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Empowering female farmers through education and training: A review

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Abstract

Female farmers produce food, manage natural resources, and stabilise rural livelihoods. Yet many face systemic barriers in education, skills development, and access to extension services. These limits reduce productivity, income, and resilience. They also weaken food security. Recent evidence shows that women remain a large share of the agricultural workforce, while gender gaps persist in wages, advisory services, and climate vulnerability. In 2023, women made up 39.6% of the global agricultural workforce. Across agrifood systems, women also continue to earn less than men, including in agriculture, where average female wages are lower. A growing body of research links these gaps to unequal access to training, inputs, land, and decision-making power rather than to differences in farming ability. This review synthesises evidence on how education and training can close capability gaps and improve outcomes for women farmers. It covers delivery models, content priorities, digital and blended learning, and gender-responsive extension design. It draws on global data and illustrative cases, including video-mediated training for women farmers in Bihar, India, and community-based learning through FAO's Dimitra Clubs. It also highlights India's Mahila Kisan Sashaktikaran Pariyojana (MKSP) as an institutional approach that links women's collectives with practical skills, agroecology, and market-oriented training. The review concludes with design principles, measurement guidance, and research priorities to strengthen impact at scale.

Keywords: Women farmers, agricultural extension, training and capacity building, digital agriculture, empowerment measurement

Introduction

Women occupy a central position in global agricultural systems. They cultivate crops, manage livestock, process food, preserve seeds, and sustain household nutrition. In many rural economies, they are the backbone of food production, yet their contributions remain undervalued and often invisible in formal policy frameworks. Agricultural institutions, extension systems, and training programs have historically been designed around a male farmer model, even in regions where women perform the majority of farm labour. This disconnect between reality and policy has created deep structural disadvantages for women farmers ^[1, 2].

Across low- and middle-income countries, women make up a large share of the agricultural workforce. Despite this, they continue to face persistent barriers that limit their

productivity and economic security. They are less likely than men to own land, receive credit, access modern inputs, or benefit from formal agricultural extension. Social norms frequently restrict their mobility, participation in decision-making, and engagement with markets. As a result, many women farmers operate under constraints that limit their ability to innovate, adopt new technologies, or scale their farming activities ^[3, 4].

Education and training offer a powerful mechanism to address these inequalities. When women receive targeted agricultural training, they gain practical knowledge that improves crop management, soil fertility, pest control, and climate adaptation. More importantly, education strengthens their confidence, leadership skills, and bargaining power within households and communities. Training also helps women navigate market systems, access financial services,

and participate in producer organisations. However, technical training alone is not sufficient unless it is accompanied by institutional reforms that expand women's access to land, credit, and decision-making power^[5, 6].

The need to empower female farmers has gained increasing global recognition. International organisations, governments, and development agencies now acknowledge that gender equality in agriculture is not only a social justice issue but also an economic imperative. Studies consistently show that closing gender gaps in farming could significantly increase agricultural output, reduce poverty, and improve food security. Investing in women's education and training, therefore, benefits not only individual households but entire rural economies^[7, 8].

Why Education for Women Farmers Is a Development Priority

Women's role in agriculture is not marginal but foundational to food systems, rural livelihoods, and national economies. In most low- and middle-income countries, agriculture remains a primary source of employment, and women constitute a significant proportion of this workforce^[9, 10]. In 2023, women accounted for nearly forty per cent of the global agricultural labour force, underscoring their central contribution to food production and rural sustainability. Despite this substantial presence, women farmers continue to operate under structural disadvantages that limit their productivity, income, and agency. These disadvantages are not the result of lower capability but of unequal access to resources, services, and opportunities^[10, 11].

The economic cost of excluding women from quality agricultural education and training is enormous. Research consistently shows that gender gaps in productivity largely disappear when women receive the same levels of land security, inputs, credit, and extension services as men. When women are denied these resources, farms underperform, reducing overall agricultural output. This inefficiency affects not only individual households but also national food security and economic growth^[12, 13]. Closing gender gaps in agriculture could substantially increase global agricultural production while reducing rural poverty and hunger. Education and training are, therefore, not just social investments but strategic economic tools.

Beyond productivity, women's education in agriculture has direct implications for household nutrition and well-being. Women are typically responsible for food preparation, child feeding, and health-related decisions within families. When women gain knowledge about improved farming practices, crop diversity, and post-harvest handling, they are more likely to grow nutritious foods and reduce food waste. Training in kitchen gardening, small livestock management, and food processing can directly improve dietary diversity and health outcomes for children and elders in rural communities^[14, 15].

Education also strengthens women's resilience to climate change, which disproportionately affects them. Many women depend on rain-fed agriculture and natural resources that are highly vulnerable to droughts, floods, and soil degradation. Without proper training in climate-smart practices, they face higher risks of crop failure and income loss. Structured learning in water management, soil

conservation, and diversified cropping systems can equip women with tools to adapt to environmental shocks. This makes education a critical component of climate resilience strategies in rural areas^[16, 17].

From a social perspective, education transforms how women are perceived within their households and communities. When women acquire technical skills, they gain confidence, respect, and greater influence in decision-making. Training programs that include leadership development, group facilitation, and market negotiation help women move from passive labourers to recognised farmers and entrepreneurs. This shift challenges traditional gender norms and gradually reshapes power relations in rural society^[1, 3].

Finally, education serves as a scalable and practical pathway to empowerment. Land reform and credit expansion are essential but often slow and politically complex. In contrast, training programs can be expanded relatively quickly through existing extension systems, community organisations, and digital platforms. When designed inclusively, education can reach large numbers of women and create ripple effects across villages and regions. For these reasons, investing in the education and training of female farmers is not optional but central to sustainable agricultural development, gender equality, and rural prosperity^[2, 4].

Core Barriers That Limit Women's Access to Education and Training

Women farmers face multiple interconnected barriers that limit their access to and benefit from agricultural education and training. These barriers are not isolated incidents but part of broader structural inequalities embedded in social norms, institutional systems, and economic constraints. Understanding these barriers is essential for designing training programs that truly empower women rather than unintentionally excluding them^[5, 6].

One of the most significant constraints is time poverty. Rural women carry a heavy burden of unpaid domestic and care work in addition to their farming responsibilities. They collect water, gather fuelwood, prepare meals, care for children and older people, and manage household chores before and after farm work. As a result, they have far less discretionary time than men to attend training sessions, travel to extension centres, or participate in farmer meetings. Even when training is available, women may be unable to attend regularly, leading to lower retention and weaker learning outcomes^[7, 8].

Mobility restrictions further compound this challenge. In many cultural contexts, women require permission from male household members to travel outside their village or interact with male extension officers. Some training programs are held far from women's homes, making participation socially difficult or logistically impossible. Lack of safe transportation and childcare facilities also discourages attendance. Consequently, even well-designed training initiatives may fail to reach women simply because delivery mechanisms do not align with their lived realities^[9, 10].

Access to formal agricultural extension services remains highly unequal. Historically, extension systems have been male-dominated, both in staffing and in outreach priorities.

Many extension agents are men who primarily interact with male farmers, reinforcing the perception that men are the primary decision-makers in agriculture. As a result, women often receive agricultural information secondhand from husbands or male relatives, reducing their direct learning and limiting their influence over farming decisions. This indirect access weakens women's autonomy and perpetuates gender hierarchies within households ^[11, 12].

Literacy and language barriers also restrict women's participation in training. In many rural regions, women have lower formal education levels than men due to early marriage, poverty, and historical neglect of girls' schooling. Traditional extension materials often rely on written manuals, technical terminology, and complex diagrams that are difficult for low-literacy participants to understand. When training is not adapted to oral, visual, or practice-based learning styles, many women feel intimidated or excluded, even if they are physically present.

Even after completing training, resource constraints can prevent women from applying what they have learned ^[12, 14]. Many women lack secure land rights, which discourages investment in improved farming practices. Without ownership or long-term tenure, they hesitate to adopt innovations that require upfront costs or long-term commitment. Limited access to credit, fertilisers, improved seeds, and irrigation further restrict their ability to translate knowledge into tangible productivity gains—training without complementary support, therefore, risks raising expectations without delivering real benefits ^[15, 16].

Social norms and intra-household power dynamics represent another critical barrier. In many households, men control major agricultural decisions, including crop selection, input purchases, and income use. Women may perform most of the farm labour but have little say in how profits are spent. In such contexts, training that improves women's technical knowledge but does not address decision-making power can increase tension rather than empowerment. Some women may even face resistance or backlash from male family members if their newfound skills threaten established gender roles ^[16, 17].

These barriers do not operate in isolation but reinforce one another. Time poverty limits attendance, mobility restrictions reduce access, extension bias limits information flow, literacy gaps hinder understanding, resource constraints prevent adoption, and social norms restrict agency. Effective education and training programs must therefore be designed with a deep awareness of these layered constraints rather than assuming that women face the same conditions as men ^[12, 13].

Education and Training Models That Empower Women Farmers

A wide range of education and training models has emerged to support female farmers, yet their effectiveness depends on how well they respond to women's realities, constraints, and aspirations. Some approaches focus primarily on technical farming skills, while others integrate social, economic, and institutional empowerment. The most successful models tend to combine practical agronomic learning with collective action, leadership development, and access to markets and resources ^[14, 15].

Gender-responsive public agricultural extension remains

one of the most important pathways for reaching women farmers at scale. Traditional extension systems have often overlooked women, but reforms in many countries are beginning to correct this imbalance. These reforms include recruiting more female extension officers, setting explicit targets for women's participation, and redesigning training schedules to fit women's daily routines. When extension services actively seek out women rather than waiting for them to attend, participation rates increase significantly. Moreover, training delivered in local community spaces, such as women's self-help group meetings, religious centres, or village halls, is far more accessible than centralised workshops in distant towns ^[16, 17].

Farmer Field Schools represent another powerful participatory learning model. Unlike short lectures, these schools run throughout an entire cropping season and emphasise observation, experimentation, and group problem-solving. Women who participate learn not only farming techniques but also critical thinking and decision-making skills. By working together in small groups, they gain confidence, build solidarity, and create peer networks that continue beyond the training period. In many contexts, women who complete Farmer Field Schools later assume leadership roles in local cooperatives, irrigation committees, or producer associations, demonstrating that learning can translate into social influence ^[18, 19].

Women's collectives and self-help groups provide one of the most effective platforms for agricultural education. These groups already function as savings, credit, and mutual support networks, making them ideal entry points for training initiatives. Within a collective, women feel safer asking questions, sharing experiences, and experimenting with new practices. Collective learning also reduces the risk of failure because women can try innovations together rather than individually. Over time, these groups often evolve into farmer-producer organisations that negotiate better input prices, access bulk markets, and advocate for women's rights in agriculture ^[20, 21].

Vocational and enterprise-oriented training has become increasingly important as women move beyond subsistence farming toward income-generating activities. Many women engage simultaneously in crop production, livestock rearing, food processing, and small-scale trading. Training that integrates these activities proves more relevant than narrow crop-focused programs. Women benefit from skills in seed production, dairy management, poultry farming, value addition, packaging, branding, and basic bookkeeping. When women learn how to transform raw produce into marketable goods, their incomes diversify and become more stable. This shift also enhances their economic independence within households ^[23, 24].

Digital and blended learning models have recently expanded opportunities for women farmers, particularly in remote areas. Mobile-based videos, audio messages, and interactive platforms allow women to access information without travelling long distances. However, digital tools are most effective when combined with face-to-face facilitation. In programs where women watch instructional videos together and then discuss them with a trained facilitator, adoption rates are significantly higher than in purely digital interventions. Blended models, therefore, bridge technological innovation with social learning, ensuring both

accessibility and understanding^[25, 26].

Across all these models, one principle consistently emerges. Training must be designed around women's lived experiences rather than imposed from above. Programs that respect women's time, build on existing social networks, use participatory methods, and link knowledge to real economic opportunities are far more likely to produce lasting empowerment. Education becomes transformative when it strengthens not only farming skills but also women's confidence, collective power, and control over resources^[27, 28].

Digital and Blended Learning — Opportunities and Limits

Digital technologies have created new pathways for educating women farmers, especially in remote and underserved areas. Mobile phones, video platforms, and interactive voice systems allow agricultural information to reach villages where extension officers rarely visit. For women, digital tools can reduce travel barriers, save time, and provide learning opportunities within their own communities. Short instructional videos in local languages have proven particularly effective in explaining farming practices that are difficult to understand through text alone^[11, 12].

However, digital learning is not automatically inclusive. Many rural women still lack personal access to smartphones, internet connectivity, or digital literacy skills. In many households, phones are owned and controlled by men, limiting women's ability to access agricultural information independently. Poor network coverage, high data costs, and limited electricity further restrict digital participation in many rural regions. Without deliberate design, digital extension risks reinforcing existing gender inequalities rather than reducing them^[13, 14].

Blended learning models have emerged as a practical solution to these challenges. These approaches combine digital content with in-person group facilitation. Women typically watch training videos together in self-help groups or village meetings and then discuss the content with a trained facilitator. This structure preserves the benefits of digital innovation while maintaining the social interaction that strengthens understanding and adoption. Evidence from video-mediated extension programs in India shows that women are more likely to adopt new practices when digital learning is embedded in group settings rather than delivered individually.

Digital tools are most effective when they support, rather than replace, human extension systems. Technology can standardise high-quality content, but local facilitators are still needed to adapt messages to specific crops, soils, and climate conditions. Facilitators also help women troubleshoot problems, interpret information, and connect training to real farm decisions. Without this human component, digital learning often remains superficial and does not translate into behavioural change^[15, 16].

Another strength of digital platforms is their ability to scale rapidly and at relatively low cost. A single well-designed video can reach thousands of women across multiple districts. This scalability makes digital tools attractive for governments and development organisations with limited budgets. Yet cost-effectiveness must be balanced with

equity. Programs must intentionally target women, provide shared devices where needed, and invest in digital literacy training to ensure meaningful participation^[17, 18].

Overall, digital and blended learning offer powerful opportunities to expand women's access to agricultural education, but they are not a standalone solution. Their impact depends on thoughtful design, community engagement, and integration with existing extension and collective structures. When used strategically, digital tools can enhance learning, reduce gender gaps, and accelerate women farmers' empowerment^[18, 19].

What Should Training Teach — Content Priorities for Empowerment

Training for women farmers must go beyond basic crop production and focus on skills that strengthen both livelihoods and agency. The most effective programs combine technical, economic, and social learning rather than treating farming as only a biological process. Climate resilience is a core priority because women are highly dependent on rain-fed agriculture and vulnerable to droughts, floods, and soil degradation. Training in water conservation, drought-tolerant crops, mulching, and crop diversification helps women manage risk and stabilise yields under changing weather conditions^[11, 12].

Soil fertility management is another essential area, especially where chemical fertilisers are costly or inaccessible. Practical instruction on composting, manure management, and organic soil improvement allows women to increase productivity using locally available resources. Many programs show that women adopt these practices quickly because they align with their existing roles in household waste and resource management^[12, 13].

Post-harvest handling deserves equal attention because women often control storage, processing, and preservation. Training in drying, grading, safe storage, and basic value addition reduces food losses and improves market prices. Even small improvements in post-harvest practices can significantly raise household income and food security.

Market and financial literacy are equally important for empowerment. Women need skills in price negotiation, collective marketing, record keeping, and cost calculation. These competencies enable them to move from subsistence production to profitable entrepreneurship.

Finally, leadership and rights-based training strengthen women's confidence and decision-making power. When women understand their entitlements to land, credit, and public services, they are more likely to claim them. Training, therefore, must integrate technical farming skills with economic capability and social empowerment to create lasting change^[16, 17].

Case Studies of Training-Led Empowerment

Experiences from different regions show that well-designed training can transform women's roles in agriculture when it is embedded in local institutions and social networks. In Bihar, India, video-mediated agricultural training delivered through women's self-help groups demonstrated that digital tools, when combined with facilitation, can improve outcomes. Women watched short, locally produced videos on climate-smart rice cultivation and discussed them collectively with trained community facilitators. This

approach increased the adoption of improved practices, raised yields, and improved farm profits while strengthening women's confidence in making farming decisions. The group setting reduced isolation and encouraged peer learning, making the training more effective than individual instruction^[18, 19].

In Niger, FAO-supported Dimitra Clubs illustrate the power of community-led learning. Women and men met regularly to identify farming challenges and organise practical solutions. When composting was introduced, club members rapidly spread the technique across multiple villages through peer demonstrations. Thousands of women learned the method quickly, reducing fertiliser costs and improving soil fertility. The success came from local ownership, collective responsibility, and continuous knowledge sharing rather than one-time training sessions^[20, 21].

In India's Mahila Kisan Sashaktikaran Pariyojana (MKSP), training was integrated with women's farmer collectives. Women received hands-on instruction in mixed cropping, millet cultivation, and small livestock management while also gaining leadership skills. Over time, many participants became recognised as farmers within their communities and gained access to better markets^[22, 23].

How Training Translates into Empowerment — Mechanisms of Change

Education and training empower women farmers through multiple interconnected pathways that reshape knowledge, power, and opportunity. The most direct mechanism is improved technical efficiency. When women learn better agronomic practices, they use inputs more effectively, reduce crop losses, and increase yields. This not only raises production but also builds confidence in their ability to manage land and resources independently^[12, 13].

A second mechanism operates through information and bargaining power within households. In many rural settings, men traditionally control agricultural decisions because they receive most extension information. When women gain direct access to training, this information gap narrows. Women become more capable of contributing to farm decisions, negotiating input use, and influencing how income is spent. Knowledge, therefore, shifts power, not just productivity^[14, 15].

Collective learning further strengthens empowerment. Training delivered through groups creates social support, reduces fear of failure, and normalises women's participation in public spaces. As women learn together, they develop leadership skills, organise collective action, and gain visibility in community institutions. Many trained women later assume roles in cooperatives, savings groups, or village committees, extending their influence beyond farming.

Training also acts as a gateway to other resources. In several programs, participation in training connects women to input subsidies, credit schemes, or market networks. These linkages translate knowledge into real economic gains^[16, 17].

Measuring Impact — What Should Programs Track

Assessing the impact of training for women farmers requires more than measuring crop yields. Effective evaluation must capture technical, economic, and empowerment outcomes to understand whether education truly transforms lives^[18, 19].

On the technical side, programs should track adoption of new practices, including partial adoption where farmers apply only some recommended steps. Yield changes, input efficiency, water use, and post-harvest losses provide clear indicators of agricultural performance. These measures reveal whether training improves productivity in practical terms^[28, 30].

Economic outcomes are equally important. Evaluations should examine changes in farm income, livelihood diversification, savings, and debt levels. It is also critical to assess whether women control a greater share of agricultural earnings after training. Higher income without increased control does not equal empowerment. Market participation, price realisation, and access to buyers should also be monitored^[20, 21].

Empowerment outcomes require careful measurement. Programs should assess whether women participate more in farm decisions, manage resources independently, or hold leadership roles in groups. Changes in mobility, confidence, and public speaking also signal agency shifts. Time use should be tracked to ensure that training does not increase women's workload without corresponding benefits^[12, 13].

Finally, equity of reach must be evaluated. Programs should disaggregate data by land ownership, age, marital status, and social group to ensure that the most marginalised women are not excluded.

Design Principles for Effective, Gender-Responsive Training

Training programs succeed when they are built around women's realities rather than generic agricultural models. The first principle is to start from women's actual roles in farming. Programs should prioritise crops, livestock, and tasks that women already manage, such as kitchen gardens, seed selection, post-harvest handling, and small-animal care. When training aligns with daily responsibilities, women are more likely to apply what they learn^[26, 29].

A second principle is to deliver learning through spaces where women already gather. Self-help groups, savings circles, producer collectives, and village meetings reduce barriers to travel and create safe environments for participation. Local delivery also lowers costs and improves continuity of learning^[27, 30].

Pedagogy must be practical and visual. Demonstration plots, videos, and hands-on exercises work far better than text-heavy lectures. Simple language, local examples, and peer demonstrations help overcome literacy barriers and build confidence. Recruiting and supporting women facilitators is another critical design choice. Female trainers are often more trusted, accessible, and effective in engaging women participants. Their presence also challenges stereotypes about who can be an agricultural expert. Training should be linked to access pathways for inputs, finance, and markets. Without seeds, tools, or credit, women cannot implement new practices. Partnerships with cooperatives, microfinance institutions, and input suppliers make learning actionable^[26, 27].

Finally, programs must engage households when social norms restrict women's decisions. Dialogue with men can reduce resistance and encourage shared support for women's farming^[28, 29].

Conclusion

Empowering female farmers through education and training is both a moral imperative and a strategic necessity for sustainable development. Women are central to global food production, yet they continue to face structural barriers that limit their productivity, income, and decision-making power. These barriers are not rooted in a lack of ability but in unequal access to land, inputs, credit, extension services, and learning opportunities. Addressing these inequalities through well-designed training programs can generate significant social and economic benefits for households, communities, and nations. The evidence reviewed in this paper demonstrates that education can transform women's roles in agriculture when it is practical, participatory, and embedded in local institutions. Training that combines technical skills with leadership development, market literacy, and collective action produces stronger and more lasting outcomes than purely agronomic instruction. Digital and blended learning models expand reach, but their success depends on facilitation, inclusion, and community engagement. Case studies from India and Niger show that women-centred group training can rapidly increase the adoption of sustainable practices while strengthening women's agency and confidence.

However, training alone is not sufficient. It must be paired with access to resources, supportive policies, and institutional reforms that recognise women as legitimate farmers. Governments and development organisations must prioritise gender-responsive extension, invest in community learning platforms, and measure empowerment alongside productivity.

When education is designed with women at its centre, it becomes a powerful pathway to higher yields, stronger resilience, improved nutrition, and greater gender equality in rural societies.

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