



Women-Led Agricultural Innovation and Rural Enterprise Resilience

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Abstract

Women-led agricultural enterprises occupy an increasingly important position at the intersection of rural development, food-system transformation, entrepreneurship, climate adaptation, and community resilience. Rural women participate in agricultural production, processing, marketing, seed systems, livestock activities, local services, and informal value chains, yet their entrepreneurial contributions frequently remain constrained by unequal access to productive assets, finance, technology, extension services, formal markets, land, business networks, and decision-making institutions. This conceptual review examines how women-led agricultural innovation can strengthen the resilience of rural enterprises and identifies the conditions under which such innovation becomes economically sustainable rather than remaining dependent on short-term development interventions. The paper treats resilience as the capacity of a rural enterprise to anticipate disruption, absorb shocks, reorganize operations, maintain essential functions, identify new opportunities, and recover without losing its long-term viability. Evidence from recent research indicates that women entrepreneurs contribute to agricultural innovation, food security, sustainability, local economic activity, and rural development, while studies of agricultural service provision show that market-driven, place-based, value-chain-oriented business models can create economic and skill-development opportunities for women.

Digital commerce also offers an emerging route for widening entrepreneurial participation by reducing information, market, social-capital, and financial constraints. Nevertheless, innovation alone cannot guarantee resilience. Women-led enterprises become more resilient when innovation is supported by control over productive assets, appropriate finance, technical and business skills, digital inclusion, collective networks, secure market relationships, climate-responsive practices, and supportive institutions. The paper proposes an ecosystem perspective in which women's agency interacts with enterprise capabilities and the wider rural business environment. It argues that policy should shift from short-term participation targets toward long-term enterprise viability, ownership, decision-making power, and the capacity to withstand climate, market, financial, and institutional shocks. Future empirical research should examine how these dimensions interact across different agricultural value chains, cultural contexts, enterprise sizes, and stages of business development.

Keywords: women-led agriculture; rural entrepreneurship; agricultural innovation; enterprise resilience; women agripreneurs; rural development; digital agriculture; climate resilience; agricultural value chains; women's economic empowerment



1. Introduction

Agriculture remains both an economic activity and a foundation of rural livelihoods in many parts of the world. Within this system, women participate not only as agricultural workers but also as producers, processors, traders, livestock managers, seed entrepreneurs, service providers, input sellers, food-business owners, and managers of household-based enterprises. Their contribution frequently extends beyond primary production into the wider agrifood system, although access to economic opportunities and productive resources remains uneven. The Food and Agriculture Organization identifies gender equality and women's empowerment as important for building sustainable, productive, and resilient agrifood systems.

The growing importance of rural entrepreneurship has expanded the meaning of agricultural participation. Farming households increasingly interact with input markets, processing activities, storage, logistics, digital commerce, mechanization services, advisory businesses, seed systems, food enterprises, and direct-to-consumer marketing. Agricultural innovation therefore extends well beyond adoption of a new crop variety or piece of machinery. It can involve a new product, production method, marketing channel, organizational model, financial practice, service, partnership, or strategy for responding to changing environmental conditions.

Within this broader environment, women-led agricultural innovation has significant potential. A recent bibliometric review covering 728 publications on women's agricultural entrepreneurship found that women entrepreneurs contribute to agricultural innovation, sustainability, and rural development, while also facing systemic barriers associated with resources and social structures. The same review identified digital agriculture, climate resilience, sustainability, and innovation among important emerging themes in the field.

Innovation becomes particularly important because rural enterprises operate in environments characterized by uncertainty. Agricultural businesses may experience drought, flood, extreme heat, pest outbreaks, input-price increases, commodity-price fluctuations, transport disruptions, credit shortages, market closures, and changes in consumer demand. The ability to remain viable under these circumstances is an issue of enterprise resilience.

Resilience in this paper is not treated as the simple ability of an entrepreneur to endure hardship. Such an interpretation can unintentionally place responsibility for structural problems entirely on individuals. Rural enterprise resilience is better understood as a combination of personal agency, organizational capability, access to resources, market position, networks, infrastructure, institutional support, and the ability to adapt to changing conditions.

Recent empirical research on rural agricultural and retail micro, small, and medium-sized enterprises in Zimbabwe reinforces the economic importance of resilience. Tete, Murendo, and Chikoko found that stronger enterprise resilience was associated with better performance and that access to internal financial resources and a conducive operational environment also supported enterprise outcomes.

For women entrepreneurs, however, resilience-building can be complicated by inequalities that influence control over land, finance, technology, labor, information, mobility, and business decisions. FAO notes that women and men can experience shocks differently and that gender inequality can affect vulnerability and coping capacity in agrifood systems. FAO also reports that female-headed households

can experience greater losses than male-headed households during climate events such as droughts, extreme heat, and floods.

This means that an enterprise may possess a promising innovative idea but still remain vulnerable if the woman managing it cannot obtain working capital, control the relevant land or equipment, access profitable markets, receive extension advice, travel to negotiate with buyers, use digital platforms, or make independent investment decisions. The relationship between innovation and resilience is therefore conditional.

Innovation can improve resilience when it enables an enterprise to diversify income, improve productivity, reduce dependence on a single market, respond to climatic uncertainty, lower costs, access information more rapidly, provide new agricultural services, or create additional customer relationships. Conversely, innovation can increase risk when it requires debt, unfamiliar technology, unstable markets, or inputs that cannot be accessed reliably. Women-led agricultural innovation should consequently be studied as part of a broader rural enterprise ecosystem.

The central argument developed in this paper is that women-led agricultural innovation strengthens rural enterprise resilience most effectively when entrepreneurial agency is supported by assets, finance, knowledge, technology, networks, market access, climate adaptation, and institutional legitimacy. The paper uses a conceptual review approach rather than presenting fabricated survey findings. Its purpose is to synthesize recent evidence and develop an integrated interpretation of how innovation and resilience interact in women-led rural enterprises.

2. Literature and Conceptual Background

Women's entrepreneurship in agriculture occupies a distinctive position because the enterprise is often interconnected with the household, community, land, natural resources, informal institutions, food security, and seasonal agricultural cycles. A rural enterprise may be formally registered, but many are semi-formal or informal. Women may simultaneously manage production, unpaid care responsibilities, food processing, livestock, local marketing, household finances, and community obligations. Consequently, conventional entrepreneurship models based primarily on firm growth or profit may not fully capture the realities of women-led rural enterprises.

Women may establish agricultural businesses for multiple reasons. Some identify commercial opportunities. Others begin enterprises as a response to limited wage employment, household income needs, market gaps, or changes in family circumstances. Many combine commercial and livelihood goals. Vuciterna and colleagues' review highlights this diversity, noting that women's agricultural entrepreneurship in developing contexts is often closely related to economic necessity, food security, and economic stability, while women continue to face resource constraints and social barriers.

Agricultural innovation can emerge from these constraints rather than only from formal research organizations. A woman may innovate by processing a crop into a higher-value food product, introducing climate-resilient seed, organizing direct sales, creating a local livestock service, establishing a nursery, developing a home-based food enterprise, coordinating group marketing, using mobile payments, supplying farm inputs, or providing agricultural advice. Women can therefore function simultaneously as adopters, adapters, distributors, and creators of innovation.



Research on women's seed entrepreneurship illustrates this broader role. Farnworth and colleagues examined women and men operating in aquaculture, maize, sorghum, and poultry seed-related value chains in Ghana, Kenya, and Tanzania. Their research shows that women can participate as agripreneurs in technically important parts of agricultural systems, including improved seed distribution and poultry services, while gender norms and institutional conditions influence their ability to establish and maintain these businesses.

In the Kenyan component of that research, agripreneurs helped promote stress-tolerant maize and sorghum varieties together with crop insurance and agricultural advice. The model demonstrates how rural entrepreneurship can connect innovation dissemination with local service provision and climate adaptation. This point is important because rural women entrepreneurs can function as last-mile innovation intermediaries. Agricultural technologies often fail to reach smaller farmers not because the innovation itself is unavailable, but because information, products, services, maintenance, finance, or trust are missing at the local level. Women-led rural businesses can potentially close some of these gaps by providing products and services through established community relationships.

Kadzamira and colleagues reviewed business models engaging women and young people as agricultural service providers across Africa and found that successful models tend to be place-based, people-focused, market-driven, and connected to identifiable value chains. Their review also identifies economic empowerment, entrepreneurial activity, skills development, networking, and employment opportunities as potential benefits of these models. This suggests that agricultural innovation and entrepreneurship reinforce one another when there is a clear market problem being solved. A training program that teaches an isolated technical skill does not automatically create a resilient enterprise. The skill needs to connect to paying customers, appropriate equipment, working capital, demand, business planning, and a viable revenue model. The same principle applies to digital innovation.

Digital technologies can reduce geographical barriers by connecting rural entrepreneurs with information, suppliers, finance, buyers, advisory services, mobile payments, and social networks. FAO has emphasized the importance of reducing the digital gender divide because access to digital technologies and education can strengthen the opportunities available to rural women. Recent causal evidence also shows that digital market infrastructure can influence entrepreneurship. Dong and colleagues analyzed China's rural e-commerce demonstration policy using panel data and found that the policy increased the probability of rural women engaging in entrepreneurship. Their analysis suggests that e-commerce can work partly through increased use of information and communication technology, skills development, and reduced financial and social-capital constraints.

Digitalization can therefore widen entrepreneurial possibilities, but the effect is not automatic. A rural woman cannot benefit fully from an e-commerce platform if she lacks a smartphone, reliable connectivity, digital literacy, packaging resources, logistics, payment access, inventory, or control over business income. Digital inclusion should therefore be understood as an ecosystem rather than simple device ownership. Financial access is similarly central.

Agricultural businesses frequently require capital before revenue is earned. Seed, livestock, equipment, irrigation, packaging, transport, certification, storage, and processing may all require advance expenditure. Seasonal income also creates cash-flow challenges. FAO notes that small and medium actors in agrifood systems can face considerable difficulties accessing financial services in

environments affected by climate risk, market volatility, changing demand, regulation, and business uncertainty.

For women, these difficulties may become stronger when formal collateral or land titles are unavailable or controlled by other household members. Finance therefore affects more than business expansion. It influences whether an entrepreneur can absorb a shock. Networks also provide resilience during shocks because entrepreneurs can share information, labor, equipment, storage, contacts, or temporary financial support.

However, collective participation should not be assumed to equal empowerment. Women may participate in groups without controlling key decisions or revenue. Resilience-oriented programs should therefore examine not only whether women are present but also whether they influence decisions, own assets, retain income, negotiate contracts, and determine the direction of the enterprise.

Table 1: Major Dimensions Connecting Women-Led Agricultural Innovation with Enterprise Resilience

Dimension	Innovation Opportunity	Contribution to Resilience	Common Constraint
Productive assets	Improved seeds, equipment, processing, irrigation	Enables continuity and productive adaptation	Weak ownership or control
Finance	Working capital, insurance, investment	Helps absorb shocks and finance recovery	Collateral requirements and limited credit
Digital access	E-commerce, mobile payments, digital advisory	Diversifies markets and improves information access	Connectivity, device and literacy gaps
Knowledge and extension	Technical and business innovation	Improves adaptation and opportunity recognition	Training not aligned with enterprise needs
Market linkages	New buyers, direct marketing, aggregation	Reduces dependence on a single customer	Weak bargaining position and poor logistics
Networks and collectives	Joint marketing and resource sharing	Provides information and mutual support	Limited influence within organizations
Climate-smart practices	Resilient varieties and efficient resource use	Reduces vulnerability to climate shocks	Cost, information and technology barriers
Decision-making agency	Independent business strategy	Accelerates adaptive response	Restrictive social and household norms

Source: Conceptual synthesis from FAO and recent studies on women's agricultural entrepreneurship and agricultural service provision.

3. Research Gap, Objectives and Conceptual Method

Research on women in agriculture is extensive, as is research on entrepreneurship, agricultural innovation, women's empowerment, and climate resilience. However, these areas are frequently examined separately.

One body of literature evaluates women's access to land, finance, inputs, and extension. Another focuses on agricultural technology adoption. Entrepreneurship studies examine business creation and performance, while resilience research examines how enterprises respond to shocks. The intersection of these literatures remains less developed.

A first research gap concerns the difference between women's participation in agricultural innovation and women's ownership of innovation-oriented enterprises. A program can report large numbers of women adopting a technology without determining whether women control the resulting income, own the business assets, influence pricing, select customers, or participate in strategic decisions.

The distinction is important because resilience depends strongly on decision-making authority. A second gap involves the transition from project-supported innovation to commercially sustainable enterprise. Its primary objective is to explain how women-led agricultural innovation can improve the resilience of rural enterprises without assuming that innovation itself is sufficient.

Specific analytical objectives are to examine the relationship between women's entrepreneurship and agricultural innovation, identify major resilience-enabling conditions, assess the role of finance and productive assets, consider digital and market innovations, examine climate-responsive enterprise adaptation, and develop policy implications for sustainable rural enterprise development. The study uses a conceptual narrative review approach. It draws on recent peer-reviewed studies and institutional evidence concerning women in agrifood systems, agricultural entrepreneurship, digital inclusion, agricultural service provision, seed entrepreneurship, finance, and rural enterprise resilience. No primary survey or field experiment was conducted for this manuscript.

For future empirical validation, the following five questionnaire questions are proposed:

- Access to appropriate finance improves the ability of women-led agricultural enterprises to respond to unexpected business disruptions.
- Women entrepreneurs are more likely to adopt agricultural innovations when they have meaningful control over productive assets and business decisions.
- Digital technologies improve enterprise resilience when they provide reliable access to markets, information, payments, or customers.
- Participation in producer groups and business networks strengthens the ability of women-led rural enterprises to cope with market and climate shocks.
- Women-led agricultural enterprises are more resilient when technical innovation is combined with market access, business skills, and institutional support.

4. Theoretical Analysis and Discussion

The relationship between women-led agricultural innovation and rural enterprise resilience can be understood through three interacting levels: the entrepreneur, the enterprise, and the enabling environment.



At the entrepreneur level, resilience depends partly on knowledge, confidence, adaptive decision making, opportunity recognition, negotiation ability, and control over business choices. At the enterprise level, resilience depends on resources, liquidity, technology, product diversification, customer relationships, supply chains, market information, and operational flexibility.

At the enabling-environment level, resilience depends on infrastructure, financial systems, property rights, social norms, extension services, digital connectivity, markets, policy stability, and institutions. The weakness of any one level can reduce the value created at the others.

For example, a technically capable woman may identify a profitable processing opportunity but remain unable to establish the enterprise because she lacks finance. A financed enterprise may acquire equipment but fail because transport and market access are inadequate. A digitally connected entrepreneur may identify buyers but be unable to supply them consistently because climate variability disrupts production. Resilience therefore emerges through combinations of capabilities rather than one isolated intervention. Innovation as diversification. One important route through which innovation can increase resilience is diversification.

A farming enterprise dependent on a single crop and single buyer is highly exposed to production and market shocks. Women entrepreneurs can diversify by introducing processing, livestock, seed sales, nursery services, local advisory services, direct retailing, digital sales, or value-added products. Diversification does not eliminate risk, but it can reduce dependence on one source of income. A woman producing vegetables, for example, may develop processed products from surplus output. Another may supplement farming income through seedling sales or agricultural services. Such enterprise innovation creates additional revenue channels and can reduce losses when one activity performs poorly.

Innovation as market connection. A second pathway is stronger market access. Traditional rural marketing can involve several intermediaries and weak price information. Digital communication and collective marketing can improve buyer discovery, transparency, and bargaining opportunities. Dong and colleagues' research on rural e-commerce provides evidence that digital market development can stimulate rural women's entrepreneurship by reducing information and other constraints.

However, sustainable digital entrepreneurship requires more than opening an online account. Product quality, logistics, packaging, trust, customer service, digital financial literacy, and reliable fulfillment remain essential. A rural enterprise that receives online demand but cannot deliver consistently may damage rather than strengthen its market reputation. Innovation as local service provision. Agricultural service entrepreneurship offers another important model. Women can provide services related to seed distribution, input retail, nursery production, advisory support, crop protection, livestock, aggregation, or digital information. This can diversify rural economies and create locally accessible services.

The review by Kadzamira and colleagues shows that service-provider models can generate entrepreneurial opportunities and economic empowerment when they are connected to real market demand. Women agricultural service providers may also possess specific advantages in reaching women farmers who have limited interaction with male extension agents or commercial representatives in particular social settings. This creates a possible multiplier effect: one women-led enterprise can improve not only the entrepreneur's livelihood but also access to agricultural technology for other rural producers.



Innovation as climate adaptation. Climate-related uncertainty is increasingly relevant to rural enterprise resilience.

Agricultural businesses face risks from rainfall variability, heat, drought, flood, pests, and other climatic stresses. FAO explicitly links women's empowerment with resilience-building within agrifood systems. Climate-responsive innovation may involve resilient crop varieties, diversification, water management, adjusted planting schedules, protected cultivation, improved storage, crop insurance, climate information services, or livelihood diversification.

Women entrepreneurs can also become distributors of adaptation technology. Farnworth and colleagues' Kenyan seed-system case is relevant because women were included among agripreneurs promoting stress-tolerant maize and sorghum varieties and agricultural insurance. This demonstrates that women-led entrepreneurship can connect enterprise development with wider climate resilience in farming communities. Nevertheless, climate-smart innovation can require upfront capital. Drought-resilient seeds, irrigation, storage, greenhouse systems, insurance, or processing equipment may involve additional costs. Without accessible finance, the entrepreneurs most exposed to climate risk may be least able to invest in adaptation.

Finance as resilience infrastructure. Finance should therefore be understood as a resilience capability rather than simply a mechanism for business expansion. An enterprise needs capital to innovate, but it also requires liquidity to survive. If a crop is damaged or a buyer delays payment, a business with reserves can continue operating. A business without reserves may be forced to sell productive assets, borrow at unfavorable terms, or close. Financial inclusion should include appropriate savings products, working-capital finance, insurance, flexible repayment schedules, digital finance, and financial-literacy support rather than only encouraging women to borrow. Debt that is poorly matched to agricultural cash flow can actually reduce resilience. FAO's work on gender and rural financial services highlights the broader financial constraints affecting agrifood actors, while recent rural-enterprise evidence reinforces the importance of financial resources to performance.

Asset control as the foundation of adaptation. The conceptual analysis identifies productive-asset control as one of the most fundamental resilience conditions. Innovation requires the authority to change something. A woman may possess agricultural knowledge but be unable to change the crop if she does not control the land. She may understand that new equipment would improve productivity but be unable to use household assets as collateral. She may earn business income but have limited authority over reinvestment. Women's ownership and meaningful control over productive resources can therefore influence how quickly an enterprise responds to shocks and opportunities.

Land rights, inheritance rules, equipment ownership, savings, and control over revenue are not peripheral gender issues. They are part of the economic architecture of resilient enterprise. Networks as distributed resilience. No rural enterprise operates in isolation. Relationships with customers, suppliers, producer groups, cooperatives, financial institutions, extension workers, transporters, processors, and community organizations influence everyday business performance. During a disruption these relationships become particularly valuable.

A supplier may provide temporary credit. A producer group may combine transport. A buyer may provide forward orders. A cooperative may negotiate higher prices. A savings group may provide emergency finance. Another entrepreneur may share information about a new market. Networks convert

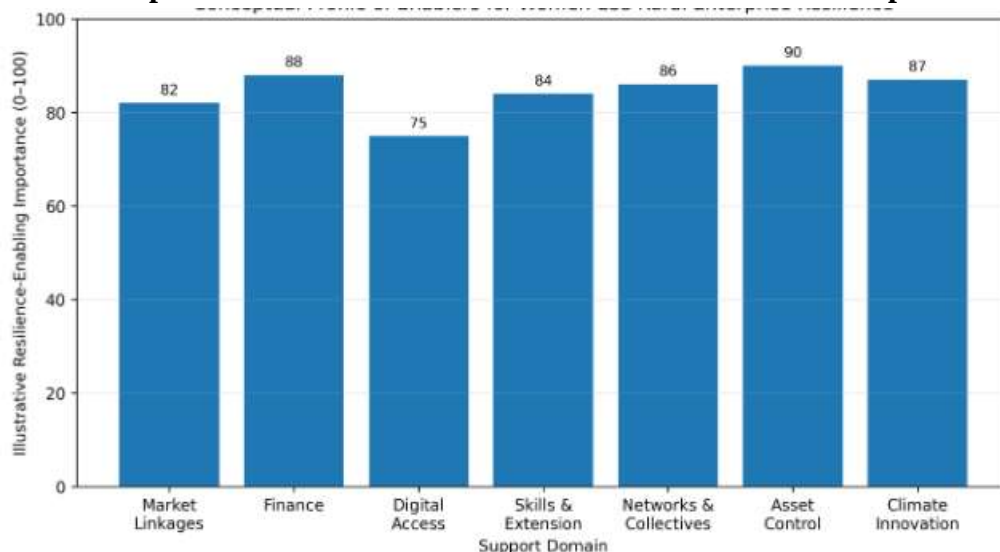
resilience from an individual capability into a collective resource. The service-provider research reviewed by Kadzamira and colleagues reports networking, confidence, and skills development among benefits associated with successful inclusive business models. However, the quality of networks matters more than simple membership.

Table 2: From Short-Term Enterprise Support to Long-Term Resilience

Traditional Intervention	Limitation When Used Alone	Resilience-Oriented Alternative
One-time technical training	Skills may not translate into income	Continuous technical and business mentoring linked to markets
Microcredit only	Debt may increase vulnerability	Appropriate finance plus savings, insurance and cash-flow planning
Equipment distribution	Equipment may be underused or unsustainable	Asset ownership plus maintenance, demand and revenue planning
Digital-app introduction	Technology may not solve market constraints	Connectivity, literacy, logistics and buyer integration
Formation of women's groups	Membership does not ensure market power	Collective marketing, procurement and negotiation capability
Production-focused extension	More output may depress income without buyers	Production advice linked with market and enterprise planning

Source: Author's conceptual synthesis based on the literature reviewed.

Graph 1. Conceptual Profile of Enablers for Women-Led Rural Enterprise Resilience





Source: Author's conceptual illustration based on the reviewed literature.

Important Note: The graph does not represent survey or field data. The numerical values are illustrative scores used only to visualize the theoretical proposition that enterprise resilience depends on several interconnected enabling domains rather than innovation alone. The conceptual graph gives greatest emphasis to productive-asset control, finance, climate-responsive innovation, collective networks, skills, and market connections. This does not imply that one universal numerical ranking applies across countries.

In one region, market access may be the decisive barrier. In another, land rights may be more important. Elsewhere, digital connectivity, social norms, irrigation access, transport, or working capital may dominate. The central theoretical message is therefore the interdependence of the factors.

An entrepreneur with strong market demand but no finance cannot expand. Finance without market demand creates repayment risk. Technology without training can remain unused. Training without productive assets creates knowledge without action. Digital access without logistics can generate orders that cannot be fulfilled.

The resilience of women-led agricultural enterprises consequently resembles a system whose performance depends on whether its critical components operate together. This perspective also changes how agricultural innovation should be evaluated. An innovation project should not ask only: Did women adopt the technology?

It should also ask whether the technology improved revenue stability, whether women controlled the resulting income, whether dependence on subsidies declined, whether the business reached sustainable customers, whether assets were retained, whether shocks could be absorbed, and whether the enterprise remained viable after external assistance ended. Such questions move evaluation from adoption toward resilience.

5. Conclusion

Women-led agricultural innovation represents an important pathway through which rural economies can become more adaptive, diversified, inclusive, and resilient.

Women already participate across agricultural production and wider agrifood systems, but entrepreneurship allows their role to move beyond labor participation toward ownership, innovation, market engagement, service provision, and economic decision making. The literature reviewed in this paper demonstrates that women entrepreneurs contribute to agricultural innovation, sustainability, rural development, and food-system activity while continuing to face constraints involving productive resources, finance, markets, technology, and gender norms.

Research on women's seed entrepreneurship further shows that women can play commercially and technically important roles in agricultural value chains and can help distribute improved agricultural technologies. Agricultural service-provider models offer another pathway. When they are place-based, market-driven, connected with value chains, and supported through appropriate skills and institutions, they can create entrepreneurial opportunities and strengthen local agricultural services.

Digital transformation adds a further opportunity. Evidence from rural e-commerce shows that stronger digital-market infrastructure can increase women's participation in entrepreneurship by



reducing some information, skill, financial, and social-capital constraints. Yet the principal conclusion of this paper is that innovation is not sufficient by itself.

A new technology does not create resilience when an entrepreneur lacks control over productive assets. Training does not create resilience when there is no viable market. Credit does not create resilience when repayment conditions increase vulnerability. Digital platforms do not create resilience when logistics and connectivity are unreliable. Participation in a cooperative does not create resilience when women remain excluded from decisions. The most resilient women-led agricultural enterprises are therefore likely to emerge where innovation operates within a supportive ecosystem combining productive assets, appropriate finance, market access, technical and business knowledge, digital capability, strong networks, climate-responsive strategies, and meaningful decision-making authority. This requires a shift in rural-development thinking.

Women should not be treated merely as beneficiaries of agricultural innovation. They should increasingly be recognized as entrepreneurs, owners, innovators, technology intermediaries, service providers, employers, and strategic decision makers within rural economies. Policy success should therefore be measured not simply by the number of women trained or technologies distributed, but by whether women-led enterprises survive, adapt, innovate, generate sustainable income, retain control over assets and revenue, enter stronger markets, and recover effectively from shocks.

When these conditions are created, women-led agricultural innovation can strengthen not only individual enterprises but also the resilience of households, value chains, communities, and rural economies.

6. Declarations

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