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Presenting a Model for Formulating Sustainable Agricultural Development Policies (A Case Study of the Greenhouse Cultivation Industry in Hamedan Province)

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A B S T R A C T

Sustainable agricultural development, given the scarcity of water resources in the country, is one of the most important issues in water and agricultural management and requires the formulation of prudent strategies and policies. This study was conducted with the aim of presenting a model for formulating sustainable agricultural development policies (a case study of the greenhouse cultivation industry in Hamedan Province). In terms of purpose, the present research is applied; in terms of data collection, it is descriptive–exploratory; with respect to the logic of inference, it follows an inductive–deductive research approach; and in terms of nature, it is qualitative. In estimating the size of the first statistical population (the academic community), through examination and review of the Planning Deputy of the Agricultural Jihad Organization, the Agricultural Research Center, and university systems, a list of faculty members who collaborated with the greenhouse cultivation industry was used for data collection, and themes were identified and refined through thematic analysis. The primary data collection instrument in this research was interviews. To enhance accuracy, the coding process and aggregation of themes were supported using MAXQDA software, and through repeated reviews, overlaps were reduced and thematic boundaries were clearly delineated. The findings indicated that 86 themes were extracted from the interviews, which were categorized into five levels and nine main components, including the role of exploitation, geographical factors, government policymaking, influential internal and external environmental factors, economic factors, cultural factors, social factors, and technical factors.

Keywords: *Policy, sustainable development, agriculture, greenhouse cultivation industry of Hamedan Province.*

1. Introduction

Agriculture remains one of the most strategic sectors in national development due to its direct role in food security, employment creation, poverty reduction, and environmental stewardship. In many developing and semi-arid countries, including Iran, the agricultural sector is under increasing pressure from climate change, water scarcity, land degradation, population growth, and market volatility. These pressures have intensified the need for a shift from conventional production-oriented approaches toward sustainable agricultural development frameworks that balance economic viability, social equity, and environmental protection. Sustainable agricultural development is no longer viewed merely as a technical or production issue, but rather as a complex policy challenge that requires integrated public policy design, multi-level governance, and coordinated action among diverse stakeholders (Farahani-Fard, 2012; Lozano, 2008; Vahdati & Sarikhani, 2020). As a result, policy formulation has become a central mechanism through which governments seek to guide agricultural systems toward sustainability outcomes.

From a public policy perspective, agricultural sustainability is deeply embedded in the broader policy cycle, encompassing problem identification, agenda-setting, policy formulation, implementation, and evaluation. Scholars of public policy emphasize that the effectiveness of policies depends not only on their technical soundness, but also on institutional capacity, stakeholder participation, and contextual compatibility with social, economic, and environmental conditions (Danai-Fard et al., 2016; Dunn, 2018; Howlett et al., 2020). In the agricultural sector, these considerations are even more critical due to the sector's sensitivity to ecological variability and its strong interdependence with rural livelihoods. Consequently, sustainable agricultural development policies must be designed as adaptive, evidence-based, and context-specific instruments rather than as uniform, top-down interventions.

At the global level, international organizations and development institutions have increasingly emphasized sustainable agriculture as a cornerstone of long-term development strategies. The Food and Agriculture Organization has highlighted that climate change, water scarcity, and ecosystem degradation pose existential threats to agricultural productivity and food security, particularly in regions with fragile natural resource bases (Fao, 2016). These global challenges have prompted governments to adopt sustainability-oriented policies that integrate climate adaptation, efficient resource use, and resilience-building mechanisms. However, translating these global frameworks into effective national and subnational policies remains a major challenge, especially in countries where agricultural systems are characterized by structural constraints, fragmented governance, and limited access to technology and capital (Momeni & Dashtbani, 2017; Pourasghr Sangachin, 2015).

In Iran, sustainable agricultural development has gained prominence in policy discourse due to persistent environmental constraints and socio-economic pressures. Chronic water scarcity, declining groundwater levels, soil salinization, and climate variability have significantly undermined agricultural productivity and rural sustainability. At the same time, the agricultural sector continues to play a vital role in employment and regional development, particularly in less-developed provinces. Studies reviewing the trajectory of sustainable agriculture in Iran indicate that while policy awareness has increased, implementation gaps remain substantial due to weak coordination, insufficient stakeholder engagement, and misalignment between national policies and local realities (Momeni & Dashtbani, 2017; Vahdati & Sarikhani, 2020). These challenges underscore the importance of revisiting policy formulation processes and developing integrated models that can better reflect the multidimensional nature of sustainability.

The concept of sustainability itself has evolved from a primarily environmental concern to a multidimensional framework encompassing economic, social, and ecological dimensions. The triple-bottom-line approach highlights that sustainable development can only be achieved when economic growth, social well-being, and environmental protection are pursued simultaneously and in a balanced manner (Lozano, 2008). In agriculture, this translates into policies that not only enhance productivity and profitability but also promote social justice, equitable access to resources, rural employment, and ecosystem conservation. Economic development theories further emphasize that long-term growth is contingent upon efficient resource allocation, institutional stability, and human capital development, all of which are highly relevant to agricultural policy design (Azimi, 2014).

Recent international research has expanded the scope of sustainable agricultural policy by incorporating supply chain governance, technological innovation, and collaborative models. Studies on sustainable agricultural supply chains demonstrate that coordination among producers, processors,

distributors, and regulators is essential for achieving sustainability outcomes across production and market systems (Cao & Tao, 2025; Pour Samani et al., 2024). Similarly, research on green logistics, digital supply chains, and resilience highlights the growing importance of innovation-driven policies that support efficiency, transparency, and adaptability in agricultural systems (Mugoni et al., 2023; Ven, 2024; Wang, 2023). These findings suggest that sustainable agricultural policies must extend beyond farm-level interventions and address broader systemic interactions.

Technological advancement has also emerged as a critical enabler of sustainable agriculture. The integration of precision agriculture, data-driven decision-making, biotechnology, and optimization algorithms has opened new opportunities for improving resource efficiency and reducing environmental impacts. Empirical studies show that the application of advanced technologies such as genetic algorithms, digital monitoring systems, and climate-smart practices can significantly enhance the sustainability of agricultural systems when supported by appropriate policy frameworks (Pádua, 2024; Rao et al., 2024; Wang et al., 2025). However, the diffusion of such technologies is highly dependent on institutional support, access to finance, and the capacity of farmers and organizations to adopt and manage innovation.

Human and social dimensions are equally central to sustainable agricultural development. Policies that neglect farmers' knowledge, attitudes, and socio-cultural contexts often fail to achieve desired outcomes. Research on land-use change, farmer behavior, and rural transformation demonstrates that local values, risk perceptions, and livelihood strategies strongly influence responses to policy interventions (Yazdanpanah et al., 2025). Moreover, youth employment, entrepreneurship, and skill development have become pressing policy concerns as rural economies face aging populations and labor shortages. Sustainable agriculture policies that incorporate inclusive business models and support youth engagement can contribute to both social sustainability and economic resilience (Kansiime et al., 2025).

Governance and legal frameworks further shape the effectiveness of sustainable agricultural policies. Comparative studies indicate that clear regulatory structures, legal certainty, and alignment with international standards are essential for promoting sustainability, particularly in contexts of economic integration and cross-border trade (Huang et al., 2023; Zghara, 2024). At the organizational level, green human resource management and institutional capacity-building have been identified as key drivers of sustainable performance in agricultural and natural resource organizations (Zarei & Izadi, 2024). These insights reinforce the argument that sustainable agriculture is not solely a technical challenge but a governance and policy design issue.

Despite the growing body of international and national research, there remains a need for context-specific policy models that integrate environmental, economic, social, technical, and institutional dimensions into a coherent framework. In particular, subnational agricultural systems with unique ecological and socio-economic characteristics require tailored policy approaches rather than generic solutions. Existing studies in Iran and comparable regions often address individual dimensions of sustainability in isolation, while comprehensive models for policy formulation remain limited (Farahani-Fard, 2012; Pourasghr Sangachin, 2015; Vahdati & Sarikhani, 2020). This gap highlights the importance of developing integrative models that can inform policymakers and practitioners in designing effective and sustainable agricultural policies.

Given these considerations, there is a clear need to systematically examine the factors influencing sustainable agricultural development policy formulation and to organize them into an empirically grounded and theoretically informed model. Such a model can enhance policy coherence, improve implementation effectiveness, and support long-term sustainability outcomes at regional and national levels by aligning environmental constraints, economic incentives, social dynamics, technological capacities, and governance structures. Therefore, the aim of this study is to develop and present an integrated model for formulating sustainable agricultural development policies by identifying and structuring the key environmental, economic, social, technical, and institutional factors influencing policy effectiveness.

2. Methods and Materials

This study was conducted using a survey method, and the data collection instrument was a semi-in-depth structured interview, accompanied by open-ended questions to obtain textual evidence from experts and stakeholders. In terms of functional orientation, this research is applied–developmental. With respect to the logic of inference, the research approach is inductive–deductive. Responses to the interview questions were coded and themes were extracted

using thematic analysis based on the approach proposed by Braun and Clarke (2006). The size of the first statistical population (the academic community) was determined through examination and review of the Planning Deputy of the Agricultural Jihad Organization, the Agricultural Research Center, and university systems, resulting in a list of faculty members who collaborate with the greenhouse cultivation industry. In the first phase, through a systematic review of the literature, documents, and relevant studies, the initial dimensions and indicators affecting public policies supporting sustainable agricultural development in greenhouse cultivation in Hamedan Province were identified. During this process, data reduction and data display were performed, and a network of initial themes was obtained as the output of the qualitative phase. The thematic analysis software used in this study was MAXQDA.

3. Findings and Results

In this study, the Attride–Stirling thematic network method was used to identify themes, encompassing three levels: "basic themes," "organizing themes," and "global themes."

First, through careful rereading of interview transcripts and field notes, each significant concept was labeled (open coding) in order to structure the raw data.

Next, these codes were grouped at the "basic" level and, based on conceptual similarities, were transformed into more coherent categories referred to as "organizing themes."

Finally, by integrating the organizing themes, several overarching and fundamental themes were formed, which were identified as "global themes" and represented the final framework explaining the factors influencing the effective implementation of sustainable agricultural development policies in greenhouse cultivation in Hamedan Province.

Table 1

Basic Themes

Basic Themes	Participant Code
Operators' mindset	1PA, 2PA, 3PA, 4PA, 5PA
Financial capacity of operators	3PA, 4PA, 5PA
Operators' training and awareness	2PA, 3PA, 4PA, 5PA, 6PA
Educational level of operators	7PA, 8PA, 9PA, 10PA
Operators' interest in agricultural activities	12PA, 13PA, 14PA, 15PA
Operators' interest in investing in greenhouse products	13PA, 14PA, 15PA, 16PA
Motivation to provide services	1PA, 2PA, 3PA, 4PA
Existence of indigenous local culture	5PA, 6PA
Traditional mindset in agricultural practices	19PA, 20PA
Traditional agricultural culture	11PA, 12PA, 13PA, 14PA
Attention to cultural values	2PA, 3PA, 4PA
Recognition of diverse cultures	5PA, 6PA, 7PA, 8PA
Recognition of societal differences	12PA, 13PA
Presence of social tensions in the region	19PA, 20PA
Existence of regional conflicts	7PA, 8PA
Political tensions	20PA
Level of social participation	1PA, 2PA, 30PA
Organization of social conditions	5PA
Public trust in greenhouse products	1PA, 2PA, 3PA
Public participation	18PA, 19PA
Attention to human rights	4PA
Equal conditions	18PA, 19PA, 20PA
Equitable use of natural resources	7PA, 8PA
Information on solar radiation conditions	17PA, 18PA
Information on radiation conditions during different months	4PA, 5PA, 6PA
Rainfall information	1PA
Information on wet and drought periods	3PA, 4PA, 5PA
Wind intensity information	18PA, 19PA
Frost timing information	13PA, 14PA, 15PA, 16PA, 17PA
Climatic changes at greenhouse site	13PA, 14PA
Attention to induced climate changes	5PA, 6PA, 7PA, 8PA, 9PA, 10PA, 11PA, 12PA
Temperature tolerance and variations	10PA, 11PA
Water resource limitations at greenhouse site	1PA

Soil resource limitations at greenhouse site	10PA, 11PA, 12PA
Environmental changes	14PA, 15PA
Environmental information of greenhouse site	3PA, 4PA, 5PA, 6PA, 7PA, 8PA
Land purchase cost at greenhouse site	4PA, 5PA, 6PA
Geographical location of greenhouse site	17PA, 18PA
Accessibility of greenhouse site	9PA, 10PA
Use of experts in technology implementation	7PA, 8PA, 9PA, 10PA, 15PA, 16PA
Training in the use of new technologies	17PA, 18PA, 19PA
Selection of greenhouse technical manager	1PA
Training and development of skilled labor	10PA, 11PA, 12PA
Technology implementation by technical personnel	13PA, 14PA
Enhancing farmers' technical knowledge	3PA
Use of up-to-date technology	1PA, 2PA, 3PA, 4PA, 5PA, 6PA, 7PA, 8PA
Purchase of new equipment	4PA
Provision of QR codes for products	18PA, 19PA, 20PA
Monopoly orientation in greenhouse production	17PA
Alignment of government with greenhouse cultivation development	17PA, 18PA, 19PA
Alignment of government policies with greenhouse cultivation development	15PA, 20PA
Provision of facilities to farmers	13PA
Subsidies for agricultural inputs	10PA, 11PA, 12PA
Creating appropriate infrastructure for export of greenhouse products	3PA
Establishment of supportive regulations	9PA, 10PA, 11PA, 12PA, 13PA, 14PA
Allocation of low-interest loans	4PA
Alignment of provincial resources and facilities	8PA, 9PA, 10PA
Support of provincial authorities for investors	15PA, 16PA, 17PA, 18PA, 19PA, 20PA
Issuance of required permits for greenhouse establishment	8PA, 9PA
Alignment of provincial policymakers with greenhouse production	1PA
Support of provincial authorities for greenhouse agricultural development	14PA
Issuance of operational permits in the province	11PA, 12PA
Prices of greenhouse products	13PA, 14PA, 15PA
Price fluctuations of pesticides and pests	12PA
Exchange rate volatility in export products	1PA
Establishment of greenhouse growers' union	17PA, 18PA, 19PA, 20PA
Institutional and ownership changes	19PA
Regulatory changes	5PA, 6PA
Unforeseen events	11PA, 12PA
Greenhouse management	4PA, 5PA, 6PA
Optimal resource management	9PA
Determination of appropriate cultivation schedules	20PA
Raising public awareness about greenhouse products	18PA
Attention to public health	1PA
Environmental education	1PA, 2PA, 3PA, 4PA, 5PA
Prevention of water pollution	18PA, 19PA, 20PA
Prevention of environmental degradation	19PA, 20PA
Improvement of farmers' economic conditions	8PA, 9PA, 10PA
Improvement of regional economic conditions	11PA, 12PA
Cost-effectiveness of greenhouse products	1PA
Employment of university graduates	14PA, 15PA, 16PA, 17PA
Reduction of regional unemployment rate	18PA, 19PA, 20PA
Employment in other sectors related to greenhouse products	14PA, 15PA
Creating appropriate infrastructure for export of greenhouse products	1PA
Establishing relations with other countries	17PA, 18PA, 19PA, 20PA
Foreign exchange earnings for the country	20PA

After consolidating the theoretical foundations and expert opinions, repetitive responses were removed across the four stages of thematic analysis.

Table 2 presents the global themes, from which it can be inferred which final variables may be extracted, and in the subsequent stage, the global themes—representing the main themes of the study—were finalized.

Table 2

Identification of Global Themes and Dimensions of Sustainable Agricultural Development Policies

Row	Global Themes
1	Role of operators
2	Cultural factors
3	Social factors
4	Geographical factors
5	Technical factors
6	Government policy
7	External environmental influencing factors
8	Internal environmental influencing factors
9	Economic factors

After completing the second stage, the study proceeded to the third stage, namely the identification of global themes, and these themes were extracted.

Table 3

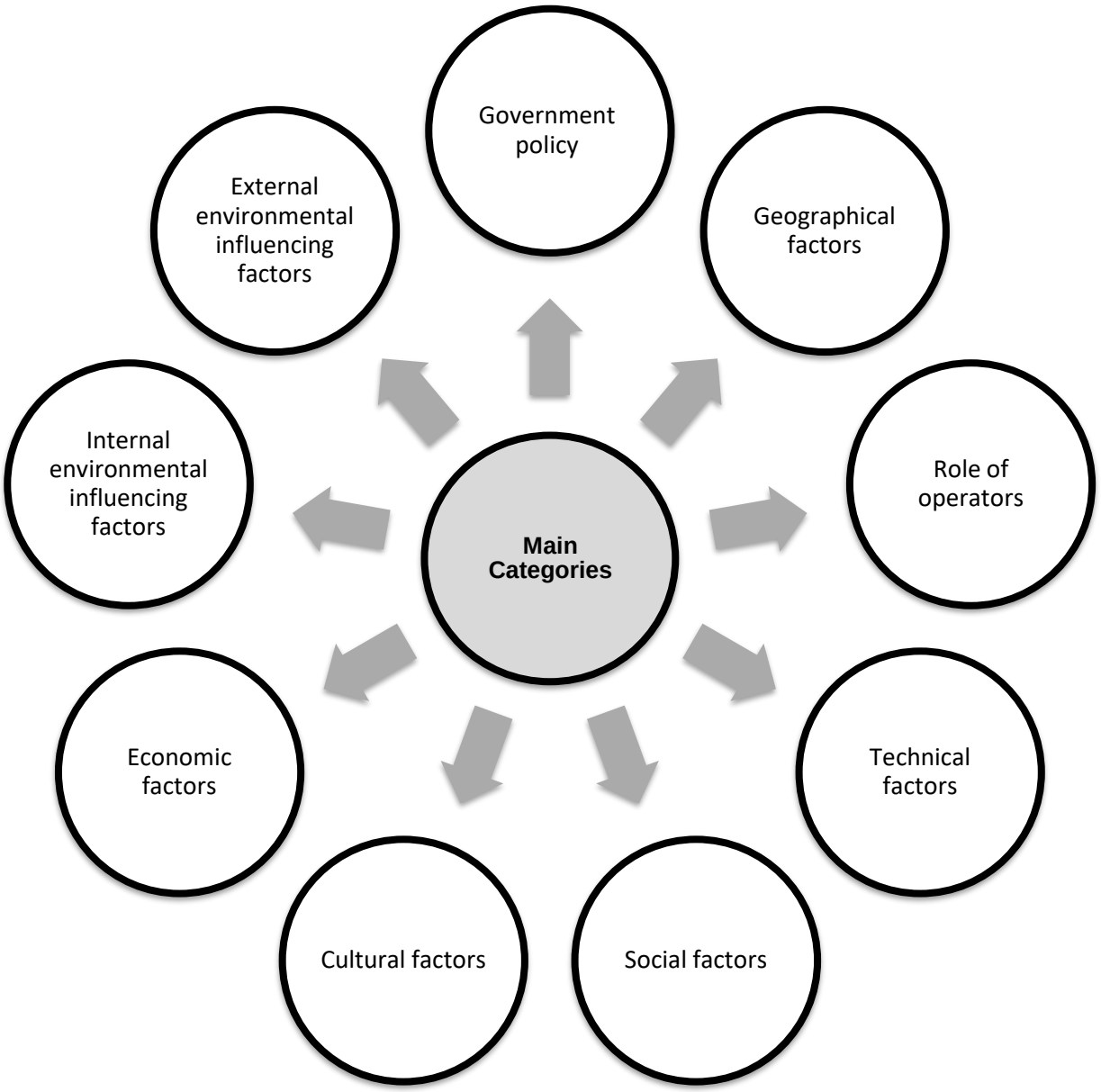
Identification of Global Themes and Dimensions of Sustainable Agricultural Development Policies

Basic Themes	Organizing Themes	Global Themes
Operators' mindset	Raising operators' awareness	Role of operators
Financial capacity of operators		
Operators' training and awareness		
Educational level of operators		
Operators' interest in agricultural activities	Operators' interest	
Operators' interest in investing in greenhouse products		
Motivation to provide services		
Existence of indigenous local culture	Indigenous culture	Cultural factors
Traditional mindset in agricultural practices		
Traditional agricultural culture		
Attention to cultural values		
Recognition of diverse cultures	Cultural differences	
Recognition of societal differences		
Presence of social tensions in the region	Social tensions	Social factors
Existence of regional conflicts		
Political tensions		
Level of social participation	Social participation	
Organization of social conditions		
Public trust in greenhouse products		
Public participation		
Attention to human rights	Social justice	
Equal conditions		
Equitable use of natural resources		
Information on solar radiation conditions	Meteorological information	Geographical factors
Information on radiation conditions in different months of the year		
Rainfall information		
Information on wet and drought periods		
Wind intensity information		
Frost timing information		
Climatic changes at the greenhouse site	Climate change	
Attention to induced climate changes		
Temperature tolerance and variations		
Water resource limitations at the greenhouse site		
Soil resource limitations at the greenhouse site		

Environmental changes		
Environmental information of the greenhouse site	Environmental information	
Land purchase cost at the greenhouse site		
Geographical location of the greenhouse site		
Accessibility of the greenhouse site		
Use of experts in technology implementation	Use of technical personnel	Technical factors
Training in the use of new technologies		
Selection of greenhouse technical manager		
Training and development of skilled labor		
Technology implementation by technical personnel		
Enhancing farmers' technical knowledge		
Use of up-to-date technology	Use of advanced technology	
Purchase of new equipment		
Provision of QR codes for products		
Monopoly orientation in greenhouse production	Government policies	Government policy
Alignment of government with greenhouse cultivation development		
Alignment of government policies with greenhouse cultivation development		
Provision of facilities to farmers		
Subsidies for agricultural inputs		
Creating appropriate infrastructure for export of greenhouse products		
Establishment of supportive regulations		
Allocation of low-interest loans		
Alignment of provincial resources and facilities	Provincial policies	
Support of provincial authorities for investors		
Issuance of required permits for greenhouse establishment		
Alignment of provincial policymakers with greenhouse production		
Support of provincial authorities for greenhouse agricultural development		
Issuance of operational permits in the province		
Prices of greenhouse products	Prices	External environmental influencing factors
Price fluctuations of pesticides and pests		
Exchange rate volatility in export products		
Establishment of greenhouse growers' union	Organizations	Internal environmental influencing factors
Institutional and ownership changes		
Regulatory changes		
Unforeseen events		
Greenhouse management	Managerial factors	
Optimal resource management		
Determination of appropriate cultivation schedules		
Raising public awareness about greenhouse products	Environmental issues	
Attention to public health		
Environmental education		
Prevention of water pollution		
Prevention of environmental degradation		
Improvement of farmers' economic conditions	Increasing farmers' financial capacity	Economic factors
Improvement of regional economic conditions		
Cost-effectiveness of greenhouse products		
Employment of university graduates	Employment of local workforce	
Reduction of regional unemployment rate		
Employment in other sectors related to greenhouse products		
Creating appropriate infrastructure for export of greenhouse products	Increasing exchanges with neighboring countries	
Establishing relations with other countries		
Foreign exchange earnings for the country		

Figure 1

Thematic Network Mapping



The proposed policy model begins with environmental and contextual factors; that is, the geographical and climatic conditions of Hamedan Province, such as weather patterns, water and soil resources, and climate change, as well as external economic conditions such as fluctuations in input prices and markets, and finally the cultural and social context, including norms, public trust, and the level of participation. These factors determine the main capacities and constraints of any policy and therefore constitute the foundation of the model. On top of this layer lies the institutional framework and national and provincial macro-level policies, including laws, regulations, licensing, subsidies, financial facilities, and coordination among responsible institutions. This layer determines the direction of action and provides the necessary resources and rules for subsequent layers.

The third layer is dedicated to internal factors of the greenhouse system; that is, issues occurring within the production chain, such as the structure and performance of associations and unions, greenhouse management practices, the skill and knowledge level of human resources, and access to modern technologies (ranging from technical managers and implementation teams to the use of modern irrigation systems, pest control, and local climatic data collection).

This section serves as the intermediary link between policy and practice and can strengthen or weaken implementation capacity.

Above these three layers are the set of operational policies that are directly implementable. These measures include training and empowering operators, employing specialists and technical managers alongside investors, collecting and updating climatic and market data, and simultaneously considering market needs, local cultural criteria, and public health. This section constitutes the practical dimension of the model and is designed to align with on-the-ground realities.

At the highest layer are the policy outcomes, which represent the main objectives of the study, including improving income and economic resilience of operators and the region, increasing entrepreneurship and local employment, enhancing food security, achieving social justice in access to opportunities and resources, safeguarding public health, and ensuring environmental sustainability through the protection of water, soil, and biodiversity. In this regard, targeted and continuous training, the deployment of technical managers and implementation teams alongside investors, and the establishment of a local data collection system are considered three key pillars of policy implementation. Moreover, institutional coordination, transparency in licensing, and stable supportive regulations are essential prerequisites for success in training and technology adoption. At all stages, attention to public health, adherence to local cultural norms, and responsiveness to market needs must be considered simultaneously to ensure both economic sustainability and social acceptance.

4. Discussion and Conclusion

The findings of this study provide a multidimensional and integrated understanding of sustainable agricultural development policy formulation by identifying nine interrelated global themes, including the role of operators, geographical factors, technical factors, social factors, cultural factors, economic factors, government policy, internal environmental factors, and external environmental factors. These results confirm that sustainable agricultural development cannot be effectively addressed through single-dimensional or sectoral policies, but rather requires a comprehensive policy framework that reflects the complex interactions between environmental conditions, governance structures, economic incentives, and human and social dynamics. This multidimensional perspective is consistent with sustainability theory, which emphasizes the simultaneous consideration of economic, social, and environmental dimensions in development planning (Farahani-Fard, 2012; Lozano, 2008).

One of the central findings of this study is the pivotal role of operators in the success of sustainable agricultural policies. The results indicate that operators' awareness, education, financial capacity, motivation, and willingness to invest in greenhouse agriculture significantly shape policy effectiveness. This finding aligns with previous research emphasizing that farmers are not passive recipients of policy interventions but active agents whose perceptions, skills, and resources determine policy outcomes (Momeni & Dashtbani, 2017; Yazdanpanah et al., 2025). Studies on agricultural sustainability in Iran and other developing contexts have similarly shown that insufficient training, limited access to capital, and weak incentives often undermine the implementation of sustainability-oriented policies (Pourasghr Sangachin, 2015; Vahdati & Sarikhani, 2020). Therefore, policies that prioritize capacity-building, education, and financial empowerment of operators are more likely to achieve long-term sustainability.

Geographical and environmental factors emerged as another foundational dimension of the proposed policy model. The findings highlight the importance of climatic conditions, water and soil resource availability, rainfall patterns, frost risk, and climate variability in shaping the feasibility and design of sustainable agricultural policies. This result is strongly supported by global evidence indicating that climate change and natural resource constraints are among the most significant challenges facing agricultural systems worldwide (Fao, 2016). Research has demonstrated that policies which fail to account for local ecological conditions often lead to inefficient resource use and unintended environmental consequences (Pádua, 2024; Rao et al., 2024). In line with these studies, the present findings underscore the necessity of place-based policy design that integrates localized environmental data into decision-making processes.

Technical factors, including access to modern technologies, skilled human resources, and effective greenhouse management practices, were identified as key enablers of sustainable agricultural development. The results indicate that the use of up-to-date technologies, employment of technical managers, training of skilled labor, and adoption of modern irrigation and climate monitoring systems enhance policy implementation capacity. These findings are consistent with prior research demonstrating that technological innovation plays a critical role in improving

resource efficiency, productivity, and environmental performance in agriculture (Wang et al., 2025; Wang, 2023). Moreover, studies on green logistics and sustainable supply chains emphasize that technological capabilities must be supported by appropriate institutional and policy frameworks to generate sustainable competitive advantages (Mugoni et al., 2023; Ven, 2024). The alignment between the present results and existing literature reinforces the argument that technology-oriented policies should be integrated with governance and capacity-building measures.

The social and cultural dimensions identified in this study further highlight the importance of social cohesion, public trust, cultural values, and participation in sustainable agricultural policy implementation. The findings suggest that social tensions, cultural norms, and levels of public participation significantly influence policy acceptance and effectiveness. This is consistent with public policy literature, which emphasizes that stakeholder participation and social legitimacy are essential for successful policy implementation (Dunn, 2018; Howlett et al., 2020). In agricultural contexts, neglecting local cultural practices and social structures has been shown to result in resistance and low compliance with sustainability initiatives (Danai-Fard et al., 2016; Yazdanpanah et al., 2025). Therefore, incorporating cultural sensitivity and participatory mechanisms into policy design is critical for achieving both social acceptance and long-term sustainability.

Economic factors also play a decisive role in shaping sustainable agricultural development policies. The results reveal that product pricing, cost-effectiveness, access to markets, export opportunities, employment generation, and regional economic development are closely linked to policy success. These findings align with economic development theories that emphasize the role of incentives, market stability, and income generation in sustaining productive sectors (Azimi, 2014). Empirical studies on sustainable supply chains further demonstrate that economic viability is a prerequisite for maintaining social and environmental commitments in agriculture (Cao & Tao, 2025; Pour Samani et al., 2024). In this regard, the study confirms that sustainability-oriented policies must be economically attractive to operators and investors to ensure their continuity and scalability.

Government policy and institutional support emerged as one of the most influential dimensions in the proposed model. The findings indicate that alignment between national and provincial policies, supportive regulations, subsidies, low-interest loans, licensing transparency, and inter-organizational coordination are essential for effective policy implementation. This result is consistent with public policy and governance literature, which stresses that coherent policy frameworks and institutional capacity are critical determinants of policy performance (Danai-Fard et al., 2016; Howlett et al., 2020). Comparative studies also show that legal clarity and policy consistency enhance investor confidence and facilitate the adoption of sustainable practices in agriculture (Huang et al., 2023; Zghara, 2024). Thus, the present findings reinforce the need for integrated and stable policy environments to support sustainable agricultural transitions.

The distinction between internal and external environmental influencing factors provides additional explanatory power to the proposed model. Internal factors such as organizational structures, management practices, and institutional changes affect the operational capacity of the agricultural system, while external factors such as market volatility, exchange rate fluctuations, and price instability shape the broader context in which policies are implemented. These results are in line with systems-based approaches to sustainability, which emphasize the interaction between internal organizational dynamics and external environmental pressures (Lozano, 2008; Rao et al., 2024). Previous studies on agricultural resilience similarly indicate that policies must address both internal governance mechanisms and external economic risks to enhance system adaptability (Cao & Tao, 2025; Wang, 2023).

Overall, the findings of this study contribute to the literature by offering an empirically grounded and integrative policy model that reflects the complexity of sustainable agricultural development. Unlike fragmented approaches that focus on isolated dimensions, the proposed model demonstrates how environmental, economic, social, technical, and institutional factors interact to shape policy outcomes. This integrative perspective is consistent with recent calls in the literature for holistic and adaptive policy frameworks capable of addressing the multifaceted challenges facing modern agricultural systems (Golmohammadi et al., 2023; Vahdati & Sarikhani, 2020). By aligning with and extending previous research, the study provides a comprehensive foundation for improving policy formulation and implementation in sustainable agriculture.

Despite its contributions, this study has several limitations that should be acknowledged. First, the research was conducted within a specific regional and sectoral context, which may limit the generalizability of the findings to other agricultural systems or geographic regions. Second,

the qualitative nature of the study, while valuable for in-depth understanding, does not allow for statistical testing of relationships among the identified factors. Third, the study relies on expert and stakeholder perceptions, which may be influenced by subjective judgments and contextual biases.

Future research could build on the findings of this study by quantitatively testing the proposed policy model using structural equation modeling or other multivariate techniques. Comparative studies across different regions or agricultural subsectors could further enhance the external validity of the model. Additionally, longitudinal research examining policy implementation outcomes over time would provide deeper insights into the dynamic interactions among policy factors and sustainability outcomes.

From a practical perspective, policymakers and practitioners should prioritize integrated policy design that simultaneously addresses environmental constraints, economic incentives, social dynamics, and technical capacities. Capacity-building programs for operators, transparent and stable regulatory frameworks, and investments in data-driven technologies should be implemented in a coordinated manner. Moreover, fostering stakeholder participation and aligning national and provincial policies can significantly enhance the effectiveness and legitimacy of sustainable agricultural development initiatives.

Authors' Contributions

Authors contributed equally to this article.

Declaration

In order to correct and improve the academic writing of our paper, we have used the language model ChatGPT.

Transparency Statement

Data are available for research purposes upon reasonable request to the corresponding author.

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Declaration of Interest

The authors report no conflict of interest.

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Ethics Considerations

In this research, ethical standards including obtaining informed consent, ensuring privacy and confidentiality were considered.

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