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Managing the Challenges of Organic Agriculture Development in Rural Areas: An Analysis of Barriers and the Provision of Commercial Strategies in Mazandaran Province

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ABSTRACT

The development of organic agriculture, as a strategic pathway toward achieving environmental sustainability and food security, despite the high natural potential of Mazandaran Province, has been progressing slowly and is confronted with numerous challenges. The present study was conducted with the objective of managing the challenges of organic agriculture development in rural areas through analyzing existing barriers and proposing commercial strategies in Mazandaran Province. This research adopted a qualitative approach and employed thematic analysis. Data were collected through in-depth semi-structured interviews with 35 key stakeholders (farmers, local officials, agricultural extension experts, cooperative activists, and traders) in rural areas of Mazandaran Province. Participants were selected using purposive sampling combined with the snowball technique until theoretical saturation was achieved. Data analysis was carried out following the thematic analysis procedure of Braun and Clarke (2006). The analysis resulted in the identification of five main themes and fifteen subthemes. The principal challenges included: (1) technical–agronomic challenges (including insufficient knowledge, complex pest management, and the transition period); (2) economic–market challenges (including high production costs, lack of guaranteed purchasing mechanisms, and weaknesses in support systems); (3) institutional–governance challenges (including inter-organizational misalignment, complexity of certification processes, and fragmented regulations); (4) socio-cultural challenges (including resistance to change, generational gaps, and low social trust); and (5) infrastructural–ecological challenges (including fragmented farmlands, contamination of soil and water resources, and deficiencies in the supply chain). These challenges dynamically interact to form a "vicious cycle" that seriously impedes the expansion of organic cultivation. The proposed commercial strategies are grounded in the creation of an integrated business ecosystem centered on establishing financial guarantee institutions (such as guaranteed purchase funds) and facilitative organizations (such as the Provincial Organic Hub), alongside the development of provincial branding and commercial clusters. This approach, by emphasizing the participation of the private sector and cooperatives, reduces producers' risk while enhancing supply chain transparency and access to high-value markets.

Keywords: Organic agriculture; rural development; organic farming challenges; Mazandaran Province.

Introduction

Agriculture stands at the center of contemporary debates on sustainable development, environmental protection, food security, and rural livelihoods. The growing awareness of the adverse ecological and health consequences of conventional agricultural practices—particularly the extensive use of chemical fertilizers and pesticides—has intensified global efforts toward alternative production systems that promote sustainability, ecosystem resilience,

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and public health (1, 2). Among these alternatives, organic agriculture has emerged as a comprehensive paradigm that integrates ecological balance, economic viability, and social responsibility into agricultural development strategies. Organic agriculture emphasizes soil health, biodiversity conservation, natural input utilization, and closed nutrient cycles, thereby offering a viable pathway toward sustainable food systems in both developed and developing economies (3, 4).

The expansion of organic agriculture is not merely an environmental necessity but also an economic and social opportunity. Global statistics demonstrate a continuous rise in organic farmland area, market value, and consumer demand, indicating that organic production has evolved from a niche movement into a mainstream sector of the global agri-food economy (3). Simultaneously, organic farming has been increasingly recognized as a catalyst for rural development by generating employment, strengthening local economies, and enhancing farmer incomes through access to premium markets (5, 6). These dynamics underscore the strategic importance of organic agriculture as a cornerstone of sustainable rural transformation.

Despite these advantages, the transition from conventional to organic agriculture remains complex and uneven across regions. Empirical evidence indicates that farmers' adoption of organic practices is shaped by an intricate interplay of technical, economic, institutional, and socio-cultural factors (7, 8). Farmers face numerous uncertainties, including yield fluctuations during conversion, high initial costs, limited technical knowledge, certification barriers, and volatile market conditions. Consequently, organic agriculture development cannot be understood solely through agronomic performance; rather, it must be examined as a multidimensional socio-economic process embedded within broader governance, market, and community structures (9, 10).

In developing and transitional economies, these challenges are particularly pronounced. Weak institutional frameworks, insufficient extension services, fragmented landholdings, and underdeveloped supply chains often hinder the effective diffusion of organic farming innovations (5, 11). Furthermore, farmers' perceptions of risk, trust in institutions, and social norms play decisive roles in shaping their willingness to engage in organic production systems (7, 12). Without coordinated policy interventions and supportive business environments, organic agriculture remains vulnerable to stagnation or marginalization within national agricultural systems.

Recent studies emphasize that sustainable transformation of agriculture requires integrated governance models and resilient agri-food ecosystems. Sustainable agricultural development increasingly depends on collaborative governance mechanisms that align the interests of farmers, policymakers, private enterprises, cooperatives, and consumers (13, 14). Digital platforms, transparent supply chains, and social mobilization further shape contemporary agricultural transitions, reinforcing the necessity of systemic approaches that extend beyond farm-level interventions (14, 15). These perspectives highlight the strategic importance of designing coherent business models and institutional arrangements that enable organic agriculture to compete effectively within modern agri-food markets.

In Iran, agriculture occupies a central role in economic development, food security, and rural employment. However, conventional agricultural practices have produced significant environmental degradation, including soil fertility decline, water contamination, and ecosystem imbalance (1, 2). Consequently, national development strategies increasingly emphasize sustainable agricultural transformation, within which organic agriculture is recognized as a priority pathway. Empirical studies conducted in various provinces of Iran reveal growing awareness of organic farming benefits alongside persistent structural and operational barriers that impede its expansion (8, 9, 16).

Research focusing on Iranian agriculture identifies multiple obstacles to organic development, including insufficient farmer knowledge, limited access to organic inputs, high certification costs, weak financial support mechanisms, market uncertainties, and inadequate institutional coordination (10, 16). Furthermore, cultural resistance to change and risk aversion among farmers significantly slow the diffusion of organic innovations (8, 9). These findings confirm that organic agriculture development in Iran requires a comprehensive understanding of both technical constraints and socio-economic conditions.

Mazandaran Province represents a particularly important context for investigating organic agriculture development. As one of Iran's most productive agricultural regions, Mazandaran plays a critical role in national food supply, rural employment, and agri-export markets. Its diverse agro-ecological conditions, favorable climate, and rich natural resources provide exceptional potential for organic farming expansion. However, despite these advantages, the adoption of organic agriculture in Mazandaran remains limited and fragmented. Preliminary evidence suggests that farmers encounter intertwined challenges related to production methods, input accessibility, market structures, certification processes, governance coordination, and rural social dynamics (8, 10, 16).

At the same time, global experiences demonstrate that organic agriculture can serve as a powerful engine for youth employment and rural entrepreneurship when supported by innovative business models and inclusive governance frameworks (14, 17). Sustainable youth employment pathways in agriculture increasingly rely on value-added production systems, cooperative enterprises, and localized processing industries—domains in which organic agriculture holds significant promise (17). These insights are particularly relevant for Mazandaran's rural communities, where youth out-migration and aging agricultural populations pose long-term development risks.

Moreover, the effectiveness of organic agriculture expansion depends on the design of sustainable supply chains that integrate economic, social, and environmental objectives. Recent modeling studies highlight the necessity of coherent supply chain architectures that coordinate production, processing, marketing, and distribution while maintaining environmental integrity and social inclusion (13, 18). Without such integrated frameworks, organic producers face persistent market vulnerabilities and limited bargaining power.

In addition, evolving governance contexts—including regulatory harmonization and legal frameworks—significantly shape agricultural sustainability trajectories. International experiences demonstrate that clear regulatory structures and supportive legal environments enhance farmers' confidence in sustainable investments and promote long-term sectoral resilience (5, 19). Complementary institutional reforms, such as green human resource management within agricultural organizations, further strengthen sustainable transitions by aligning organizational capacities with environmental objectives (20).

Collectively, these perspectives underscore that organic agriculture development is not solely a technological shift but rather a systemic transformation encompassing governance, markets, institutions, communities, and ecological processes. While previous studies have documented many individual barriers to organic farming, there remains a critical gap in comprehensive, context-specific analyses that integrate these dimensions into actionable commercial and policy strategies, particularly within rural regions of Iran such as Mazandaran.

Accordingly, there is a pressing need for empirically grounded research that examines the interrelated challenges of organic agriculture development at the rural level and formulates practical business-oriented solutions that can unlock this sector's full potential. Such research contributes not only to academic knowledge but also to policy formulation, rural development planning, and sustainable economic transformation.

Therefore, the aim of this study is to analyze the multidimensional challenges of organic agriculture development in the rural areas of Mazandaran Province and to propose integrated commercial strategies for fostering a sustainable and resilient organic farming ecosystem.

Methods and Materials

This study was conducted using a qualitative approach with the aim of elucidating the challenges of organic farming development in the rural areas of Mazandaran Province. The present research is exploratory–explanatory in nature, as it seeks to achieve an in-depth understanding and a multidimensional interpretation of complex barriers and challenges within a real and natural context (the rural communities of Mazandaran).

The principal research strategy employed was a multiple case study design. This strategy enabled the researcher to investigate the phenomenon under study (challenges of organic farming development) deeply across diverse rural contexts (such as crop-farming villages, livestock-based villages, and mixed-economy villages) while preserving descriptive richness and facilitating cross-case comparison and analysis.

Research Population: The study population comprised all stakeholders associated with organic farming in the rural areas of Mazandaran Province, including farmers (both organic and conventional), local officials (village heads and council members), agricultural extension experts, members of community-based organizations and rural cooperatives, and traders and marketers of agricultural products.

Sampling Method: Purposive sampling combined with the snowball technique was applied. Initially, with the assistance of agricultural extension experts at the provincial and county levels, key informants and leading farmers with experience in organic agriculture or related fields were identified. Subsequently, additional participants were recruited through referrals until theoretical saturation was achieved (i.e., when new data no longer generated novel concepts or insights). Sampling was conducted with maximum variation in terms of village type, gender, age, work experience, and stakeholder role, resulting in a total of 35 participants.

The primary data collection instrument was semi-structured interviews. An interview guide was developed based on a preliminary review of the literature and consultations with several subject-matter experts. Open-ended questions focused on participants' experiences, perceptions, attitudes, and recommendations regarding the barriers to organic farming development. Interviews were conducted at participants' workplaces or residences and, with informed consent, were audio-recorded. The duration of interviews ranged from 45 to 90 minutes.

Data analysis was conducted using thematic analysis following the approach proposed by Braun and Clarke (2006). To enhance qualitative rigor in terms of credibility and reliability, the following strategies were employed:

Member Checking: Summaries of the findings were returned to a subset of participants for verification and final confirmation.

Inter-Coder Agreement: A portion of the data was independently coded by another researcher, and the level of agreement was assessed.

Thick Description: Detailed contextual and participant descriptions were provided in the report.

Triangulation: Multiple data sources (farmers, officials, observations, documents) and multiple methods (interviews, observations) were utilized.

Findings and Results

Based on qualitative data collected through in-depth interviews, field observations, and document analysis, the challenges of organic farming development in the rural areas of Mazandaran were organized into five main themes and fifteen subthemes. These challenges interact in a complex manner, forming a “vicious cycle” whose resolution requires multi-level and systematic interventions.

Table 1. Main Themes and Subthemes Extracted from Qualitative Analysis

Main Theme	Code	Subtheme	Representative Codes (Selected from Interviews and Observations)
1. Technical–Agronomic Challenges	TEC	1.1 Insufficient knowledge and complex techniques	“It is like learning a new language”; “The manuals are theoretical and intangible”; “There is no local practical model.”
		1.2 Difficult pest and disease management	“Each leaf must be inspected individually”; “Plant-based pesticides act slowly”; “Every season there is stress about pest outbreaks.”
		1.3 Problematic transition period	“Two to three years of financial loss”; “No certification during the transition”; “Lower yields”; “No institutional support during this period.”
2. Economic–Market Challenges	ECO	2.1 High production costs	“The price of bio-fertilizer is five times higher”; “It requires more labor”; “Organic inputs are hard to obtain.”
		2.2 Lack of purchase guarantees and pricing mechanisms	“We do not have pre-sale contracts”; “Consumers do not recognize the difference”; “Products are sold at conventional market prices.”
		2.3 Weak support and insurance systems	“Subsidies are for chemical pesticides”; “Insurance does not cover organic losses”; “There is no compensation mechanism.”
3. Institutional–Governance Challenges	INS	3.1 Institutional misalignment and overlapping functions	“The agricultural office provides training, cooperatives offer loans, and each organization acts independently.”
		3.2 Complex and costly certification process	“Certification is for large companies”; “Bureaucracy is concentrated in Tehran”; “Inspection costs exceed annual income.”
		3.3 Fragmented regulations and weak enforcement	“Regulations are merely symbolic”; “They lack executive budgets”; “Guidelines exist without effective backing.”
4. Socio–Cultural Challenges	SOC	4.1 Resistance to change and risk aversion	“My father says our ancestors used these methods”; “If you fail, everyone mocks you”; “We are accustomed to chemical inputs.”
		4.2 Generational gap and lack of succession	“Young people migrate to cities”; “Older farmers lack the energy to change”; “No one is learning new techniques.”
		4.3 Low social trust and weak collective action	“Promises were made before and nothing happened”; “People do not trust each other”; “Cooperatives collapse due to mutual suspicion.”
5. Infrastructural–Ecological Challenges	INF	5.1 Fragmented landholdings and spatial dispersion	“Half a hectare here, half a hectare there”; “Integrated management is impossible”; “Certification is not economically viable.”
		5.2 Soil and water contamination	“Even groundwater contains high nitrate levels”; “The soil is exhausted”; “Chemical runoff comes from neighboring farms.”
		5.3 Weak supply chain and processing infrastructure	“We lack dedicated cold storage”; “Packaging is not feasible in villages”; “If leaves wilt, the product is no longer considered organic.”

Theme 1: Technical–Agronomic Challenges

This theme refers to barriers that are directly related to the production process.

1.1 Insufficient Knowledge and Complex Techniques

Nature of the challenge: A lack of indigenous and scientific knowledge regarding the principles of organic farming (such as specialized crop rotation, bio-fertilizers, and biological pest control) among the majority of farmers.

Representative quotation: A leading farmer from Esk village stated: “For us, who have been accustomed for generations to chemical fertilizers and pesticides, understanding how to maintain soil fertility using beneficial insects

or specific crop rotations is like learning a new language. The training manuals of the Agricultural Jihad Organization are also highly theoretical and intangible."

Consequence: Farmers revert to conventional chemical-based practices because they perceive them as "more reliable" and "less demanding."

1.2 Difficult Pest and Disease Management

Nature of the challenge: Under the humid climatic conditions of Mazandaran, which are conducive to pest outbreaks and fungal diseases, non-chemical methods (such as the use of ladybirds, pheromone traps, and plant-based pesticides) are costly, time-consuming, require high precision, and their effectiveness is difficult to guarantee.

Field observation: In an organic citrus orchard, a farmer demonstrated how each individual leaf must be inspected to identify pest eggs—an effort that, under conventional farming, would be resolved with a single pesticide application.

Consequence: The high risk of economic loss constitutes the main deterrent for smallholder farmers.

1.3 The Transition Period

Nature of the challenge: A two- to three-year period during which the land is being очищед from chemical residues while the product cannot yet be sold as organic and yields may decline. This period is economically unbearable for farmers who depend on annual income.

Representative quotation: A village head stated: "The farmer asks: should I endure two or three years of loss, and then will anyone guarantee that my product will be purchased at a higher price? Naturally, the answer is no."

Theme 2: Economic–Market Challenges

This theme addresses the core issue of "financial incentives" and "market access."

2.1 High Production Costs

Nature of the challenge: The cost of organic inputs (bio-fertilizers, natural pesticides, organic seeds or seedlings) is significantly higher than conventional chemical inputs. In addition, the need for manual weeding, specialized care, and related activities increases labor requirements.

Documentary confirmation: Input purchase invoices from agricultural suppliers indicate that the price of one liter of natural pesticide may reach up to five times the price of an equivalent chemical pesticide.

2.2 Lack of Guaranteed Purchase and Pricing Mechanisms

Nature of the challenge: The absence of pre-production purchase contracts with appropriate guaranteed prices. Farmers are compelled to sell their products in traditional markets, usually at conventional prices, because:

– an organic value chain has not yet been established;

– there is no recognized local brand or certification identity that would enable consumers to trust the product and pay a premium price.

Representative quotation from a local trader: "People in the local market either do not understand the difference between organic and conventional tomatoes or do not believe it. I cannot buy the product at a higher price and let it sit unsold. So I pay the prevailing market price."

2.3 Weak Support and Insurance Systems

Nature of the challenge: Subsidies are still largely allocated to chemical inputs. Agricultural insurance schemes either rarely accept pest-related losses in organic farming or do so at extremely high premium rates.

Statement by an agricultural extension expert: "We do not have a clear directive for compensating an organic farmer who loses the entire harvest, whereas for conventional losses there is a defined mechanism."

Theme 3: Institutional–Governance Challenges

This theme addresses the structural, regulatory, and governmental dimensions of organic agriculture development.

3.1 Institutional Misalignment and Overlapping Functions

Nature of the challenge: Fragmented and overlapping activities among the Agricultural Jihad Organization, the Environmental Protection Agency, rural cooperative unions, and the provincial governorate, without a strong and unified steering body. Each institution follows its own agenda.

Evidence from meeting records: In one village, the Agricultural Jihad Organization held training sessions on organic farming, while in the same month the rural cooperative provided preferential loans to members for purchasing chemical fertilizers.

3.2 Complex and Costly Certification Process

Nature of the challenge: The organic certification process conducted by authorized private companies is inaccessible to smallholder farmers. It involves inspection, laboratory testing, and administrative costs that exceed the financial capacity of individuals.

Representative quotation: “Certification? Do we own a factory? Should we pursue paperwork in Tehran? We ourselves know we farm organically, our neighbors know it too—that should be enough” (senior orchard owner).

3.3 Fragmented Regulations and Weak Enforcement

Nature of the challenge: The absence of a comprehensive and binding national law to support and promote organic farming with strong enforcement mechanisms. Existing guidelines are largely rhetorical and lack operational frameworks and dedicated budgets.

Theme 4: Socio–Cultural Challenges

This theme concerns the prevailing norms, beliefs, and social relations within rural communities.

4.1 Resistance to Change and Risk Aversion

Nature of the challenge: The conservative mindset of older farming generations, rooted in past experiences. Changing farming patterns implies breaking entrenched habits and social norms and entails fear of social judgment in the event of failure.

Representative quotation: “My father always says: our ancestors earned their living with these fertilizers and pesticides—do you know better than them? If your crop fails, everyone will laugh” (young farmer intending to change practices).

4.2 Generational Gap and Lack of Succession

Nature of the challenge: The migration of educated youth away from rural areas and agriculture, resulting in a decline in human capital interested in learning and implementing innovative practices such as organic farming. Agriculture is increasingly managed by elderly farmers with limited energy and motivation for change.

4.3 Low Social Trust and Weak Collective Action

Nature of the challenge: Historical distrust between farmers and institutions (due to unfulfilled promises), as well as among farmers themselves. This undermines the formation of strong community-based organizations (such as organic production and marketing cooperatives), which constitute the cornerstone of success in this system.

Field observation: A newly established organic cooperative was on the verge of dissolution due to disputes among members regarding shared certification costs and non-compliance with internal regulations.

Theme 5: Infrastructural–Ecological Challenges

This theme refers to the physical and environmental context of production.

5.1 Fragmented Landholdings and Spatial Dispersion

Nature of the challenge: Small and scattered land parcels (resulting from inheritance division) render integrated and economically viable organic management (such as buffer zone establishment, group input procurement, and certification inspections) either impossible or prohibitively expensive.

5.2 Soil and Water Contamination

Nature of the challenge: Contamination of lakes, rivers, and groundwater with nitrates and pesticides (stemming from conventional agriculture, wastewater discharge, and other sources), along with soil erosion and depletion of organic matter. Even when farmers intend to practice organic farming, the degraded quality of base resources prolongs and complicates the transition process.

5.3 Weak Supply Chain and Processing Infrastructure

Nature of the challenge: The absence of dedicated cold storage facilities, appropriate packaging, and small-scale local processing units for organic products. This deficiency increases post-harvest losses and eliminates opportunities for value addition within the villages.

In practice, these challenges form a self-reinforcing vicious cycle:

1. Farmers are reluctant to initiate organic farming due to technical challenges and high risk (Theme 1).
2. If they do begin, they encounter high costs and lack of guaranteed markets (Theme 2).
3. Institutions are unable to break this cycle because they themselves suffer from misalignment and weak legal frameworks (Theme 3).
4. A conservative and distrustful social environment further constrains collective change (Theme 4).
5. Ultimately, inadequate infrastructure limits the practical realization of an alternative system (Theme 5).

Therefore, the development of organic farming in the rural areas of Mazandaran represents a complex, multidimensional puzzle. One-dimensional solutions (such as technical training alone or subsidy provision alone) are destined to fail. What is required is a systemic and integrated strategy that simultaneously strengthens economic incentives (market development and support mechanisms), enhances social capacity (collective organization and trust), reinforces institutional frameworks (regulation and coordination), and advances infrastructural development, all centered on locally scaled successful models and genuine stakeholder participation. Only under such conditions can this vicious cycle be transformed into a virtuous cycle.

Discussion and Conclusion

The present study set out to analyze the multidimensional challenges of organic agriculture development in the rural areas of Mazandaran Province and to propose integrated commercial strategies for advancing this sector. The qualitative findings revealed five interrelated domains of constraints—technical–agronomic, economic–market, institutional–governance, socio–cultural, and infrastructural–ecological—which together form a self-reinforcing “vicious cycle” that systematically inhibits farmers’ willingness and ability to transition toward organic production. This pattern indicates that organic agriculture in Mazandaran is not constrained by isolated operational weaknesses but rather by a deeply embedded systemic configuration of risks, uncertainties, and institutional deficiencies.

At the technical–agronomic level, farmers reported inadequate knowledge of organic methods, the complexity of non-chemical pest and disease management, and the financial and psychological burden of the conversion period.

These results align strongly with previous empirical findings demonstrating that insufficient technical capacity and high production risk constitute primary barriers to organic adoption (7-9). Similar to farmers in northern Vietnam and various Iranian provinces, respondents in Mazandaran perceived organic farming as an unfamiliar and uncertain practice requiring specialized skills and continuous monitoring, especially under humid climatic conditions that intensify pest pressure (7, 11). The perceived fragility of organic systems during the two- to three-year conversion phase further discouraged participation, a phenomenon extensively documented in international studies where yield reduction and delayed certification erode farmers' economic resilience (5, 6).

Economic–market challenges emerged as the most decisive determinant of farmer behavior. High costs of organic inputs, the absence of guaranteed purchase contracts, weak insurance systems, and limited consumer recognition created a commercial environment in which organic production was perceived as economically irrational. These findings reinforce global evidence that market insecurity and weak price incentives represent the dominant obstacles to organic expansion, particularly among smallholder farmers (7, 12). The inability of local markets in Mazandaran to differentiate organic products mirrors observations in Thailand and Mexico, where insufficient branding and consumer awareness undermined farmers' capacity to capture organic price premiums (6, 12). Moreover, the lack of effective agricultural insurance coverage for organic risks replicates structural failures identified in Iran's agricultural policy environment, where subsidy mechanisms remain disproportionately oriented toward conventional chemical inputs (10, 16).

Institutional–governance deficiencies further compounded these economic vulnerabilities. Participants described fragmented responsibilities across public agencies, overlapping programs, and contradictory incentives, such as simultaneous promotion of organic training and subsidization of chemical fertilizers. This institutional incoherence reflects broader governance challenges documented in both national and international contexts, where weak coordination, ambiguous regulatory frameworks, and costly certification processes discourage farmer participation in organic systems (5, 19). The inaccessibility of certification for smallholders in Mazandaran parallels patterns observed in China, Brazil, and Mexico, where certification costs and bureaucratic complexity systematically exclude resource-constrained farmers from formal organic markets (5, 6). Such governance failures ultimately undermine policy credibility and farmer trust.

The socio–cultural dimension further deepened the structural rigidity of the system. Resistance to change, generational gaps, erosion of social trust, and the collapse of collective action mechanisms weakened the social infrastructure necessary for organic agriculture to flourish. These dynamics are consistent with findings from Iranian and international research highlighting that cultural conservatism, risk aversion, and distrust significantly slow agricultural innovation diffusion (7-9). Without cohesive farmer organizations, the collective benefits of organic systems—such as group certification, cooperative marketing, and shared risk management—remain unattainable. The resulting fragmentation exacerbates farmers' vulnerability to market shocks and reinforces dependence on conventional production pathways.

Infrastructural–ecological constraints represented the final structural barrier within this interlocking system. Fragmented landholdings, contamination of soil and water resources, absence of specialized storage and processing facilities, and weak supply chain integration collectively restricted the feasibility of organic expansion. These findings echo sustainability research demonstrating that ecological degradation and infrastructural underdevelopment systematically obstruct transitions toward environmentally friendly production models (1, 2).

Without investment in rural infrastructure and environmental rehabilitation, organic agriculture remains operationally constrained regardless of farmer motivation or policy intent.

The integration of these five domains produces a self-reinforcing vicious cycle: technical risk deters adoption; economic losses confirm reluctance; institutional weakness prevents corrective intervention; socio-cultural inertia inhibits collective mobilization; and infrastructural deficits restrict implementation. This systemic configuration supports recent theoretical models of sustainable agriculture which argue that agricultural transformation requires coordinated governance, resilient supply chains, social empowerment, and market integration (13, 14). The findings further validate sustainable supply chain frameworks emphasizing that economic, social, and environmental objectives must be pursued simultaneously through integrated institutional design (18).

The commercial strategies proposed in this study—namely the creation of a unified organic business ecosystem, financial guarantee institutions, facilitative organizations, provincial branding, and commercial clusters—directly respond to this systemic diagnosis. Such mechanisms mirror successful international experiences where structured value chains, cooperative governance, and youth-inclusive business models revitalized rural economies and strengthened sustainability outcomes (14, 17). By reducing producer risk, enhancing market transparency, and fostering stakeholder collaboration, these strategies offer a realistic pathway for converting Mazandaran's organic sector from stagnation to growth.

This study relied on qualitative data collected from a specific regional context, which may limit the generalizability of the findings to other provinces or agricultural systems. Additionally, the research focused primarily on stakeholder perceptions rather than quantitative production and market performance indicators. Time constraints and access limitations restricted longitudinal observation of organic transitions, preventing assessment of long-term economic and environmental outcomes.

Future studies should incorporate mixed-method designs combining qualitative insights with quantitative performance metrics, including yield dynamics, income trajectories, and ecological indicators. Comparative studies across multiple provinces and international regions would deepen understanding of contextual influences. Longitudinal research tracking farmers throughout the organic conversion process is also recommended to capture adaptive learning and policy effects over time.

Policymakers should establish integrated governance platforms that align financial incentives, certification systems, infrastructure investment, and market development. Rural development agencies must strengthen cooperative institutions and trust-building mechanisms among farmers. Targeted investments in organic supply chains, branding, and youth entrepreneurship programs are essential for long-term sustainability and competitiveness of the organic agriculture sector.

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Authors' Contributions

All authors equally contributed to this study.

Declaration of Interest

The authors of this article declared no conflict of interest.

Ethical Considerations

All ethical principles were adheried in conducting and writing this article.

Transparency of Data

In accordance with the principles of transparency and open research, we declare that all data and materials used in this study are available upon request.

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