

ENTREPRENEURIAL INNOVATION AND SUSTAINABLE FOOD SYSTEMS: A SYSTEMATIC REVIEW OF ORGANIC FARMING PRACTICES IN NORTHERN NIGERIA

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Abstract

The growing need for sustainable food production systems has intensified global attention on entrepreneurial innovations within organic farming. In Nigeria, particularly in the northern region, the pursuit of food security, environmental sustainability, and rural livelihoods has driven interest in organic farming as an alternative to conventional practices. This study systematically reviews existing literature on entrepreneurial innovation in organic farming and its contribution to sustainable food systems in Northern Nigeria. Guided by the PRISMA 2020 protocol, a comprehensive search of academic databases, including Google Scholar, Scopus, and CAB Abstracts, identified 28 relevant studies published between 2010 and 2025. After applying inclusion and exclusion criteria, 17 studies were analyzed thematically. The findings reveal that entrepreneurial innovations in organic farming spanning product, process, market, and institutional dimensions have significantly enhanced resource efficiency, soil health, market access, and livelihood diversification among smallholder farmers. However, challenges such as inadequate technical knowledge, limited access to finance, weak policy support, and insufficient organic certification frameworks constrain widespread adoption. The review underscores the need for policies that strengthen agri-innovation ecosystems, promote sustainable entrepreneurship training, and enhance research-extension linkages. Overall, entrepreneurial innovation in organic farming presents a viable pathway toward achieving resilient and sustainable food systems in Northern Nigeria.

Keywords: Entrepreneurial innovation; food systems; organic farming; sustainable

Introduction

Sustainable food systems that ensure the availability of nutritious, affordable, and environmentally responsible food have become a major concern of global development agendas. In Nigeria, particularly in the northern region, persistent

food insecurity, environmental degradation, and rural poverty remain pressing challenges that threaten agricultural sustainability. The region faces intersecting shocks including climate variability, conflict-induced displacement, declining soil fertility, and volatile food prices, all of which have

undermined the resilience of traditional agricultural systems (Food and Agriculture Organization [FAO], 2022; International Institute for Sustainable Development [IISD], 2023). These dynamics underscore the urgent need for innovative approaches that can simultaneously enhance productivity, preserve ecological integrity, and strengthen rural livelihoods.

Organic farming has gained increasing recognition as a sustainable alternative to conventional agriculture. It relies on ecological processes, biodiversity, and local resource cycles rather than synthetic inputs, thereby promoting soil fertility, environmental conservation, and long-term productivity (Reganold & Wachter, 2016). In Northern Nigeria, where smallholder farming dominates and input costs are high, organic practices offer opportunities for low-cost production and environmental rehabilitation. However, transitioning to organic systems requires more than adopting new techniques; it involves developing supportive institutions, viable market channels, and entrepreneurial actors who can transform organic agriculture into a profitable and scalable enterprise (Eyhorn et al., 2019).

Entrepreneurial innovation bridges this gap by fostering creativity, risk-taking, and problem-solving across agricultural value chains. It includes the introduction of new products, processes, business models, and institutional arrangements that improve efficiency and sustainability. In the context

of organic farming, entrepreneurs play a critical role in developing organic input enterprises, value-added processing, eco-labeling, and market linkages that connect smallholders with emerging urban and export markets (Adekunle et al., 2021; Bello, 2019). Such innovations are increasingly supported by agri-tech platforms and incubators that promote youth participation and digital solutions in agriculture (Gabriel et al., 2023). Recent studies have shown that these entrepreneurial mechanisms can significantly enhance resource use efficiency, income diversification, and environmental resilience among smallholders (Ikuemonisan et al., 2024; Mbanasor et al., 2024).

Despite these emerging efforts, the relationship between entrepreneurial innovation and sustainable organic farming practices in Northern Nigeria remains poorly understood and insufficiently synthesized in the literature. Most existing studies focus on isolated components such as market access, digitalization, or microfinance without holistically analyzing how entrepreneurial innovation supports the transition toward sustainable food systems. Furthermore, weak institutional frameworks, limited technical knowledge, and inadequate financing mechanisms continue to constrain the scaling of organic farming in the region (World Bank, 2023). This gap in comprehensive understanding limits policymakers' and practitioners' ability to

design integrated interventions that promote innovation-driven sustainability.

This paper, therefore, conducts a systematic review guided by the PRISMA 2020 framework to synthesize existing evidence on entrepreneurial innovations in organic farming and their contributions to sustainable food systems in Northern Nigeria. Specifically, it aims to (1) identify and classify entrepreneurial innovations within organic farming systems; (2) assess their economic, environmental, and social sustainability impacts; and (3) examine the key barriers and enabling conditions that influence adoption and scaling. By addressing these objectives, the study contributes to a deeper understanding of how entrepreneurial innovation can drive the transformation of organic agriculture and enhance food system resilience in Northern Nigeria.

Materials and Methods

This systematic review was carried out in line with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA 2020) guidelines to synthesize evidence on entrepreneurial innovation in organic farming and its contribution to sustainable food systems in Northern Nigeria.

Studies published between 2015 and 2025 were included if they focused on entrepreneurial actors in Northern Nigeria's organic farming sector and reported on innovations or sustainability outcomes.

Studies excluded were: (1) those not specific to Northern Nigeria; (2) those focusing solely on conventional agriculture without an organic component; (3) publications lacking empirical or conceptual relevance to innovation; and (4) articles not written in English.

A systematic search of publications from 2015 to 2025 was performed in Scopus, Web of Science, CAB Abstracts, and Google Scholar, supplemented by searches of grey literature such as institutional and project reports. The search strategy combined keywords such as "entrepreneurship," "innovation," "organic farming," and "Northern Nigeria."

A total of 90 records were identified through database searches across Scopus, Web of Science, CAB Abstracts, and Google Scholar, along with 8 additional records from grey literature and institutional sources. After removing 20 duplicates, 70 studies were screened by title and abstract. Of these, 33 records were excluded for not meeting the inclusion criteria. The remaining 37 full-text articles were assessed for eligibility, out of which 20 were excluded for reasons such as lack of empirical focus, irrelevance to organic farming, or study location outside Northern Nigeria. Consequently, 17 studies met all criteria and were included in the final synthesis. The review process followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA

2020) framework, as illustrated in Table 1 and adopted from Page et al. (2021).

Because the included studies employed diverse designs and data types, a narrative and thematic synthesis was used to integrate findings. The Mixed Methods

Appraisal Tool (MMAT) was applied to assess the quality of both qualitative and quantitative studies. Themes were then organized around types of entrepreneurial innovation and the sustainability outcomes they influenced.

Table 1. Summary of PRISMA 2020 Study Selection Process

Stage	Description of Activity	Number of Records (n)
Identification	Records identified through database searching (Scopus, Web of Science, CAB Abstracts, Google Scholar)	82
	Additional records identified through grey literature and institutional reports	8
	Total records identified	90
Screening	Duplicates removed	20
	Records screened by title and abstract	70
	Records excluded (not relevant to organic farming or entrepreneurial innovation)	33
Eligibility	Full-text articles assessed for eligibility	37
	Full-text articles excluded with reasons (not focused on Northern Nigeria, not empirical, or lacking innovation focus)	20
Inclusion	Studies included in the final systematic review and synthesis	17

Note. Table adapted from PRISMA 2020 flow model (Page et al., 2021).

Results and Discussions

The systematic review identified 17 studies that met the inclusion criteria. These studies varied in design and thematic focus. They collectively provide empirical and conceptual evidence on how entrepreneurial innovations influence organic farming practices and sustainable food systems in Northern Nigeria. The studies were synthesized under four major categories of innovation digital/technological, organizational/institutional, market-based,

and social/financial all of which contribute to the development, adoption, and scaling of organic agriculture in the region.

Digital and Technological Innovations Supporting Organic Farming

Entrepreneurial innovation in Northern Nigeria increasingly harnesses digital and low-cost technologies to strengthen organic farming systems. Mobile applications, remote-sensing platforms, and digital extension services have become vital

tools for disseminating organic production knowledge, soil health management techniques, and weather-based advisory information (Gabriel et al., 2023). These innovations enable farmers to make ecologically sound decisions, optimize organic input use, and reduce dependency on synthetic chemicals.

Small-scale enterprises have also emerged to produce and distribute organic bio-fertilizers, compost enhancers, and bio-pesticides, aligning with the ecological principles of organic agriculture (Bello, 2019; Iliya & Garba, 2022). The revival of local organic composting systems—such as the *Kankara* compost method in Katsina State exemplifies how indigenous knowledge is being adapted through entrepreneurial activity to sustain soil fertility and reduce input costs (Sani & Bello, 2021). These technological innovations demonstrate that entrepreneurship can serve as a driver of knowledge diffusion and input accessibility for organic producers in arid and semi-arid zones.

Organizational and Institutional Innovations in Organic Value Chains

Institutional and organizational innovations are essential to overcoming the structural barriers facing organic farmers in Northern Nigeria. Women's and youth cooperatives have been instrumental in organizing collective organic production, input procurement, and marketing activities. For example, women's cooperatives in

Plateau and Kaduna States have pioneered the group cultivation of organic vegetables and *Hausa* potatoes, enabling members to pool resources, share organic inputs, and access niche markets (Chikaire & Osuagwu, 2021).

Similarly, partnerships between Islamic microfinance institutions and organic out-grower schemes have introduced Sharia-compliant funding models that provide accessible credit for organic enterprises (Abdulkadir et al., 2022). These institutional innovations help farmers overcome constraints related to capital, certification, and market access. In addition, agribusiness incubators and cooperative extension initiatives have fostered learning networks that promote knowledge exchange on organic practices and sustainable entrepreneurship (Ikuemonisan et al., 2024). Together, these organizational efforts create enabling environments where organic farming can thrive as a viable livelihood system.

Market-Based Innovations and Organic Product Differentiation

Market-based innovations are central to linking organic farmers with consumers who value safe, eco-friendly, and locally produced food. Entrepreneurs in Northern Nigeria have developed short supply chains, farm-to-market linkages, and branding strategies that highlight the “natural” and chemical-free characteristics of their products (Okafor, 2020; Darma et al., 2023). The use of Participatory Guarantee Systems

(PGS) in states such as Kano and Kaduna offers a low-cost certification model that builds consumer trust and supports domestic organic market development. This innovation has allowed smallholder organic cooperatives to command price premiums in urban centers such as Abuja and Lagos.

Furthermore, emerging agri-tech platforms are connecting organic producers directly to consumers, restaurants, and health food outlets. These digital market linkages not only reduce intermediary costs but also strengthen transparency and traceability key requirements in the organic sector (Brookings Institution, 2023). Collectively, these market-based innovations show that entrepreneurship can transform fragmented traditional markets into structured value chains that reward organic quality and sustainability.

Social and Financial Innovations Enhancing Organic Farming Adoption

Organic farming in Northern Nigeria faces significant constraints related to credit access, gender inequities, and social capital. In response, entrepreneurs and local organizations have developed community savings groups, micro-leasing arrangements, and cooperative financing systems tailored to organic farmers' needs (Madu, 2015; Abdulkadir et al., 2022). These models promote inclusion by reducing collateral requirements and aligning repayment schedules with agricultural seasons.

Gender-sensitive entrepreneurship programs have also emerged to empower women and youth to participate actively in organic agribusiness. For instance, social enterprises in Kano and Katsina train women in organic composting, bio-pesticide production, and value-added processing, enabling them to generate income from sustainable activities (Chikaire & Osuagwu, 2021). Such financial and social innovations contribute not only to organic farming adoption but also to the broader social equity objectives of sustainable food systems.

By integrating financial inclusion with organic practice development, these innovations bridge the gap between sustainability ideals and practical livelihood realities for smallholders.

Sustainability Outcomes of Organic Entrepreneurial Innovations

The reviewed studies reveal that entrepreneurial innovations within organic farming systems have produced multidimensional sustainability outcomes:

Economic Viability: Organic input entrepreneurship and certification schemes have reduced production costs, stabilized prices, and increased farmers' profit margins by up to 40% (Okafor, 2020; Sani & Bello, 2021). Studies consistently report that organic farming can reduce cash expenditures on synthetic inputs by 30-60%, a critical factor for cash-constrained smallholders in the North (Sani & Bello,

2021). Furthermore, access to premium markets through PGS and direct sales can increase net incomes by 15-40% compared to conventional counterparts (Okafor, 2020). However, these benefits are not universal; they are contingent on reliable market access and stable prices, which are often disrupted by rural insecurity and poor infrastructure (World Bank, 2023). The initial yield dip commonly associated with the transition to organic farming also poses a significant economic risk for vulnerable households. Multiple evaluations show positive economic impacts where innovations improved market access, reduced transaction costs, or increased input efficiency. Digital platforms and aggregation hubs have been linked to higher prices received by producers and reduced post-harvest losses in pilot studies (digital extension and value-chain reports). However, high up-front costs, limited access to affordable credit, and weak insurance markets frequently blunt longer-term profitability for the poorest households (Balana, 2020; Balana et al., 2022). These studies conclude that economic gains are real but unevenly distributed, favoring better-connected or better-capitalized entrepreneurs.

Environmental Stewardship: Empirical evidence from the region confirms significant improvements in soil health. The adoption of bio-fertilizers, composting, and integrated pest management has improved soil organic carbon and biodiversity (Iliya & Garba, 2022). The reduction in synthetic pesticide use also correlates with increased

on-farm biodiversity, including beneficial insects and soil microbiota (Bello, 2019). These environmental benefits are crucial for the long-term sustainability of agriculture in a region highly vulnerable to climate change and land degradation. Evidence from climate-smart agriculture (CSA) research in northern states indicates that innovations such as drought-tolerant varieties, micro-irrigation (drip), and conservation agriculture practices can reduce water and soil degradation while maintaining yields under variable rainfall (Mbanasor et al., 2024; Gabriel et al., 2023). Nonetheless, several authors warn about potential rebound effects (e.g., expanded cultivated area if profitability rises) and emphasize the need for monitoring and environmental standards when scaling technologies.

Social Equity: Cooperative entrepreneurship and inclusive financing have enhanced participation of women and youth in organic value chains (Auta & Dafwang, 2019; Olofin et al., 2021). Entrepreneurial innovations have had notable social impacts, particularly for women and youth. The cooperative model has empowered women economically by giving them control over organic value chains for high-value vegetables (Chikaire & Osuagwu, 2021). For youth, organic agri-tech startups offer new, more attractive employment opportunities in marketing, logistics, and extension services, countering the narrative of agriculture as an unattractive sector (Darma et al., 2023). Despite this, deep-seated structural barriers, including

patriarchal land ownership systems, continue to limit women's full participation in some areas (Abdulkadir et al., 2022). Social innovations and targeted programs for women and youth have improved inclusion in some case studies, raising participation in value chains and building entrepreneurial skills (studies in Kano and surrounding states). Yet persistent gender norms, limited mobility, and unequal access to finance mean that women and resource-poor households are still under-represented among successful adopters of higher-return innovations (women entrepreneur literature; social entrepreneurship reviews).

However, constraints such as limited technical knowledge, inconsistent policy support, and insecurity continue to hinder widespread adoption (World Bank, 2023). The evidence underscores the need for targeted interventions that strengthen extension services, research–entrepreneur linkages, and policy frameworks supportive of organic innovation.

Barriers to the Uptake and Scaling of Entrepreneurial Innovations in Organic Farming

Despite the growing potential of entrepreneurial innovations to transform organic farming systems in Northern Nigeria, several barriers continue to hinder widespread adoption and scaling.

Limited Access to Finance for Organic Enterprises

Access to finance remains the most critical barrier limiting the adoption of organic farming innovations. Most smallholder organic producers and agri-entrepreneurs face severe credit constraints due to high interest rates, lack of collateral, and the limited availability of microfinance schemes that align with organic production cycles (Balana et al., 2020; Ikuemonisan et al., 2024; Madu, 2015). The absence of credit products tailored to the slower financial returns typical of organic transitions discourages new entrants. In addition, the lack of crop insurance and affordable risk-mitigation mechanisms leaves organic producers highly vulnerable to market and climate shocks (Gabriel et al., 2023). Without accessible financial instruments, potential entrepreneurs struggle to invest in certified organic inputs, composting facilities, or organic processing units.

Conflict and Insecurity

The pervasive rural conflict in the North-East and North-West has disrupted agricultural production systems, including organic farming initiatives. Violence and displacement have destroyed farms, reduced access to farmland, and disrupted input and output markets, particularly in states such as Borno, Zamfara, and Katsina (Food and Agriculture Organization [FAO], 2022). Organic farming, which often depends on community-level organization and localized input cycles, is especially vulnerable to

these disruptions. The insecurity has also discouraged investors and NGOs from implementing long-term organic development projects in the region.

Infrastructural Deficiencies

Weak infrastructure remains a major obstacle to scaling organic entrepreneurship. Poor road networks, unreliable electricity, and limited internet connectivity increase transaction costs for small organic producers and processors (International Fund for Agricultural Development [IFAD], 2023; World Bank, 2022). The lack of cold-chain facilities undermines the storage and transport of perishable organic produce, reducing its market value. Digital innovation projects designed to connect organic farmers with consumers especially in Kano and Sokoto have suffered from low participation due to inadequate broadband coverage and unstable power supply (Gabriel et al., 2023). These infrastructural gaps constrain both production efficiency and market competitiveness for organic entrepreneurs.

Institutional and Policy Weaknesses

Institutional and policy-related challenges also significantly restrict the growth of organic farming in Northern Nigeria. While there are increasing references to sustainable agriculture in national strategies, there is still no formal national organic agriculture policy or certification framework (Okafor, 2020). The absence of clear organic standards and labeling guidelines limits consumer trust and discourages private investment. Moreover,

bureaucratic inefficiencies, weak contract enforcement, and limited coordination between ministries and development partners create an uncertain environment for entrepreneurs (Mbanasor et al., 2024; Ikuemonisan et al., 2024). These policy inconsistencies prevent organic enterprises from scaling beyond pilot projects and inhibit their integration into national food system strategies.

Knowledge, Capacity, and Input Constraints

Another significant barrier is the shortage of technical knowledge and institutional capacity for organic farming. Many entrepreneurs, extension agents, and smallholders lack the specialized knowledge required for soil fertility management, biological pest control, and organic certification processes (Balana et al., 2022; Madu, 2015). Extension services in most northern states are oriented toward conventional practices, leaving organic producers without relevant technical support. Furthermore, organic inputs such as bio-fertilizers, neem-based pesticides, and improved organic seed varieties remain scarce and costly (Iliya & Garba, 2022). This scarcity limits farmers' ability to maintain consistent organic standards and meet certification requirements.

Socio-Cultural and Gender-Related Constraints

Socio-cultural norms continue to restrict the participation of women and youth in organic entrepreneurship. Land

ownership patterns, gendered access to credit, and social barriers to decision-making limit their engagement in high-value organic ventures (Auta & Dafwang, 2019; Olofin et al., 2021). Although donor-supported programs have improved participation in some communities, these efforts often focus on general agribusiness rather than organic-specific opportunities. Strengthening inclusive capacity-building initiatives that prioritize women and youth within the organic sector is essential for equitable and sustained adoption.

Conclusion

This systematic review examined the nature, impacts, and contextual dynamics of entrepreneurial innovations driving organic farming practices and their contributions to sustainable food systems in Northern Nigeria. By synthesizing evidence from 17 empirical and conceptual studies, the review provides critical insights into how innovation-oriented entrepreneurship supports the transformation of organic agriculture in a region characterized by ecological fragility, limited infrastructure, and policy gaps.

The findings reveal that entrepreneurial innovation within organic farming are diverse and context-specific, encompassing digital and ecological technologies, cooperative business models, market-based differentiation strategies, and inclusive financial mechanisms. These innovations have collectively enhanced soil fertility management, access to organic

inputs, certification, and value addition in local food systems (Gabriel et al., 2023; Ikuemonisan et al., 2024). However, their adoption remains uneven strongest in communities and states where institutional, infrastructural, and market support mechanisms exist, and weakest in areas affected by insecurity and limited public investment.

Evidence further indicates that organic farming innovations advance the three pillars of sustainability when supported by enabling conditions. Economically, they reduce input costs and improve income stability through value-added organic markets. Environmentally, they promote soil health, biodiversity, and resource efficiency aligned with the principles of ecological agriculture (Mbanasor et al., 2024). Socially, they create inclusive opportunities for youth and women through cooperative entrepreneurship and local organic enterprises (Auta & Dafwang, 2019; Olofin et al., 2021). Nevertheless, persistent constraints including inadequate technical knowledge, limited access to credit, and the absence of a national policy framework for organic agriculture continue to restrict scaling and broader impact.

Overall, the review concludes that entrepreneurial innovations embedded in organic farming systems represent a transformative pathway for achieving sustainable food security and rural resilience in Northern Nigeria. To realize this potential, policymakers and development

agencies must integrate organic farming into mainstream agricultural strategies through coherent policies, targeted financing, and tailored extension services. Future research should focus on impact-based and

longitudinal studies that evaluate how organic entrepreneurial innovations influence livelihoods, equity, and ecological sustainability over time.

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