge critical information gaps. By delivering personalized, accessible, and location-specific guidance, AI enhances decision-making capacity, reduces risk, and strengthens women's participation and confidence in agricultural management.

Enhancing Farm Productivity:

Artificial Intelligence (AI) plays a vital role in enhancing farm productivity by equipping women farmers with precise, data-driven decision-making tools. AI-powered image recognition systems enable early detection of crop diseases and pest infestations through simple smartphone photographs, allowing timely intervention and reducing crop losses. Smart advisory platforms also help optimize irrigation schedules and fertilizer application by analyzing soil conditions, weather patterns, and crop requirements, thereby minimizing input costs and preventing resource wastage. Additionally, predictive analytics tools assist in estimating crop yields, helping women farmers plan storage, marketing, and financial decisions more effectively. These technologies not only improve productivity and profitability but also reduce physical labor and time burden—an especially significant

benefit for women who balance agricultural work with household and caregiving responsibilities.

Financial Inclusion and Credit Access:

Artificial Intelligence (AI) is transforming financial inclusion for women farmers by expanding access to formal credit and digital financial services. AI-based fintech platforms use alternative data—such as mobile usage patterns, transaction histories, crop records, and repayment behavior—to assess creditworthiness, enabling women without traditional collateral or credit history to qualify for loans. These systems facilitate quick approval of microloans, provide customized insurance products, and support seamless digital payments through mobile wallets and banking apps. By improving access to institutional credit, government subsidies, and crop insurance schemes, AI reduces women's dependence on informal moneylenders who often charge high interest rates. As a result, women gain greater financial security, investment capacity, and economic independence within the agricultural sector.

Market Linkages and Entrepreneurship:

AI-driven platforms connect women farmers directly with buyers, reducing reliance on intermediaries and increasing their market access. By using data analytics for demand forecasting, these systems help farmers understand market trends and plan production accordingly. They also suggest optimal pricing strategies based on real-time market data, improving profitability. As a result, women gain stronger bargaining power, better income opportunities, and greater confidence to engage in agribusiness and entrepreneurial activities.

Capacity Building and Skill Development:

AI-enabled e-learning platforms play an important role in building the capacity and skills of women farmers. Through training videos, voice-assisted learning modules, and personalized advisory services, women can access practical knowledge on improved farming techniques, post-harvest management, value addition, and digital literacy. These platforms allow flexible, home-based learning, which is especially beneficial for women balancing agricultural and household responsibilities. By enhancing technical and digital competencies, AI-based learning systems support greater productivity, confidence, and economic empowerment.

Reducing Gender Gaps in Extension Services:

Traditionally, agricultural extension services have predominantly reached male farmers, often overlooking women despite their major contribution to farm activities. AI-based advisory systems help bridge this gender gap by providing women with direct and equal access to agricultural information through mobile platforms. These systems offer personalized recommendations based on specific crops and local conditions, along with real-time support for problem-solving. By ensuring inclusive access to knowledge and services, AI promotes more equitable and sustainable agricultural development.

Challenges:

Despite its transformative potential, the adoption of Artificial Intelligence (AI) among women farmers is constrained by several structural, social, and technological barriers. These challenges must be clearly understood to design inclusive and effective interventions.

Digital Illiteracy:

A large proportion of rural women lack basic digital skills such as operating smartphones, using mobile applications, accessing the internet, or understanding digital interfaces. Many women are first-generation technology users and may not be familiar with English-language platforms, technical terminology, or app-based navigation. Limited exposure to formal education further compounds this issue. As a result, even when AI-powered advisory services are available, women may be unable to utilize them effectively without proper digital literacy training and continuous support.

Limited Smartphone Ownership:

In many rural households, mobile phones are owned and controlled primarily by male members. Women often have restricted or shared access to devices, limiting their ability to independently use AI-based agricultural applications. Financial constraints also prevent women from purchasing smartphones or upgrading to internet-enabled devices. This gender gap in digital device ownership directly affects women's access to real-time information, digital payments, and AI-enabled advisory services.

Poor Internet Connectivity:

Rural areas, particularly in remote regions, often suffer from weak network coverage, slow internet speed,

and unreliable electricity supply. AI-based tools frequently depend on stable internet connectivity for weather updates, market prices, disease detection, and cloud-based analytics. Inadequate infrastructure discourages regular use and reduces trust in digital platforms. Connectivity issues are particularly pronounced in geographically challenging areas, including parts of Assam and other rural regions.

Cultural and Social Barriers:

Deep-rooted gender norms and patriarchal structures often limit women's mobility, decision-making authority, and participation in training programs. In many communities, agriculture is recognized as women's labour but not as women's leadership. Women may not be encouraged to attend digital training sessions, interact with extension agents, or engage in agri-tech entrepreneurship. Time poverty—due to the dual burden of farm work and household responsibilities—further reduces opportunities for skill development and technology adoption.

Data Privacy and Trust Concerns:

AI systems rely on data collection, including farm details, financial records, and personal information. Women farmers may be unaware of how their data is used, stored, or shared. Lack of transparency, fear of misuse, and limited awareness about digital rights can create mistrust toward AI platforms. Inadequate cybersecurity measures and absence of clear data protection policies may further discourage adoption.

Addressing these challenges requires integrated efforts involving digital literacy programs, affordable device access, improved rural connectivity, gender-sensitive training models, and strong data protection frameworks. Only through such comprehensive measures can AI become a truly empowering tool for women farmers.

Strategies to Promote AI for Women Empowerment:

Promoting AI for women's empowerment in agriculture requires coordinated policy, infrastructure, capacity-building, and institutional support. The following strategies explain how this can be achieved in a practical and sustainable way.

Provide Digital Literacy Training for Rural Women:

Digital literacy is the foundation for AI adoption.

Structured training programs should teach women how to operate smartphones, use agricultural apps, access online services, and interpret digital advisories. Training must be practical, hands-on, and conducted in community spaces such as self-help group (SHG) centers, Krishi Vigyan Kendras (KVKs), and panchayat halls. Peer learning models, where trained women act as digital ambassadors, can improve confidence and sustainability. Programs should also include financial literacy, cyber safety awareness, and digital payment systems to ensure comprehensive empowerment rather than superficial exposure to technology.

Develop AI Tools in Local Languages:

Many AI-based agricultural platforms operate in English or dominant national languages, limiting accessibility for rural women. AI tools must be developed in local languages and dialects with voice-based interfaces to accommodate women with low literacy levels. Features such as speech-to-text, interactive voice response systems, and simple visual icons can make platforms more inclusive. Localization should also consider region-specific crops, climate conditions, and market systems to ensure relevance and usability. When technology “speaks” the user’s language, adoption increases significantly.

Promote Affordable Smartphones and Internet Access:

Bridging the gender digital divide requires improving women’s access to devices and connectivity. Government and private sector initiatives can provide subsidized smartphones, installment-based purchase schemes, or device-sharing models through women’s self-help groups. Expanding rural broadband infrastructure and ensuring reliable electricity supply are equally important. Public Wi-Fi hotspots in villages and community digital centers can support women who do not own personal devices. Without affordable access, AI remains a theoretical promise rather than a practical tool.

Encourage Women-Led Agri-Tech Startups:

Women should not only be users of AI technologies but also innovators and entrepreneurs in the agri-tech sector. Policies should promote women-led startups through financial incentives, incubation centers, mentorship programs, and venture capital support. Encouraging women engineers, agricultural graduates, and rural entrepreneurs to develop AI-based solutions

ensures that technologies reflect women’s real needs and perspectives. Supporting women’s producer organizations and cooperatives to adopt AI tools for value addition, marketing, and supply chain management can further strengthen leadership and economic independence.

Ensure Gender-Sensitive Policy Frameworks:

AI integration into agriculture must be guided by inclusive and gender-responsive policies. Governments should incorporate gender considerations into digital agriculture missions, extension programs, and rural development schemes. Data collection systems should record sex-disaggregated information to monitor women’s participation and impact. Policies must also address data privacy, cybersecurity, and ethical AI usage to build trust among women users. Collaboration between ministries of agriculture, women and child development, rural development, and information technology is essential to create coordinated and sustainable frameworks.

In short, AI will not magically empower women just because someone installs an app. It requires training, access, representation, infrastructure, and policy alignment. When these strategies work together, AI can move from being a shiny buzzword to a genuine tool for economic independence, leadership, and social transformation for women in agriculture.

Conclusion:

AI has immense potential to empower women in agriculture by improving access to knowledge, finance, markets, and technology. When combined with supportive policies, digital literacy, and inclusive design, AI can enhance women’s productivity, income, and decision-making power—leading to sustainable agricultural development and gender equality.

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