



## Designing a Market-Oriented Agricultural Extension System in Yazd Province

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| Article Info                                                                                                                                                                                       | ABSTRACT                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
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| <b>Article type:</b><br>Research Article                                                                                                                                                           | Agricultural extension systems in arid regions must respond simultaneously to resource scarcity, fragmented institutions, market volatility, and the limited bargaining power of smallholders. This study designed a context-specific Market-Oriented Agricultural Extension (MOAE) system for Yazd province, Iran, using Soft Systems Methodology (SSM). Empirical material was generated during a two-day participatory workshop with 29 agricultural extension and development experts purposively selected for their professional experience. Workshop statements were thematically organized and examined through rich-picture development, CATWOE analysis, root definition, conceptual modeling, comparison with the perceived real-world situation, and identification of feasible and desirable changes. The analysis identified interdependent needs related to local needs assessment, market and value chain development, multi-actor coordination, human and social capital, knowledge integration, private advisory services, institutional continuity, investment, and market risk management. The resulting design comprises three interacting subsystems: extension–farmer–market–consumer interaction; policy, regulation, and support; and research, education, and adaptive learning. Five implementation principles connect these subsystems: human and social capital development; market responsiveness and value-chain orientation; decentralized and accountable governance; multi-actor networking and adaptive learning; and risk management and smallholder inclusion. The study contributes a system-design perspective to the MOAE literature by showing how SSM can translate an ill-structured regional problem into a locally differentiated institutional architecture. The model remains conceptual and should be validated with farmers, value-chain actors, financial institutions, and consumers before pilot implementation. |
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| <b>Keywords:</b><br><i>Market-Oriented Agricultural Extension; Soft Systems Methodology; Agricultural innovation systems; Decentralized governance; Value chains; Arid regions; Yazd province.</i> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
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## Introduction

Agricultural extension is increasingly expected to do more than transfer production technologies. Smallholders also require reliable market intelligence, value-chain coordination, quality and safety guidance, business and collective-action capabilities, access to finance and risk-management services, and support for adapting production to environmental constraints. These functions are especially important in arid regions, where scarce water and climatic stress increase the cost of production errors and make the economic value generated per unit of resource a central concern. Conventional top-down and production-focused services are often poorly equipped to address these interdependent technical, institutional, and market problems ([Leeuwis & Van den Ban, 2004](#); [World Bank, 2008](#); [Ruben, 2024](#)).

In this study, Market-Oriented Agricultural Extension (MOAE) refers to a pluralistic and demand-responsive advisory system that links farmers and their organizations with extension providers, research and education institutions, buyers, processors, consumers, financial and insurance services, infrastructure agencies, and public regulators. Its purpose is not only to increase sales volume, but also to improve quality, value addition, market fairness, risk mitigation, and resource sustainability. MOAE-related approaches are not absent internationally. Frameworks for market-oriented advisory services, value-chain extension models, and approaches such as the Smallholder Horticulture Empowerment and Extension (SHEE) approach have been developed and applied in different settings ([Neuchâtel Group, 2008](#); [Fofana et al., 2020](#); [Kitajima, 2024](#)). However, these experiences do not provide a universally transferable organizational model. The effectiveness of these systems depends on various factors, including local institutions, power relations, market structure, service providers' capacity, and agricultural ecological conditions. Therefore, their effectiveness is highly contingent on the local institutional, economic, and ecological context in which they operate. Yazd province, located in central Iran, is a region where agriculture faces severe water resource limitations, harsh climatic conditions, dispersed institutional responsibilities, and the necessity to focus on high-value-added activities and increased resource productivity. Studies conducted in Iran indicate that agricultural extension services can play an effective role in agricultural development by enhancing farmers' knowledge, facilitating the adoption of innovations, and improving farm performance. However, challenges such as limited stakeholder participation, weak coordination among institutions, insufficient institutional support, and services that do not align with farmers' actual conditions and needs remain persistent ([Salehi et al., 2021](#); [Amghani et al., 2023](#); [Amghani et al., 2025](#)). For international audiences, Yazd province exemplifies the reality that the development of agricultural markets cannot be separated from environmental constraints, decentralized decision-making structures, institutional stability, and the need for smallholder farmers to participate.

Although research related to MOAE, participation in value chains, digital consulting services, and multi-actor innovation systems in agriculture has been increasing in recent years, to our knowledge, few studies have explicitly designed a comprehensive framework tailored to complex arid regions prior to implementation. Most existing research has focused on evaluating individual services, technology adoption, commercialization, or welfare outcomes, while fewer studies have answered the fundamental question of how to organize actors, decision-making structures, knowledge flows, financial resources, market feedback, and accountability mechanisms within an integrated and coherent system before implementing programs. This study, employing Soft Systems Methodology (SSM), aims to fill this gap for Yazd province. In this research, the concerns and needs of specialists in Agricultural extension and development have been gathered and formulated into a local conceptual model, outlining practical pathways for change and a multi-level organizational structure for the effective implementation of a MOAE system.

## Literature review

### Concept and functions of market-oriented extension

MOAE has broadened its focus beyond farm-level production to encompass the entire chain of connections among production, market demand, standards, processing, logistics, financing, and consumption. As shown in Table 1, the main functions of this approach include market information and analysis; value addition and post-harvest; market linkages and partnerships; and farmer organization and bargaining. In such a system, agricultural promoters not only serve as technical knowledge transmitters but also act as facilitators, coordinators, and intermediaries among various actors in the agricultural innovation system. ([Neuchâtel Group, 2008](#); [Swanson & Rajalahti, 2010](#); [Fofana et al., 2020](#)). From this perspective, market orientation is not merely about commercializing production; rather, sustainable MOAE must balance economic profitability, food quality and safety, fair participation of stakeholders, resilience of agricultural systems, and responsible utilization of natural resources.

**Table 1.** Core functions of MOAE systems

| Function                         | Examples                                               | Citations                                                                                                                                                       |
|----------------------------------|--------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Market information & analysis    | Prices, demand, and SWOT of markets                    | ( <a href="#">Krishna et al., 2019</a> ; <a href="#">Ovwigho, 2014</a> )                                                                                        |
| Value addition & post-harvest    | Grading, processing, packaging, branding               | ( <a href="#">Mahfud et al., 2024</a> ; <a href="#">Promkhambut et al., 2023</a> ; <a href="#">Krishna et al., 2019</a> ; <a href="#">Fofana et al., 2020</a> ) |
| Market linkage & partnerships    | Contracting, trader-trainer, agribusiness partnerships | ( <a href="#">Mahfud et al., 2024</a> ; <a href="#">Kitajima, 2024</a> ; <a href="#">Fofana et al., 2020</a> )                                                  |
| Farmer organization & bargaining | Groups, collective marketing, cluster aggregation      | ( <a href="#">Miirro et al., 2024</a> ; <a href="#">Fofana et al., 2020</a> )                                                                                   |

### Evidence from market- and value-chain-oriented approaches

Empirical evidence supports many aspects of this approach. Study results indicate that establishing effective communication between extension services and the market, along with farmers' access to market information, can increase the level of commercialization of production among smallholders ([Kirimi et al., 2022](#)). Additionally, participation in agricultural value chains leads to increased income and improved household consumption levels, with membership in agricultural organizations and access to extension services being important factors influencing this participation ([Ma et al., 2023](#)). Studies related to redesigning small-scale production systems based on the market and developing extension models rooted in the value chain also emphasize the need to simultaneously address market needs, coordinate services, and enhance producers' capabilities ([Fofana et al., 2020](#); [Promkhambut et al., 2023](#)).

However, presence in the market alone does not guarantee poverty reduction or the equitable distribution of benefits. Factors such as inequality in bargaining power, transaction costs, price fluctuations, and the exclusion of certain producer groups can hinder farmers' fair access to market opportunities ([Ruben, 2024](#)). Therefore, the design of a MOAE system must be accompanied by mechanisms for risk management, increased transparency, strengthening farmers' bargaining power, and ensuring the participation of small-scale stakeholders.

### Participation, pluralism, and adaptive learning

Participatory approaches and multi-stakeholder Agricultural extension systems enable the integration of scientific knowledge, indigenous and experiential knowledge, private sector expertise, and public sector support in a complementary manner. This type of collaboration becomes particularly important when sustainability issues transcend organizational boundaries and no single

actor possesses the necessary knowledge or resources to address the problem ([An et al., 2024](#)). However, the mere presence of multiple actors does not guarantee adequate accountability to farmers' needs. Research by [Goodluck et al \(2024\)](#) in Tanzania demonstrated that although service providers offered a diverse range of services, including production advice and market information, these services still did not fully align with farmers' real needs. Digital advisory tools can also facilitate access to weather, production, and market information, but their effectiveness depends on user-centered design, appropriate infrastructure, user capacity, and their connection to human relationships based on trust ([Ortiz-Crespo et al., 2020](#); [Sen et al., 2025](#)). These findings emphasize the importance of ongoing local needs assessments, participatory design, feedback collection, and adaptive learning, rather than providing standardized and uniform service packages

### ***Agricultural extension reform in Iran and the relevance of Yazd***

Research conducted in Iran indicates that the agricultural extension system, despite its considerable capacities, still faces significant challenges in design and implementation. Results from evaluations of model extension sites, including irrigated wheat production, demonstrate positive economic and technical effects of these programs, and recent studies have also examined the factors influencing their performance ([Amghani et al., 2023](#); [Amghani et al., 2025](#)). However, assessments of these experiences have shown that the success of such programs depends on the level of stakeholder participation, mutual trust, the quality of institutional arrangements, and the alignment of programs with local conditions ([Salehi et al., 2021](#)). Although these findings are also applicable to Yazd province, they still do not clarify how the extension system should establish coherent connections between county priorities, provincial coordination, national policies, market actors, the financial system, research and training centers, and consumer feedback. In a dry province like Yazd, this organizational communication issue is inherently linked to water resource limitations, production model choices, investment risks, and the need to create sustainable value from limited resources.

### ***Literature gaps and analytical contribution***

Literature review indicates that the importance of market information, agricultural cooperatives, participatory services, digital tools, multi-stakeholder collaboration, and decentralized decision-making systems has been well established. However, these components are often examined separately or evaluated after program implementation. Meanwhile, three research gaps remain. First, few studies have explained how these elements should be organized within a coherent institutional architecture suited to dry regions. Second, insufficient attention has been paid to the simultaneous design of decision-making mechanisms, resource flows, knowledge exchange, market feedback, accountability, and risk management at various managerial levels. Third, common linear research approaches are less effective when stakeholders have differing perceptions of the issue and achieving change requires negotiation and consensus among them.

SSM addresses these gaps by considering system design as a participatory learning process. This approach, through structuring the problem situation, revealing perspectives and power structures using CATWOE analysis, developing goal-oriented activity models, and comparing them with the existing reality, enables the identification of changes that are feasible both from a desirable systemic perspective and in terms of cultural and operational considerations ([Checkland, 1999](#)). Accordingly, this study aims to answer three main questions: (1) What are the challenges and requirements shaping the development of a MOAE system in Yazd province? (2) How can these concerns be transformed into a conceptual model suitable for the province's conditions using the Soft Systems Methodology?

and (3) What multi-level organizational structure and operational principles are necessary for the establishment and operationalization of the proposed system?

## Materials and methods

### Study Area

The study area is Yazd province, located in central Iran. Yazd is a desert region with inadequate water resources due to low annual precipitation and high evaporation rates. In Yazd, agricultural production continues to rely on efficient resource management, the cultivation of high-value crops, and the development of market access. These factors make Yazd an appropriate case for exploring the requirements of MOAE and for designing a system to support sustainable agricultural development.

### Participants and sampling

The study involved 29 agricultural extension and development professionals. Participants were selected purposively because they had direct experience of extension delivery, county or provincial planning, rural service centers, crop and livestock activities, or interaction with farming communities in Yazd Province. The sample included frontline experts as well as staff with supervisory and managerial responsibilities, thereby incorporating operational and organizational perspectives on the existing extension system.

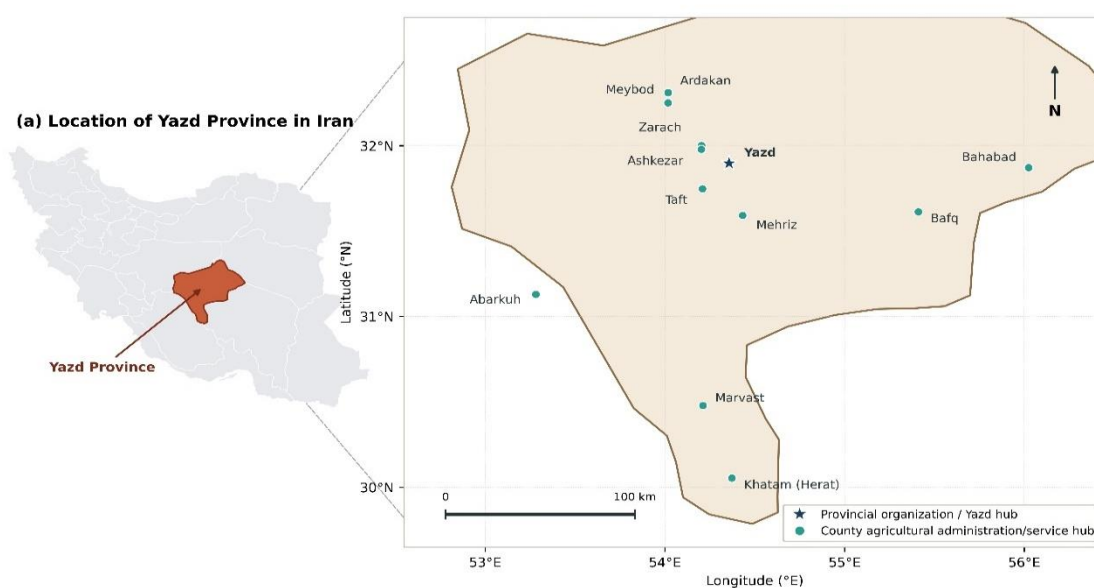


Fig. 1- The study area in Yazd province

### Data Collection

Data were generated during a two-day participatory workshop combining structured participant-profile forms, facilitated group discussion, and collaborative systems-mapping activities. Before the analytical sessions, participants recorded available professional characteristics, including organizational position, work unit, educational level and field, managerial level, years of professional experience, and employment status. The workshop then examined the current extension situation, organizational and institutional constraints, market challenges, stakeholder relationships, and

mechanisms for improving extension services. Discussion was organized around the following guiding questions:

- Who are the key actors in agricultural development?
- What activities are currently taking place?
- What activities should be pursued?
- What outcomes should we expect from a market-oriented extension system?

Participant-profile forms and workshop statements were documented separately. Personal identifiers were removed during analysis, and participant records were assigned codes P01–P29. The workshop material was used to construct the rich picture, identify stakeholder relationships, and formulate root definitions.

### ***Data Analysis Procedure***

Analysis comprised a descriptive profile and an SSM-based qualitative analysis. Available participant characteristics were summarized using frequencies and percentages; years of professional experience were summarized using the mean, standard deviation, median, and range. Missing or illegible entries were retained as not reported and were not imputed. For the qualitative analysis, concerns, needs, and proposed actions documented during the workshop were first coded as individual statements and then grouped by conceptual similarity into eight overlapping analytical themes. Frequencies represent the number recorded for each statement rather than mutually exclusive participant categories. The themes informed the rich picture and stakeholder analysis; CATWOE was then used to specify customers, actors, transformation, worldview, ownership, and environmental constraints. Root definitions, conceptual models, and the proposed organizational structure were subsequently developed, compared with the perceived real-world situation, and refined through participant discussion and consensus.

### ***Soft Systems Methodology***

SSM was first introduced by Peter Checkland et al. in the 1970s in response to the existing failures of studies in the face of social and human issues ([Checkland and Scholes, 1990](#)). As Figure 2 shows, the SSM process has different steps which are not necessarily followed in a linear sequence. Steps 1 and 2 deal with the problem situation. These steps include entering the problem situation and identification of people, standards, and values through interviews and discussions, observations, and rich pictures. Rich pictures are graphs, charts, and pictures that the actors (in the problem situations) present consequences, problems, relationships, and existing conflicts, and provide a general idea of how the status quo is ([Checkland, 1999](#)).

With respect to the first and second stages, systems analysis was performed to offer a market-oriented system to help agricultural development of the studied region and for the active participation of various stakeholders in this field. As mentioned, SSM was used as a guide for analysis and conceptual modeling ([Checkland, 1999](#)).

During the workshop, the 29 participants documented and discussed the current situation, recurring concerns, and constraints affecting agricultural extension in Yazd. They collaboratively prepared an initial rich picture, reviewed the representation for accuracy, and revised it until agreement was reached on the principal actors, relationships, tensions, and environmental constraints. This validated rich picture became the basis for the subsequent CATWOE analysis and conceptual modelling.

**Step 3: Developing root definitions:** Root definitions are the requirements of the SSM method. A root definition is a phrase or sentence that describes an ideal system, the objectives of that system, those who will be involved in it, those who are currently involved in it, those who are affected, and those who influence it. For the development of root definitions, a technique called CATWOE was

used ([Checkland, 1999](#)). CATWOE is an acronym for Customers (or Clients), Actors, Transformation, Worldview, Owners, and Environmental constraints.

A series of root definitions was created using the above procedure. Group discussions were then conducted, and the members participating in the workshop agreed on a root definition.

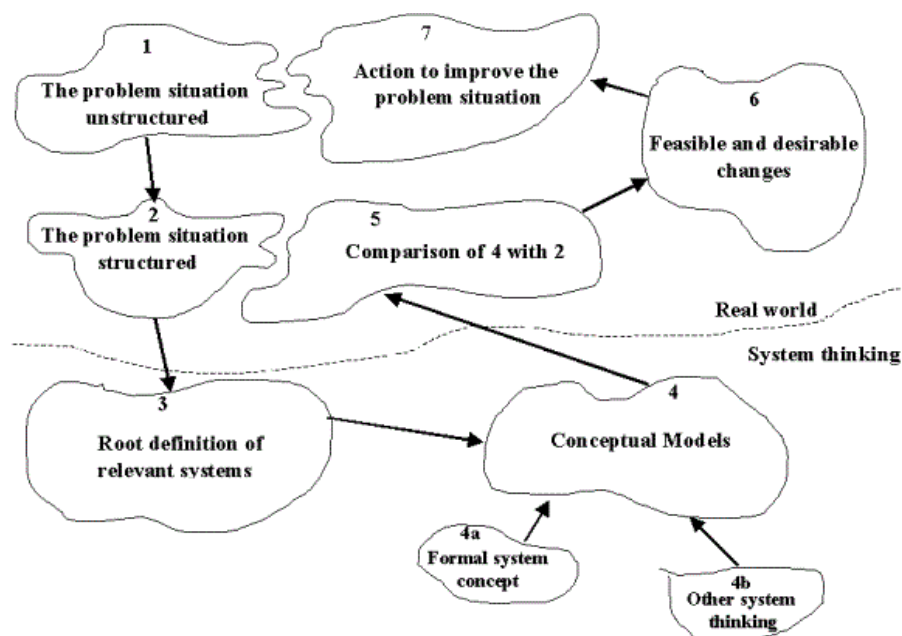


Fig. 2- Structure of the SSM Process of Inquiry (adopted from [Checkland & Scholes, 1990](#))

Step 4: Building a conceptual model: A model in SSM is a diagram formed of a series of activities and communication lines that connect them ([Checkland, 1998](#)). This model was extracted directly from the CATWOE elements and the root definition, and presented key activities in the root definition.

Step 5: Comparison of the model with the real world: This step was designed to structure and content negotiations to improve the current situation. In this step, a series of regular questions about each activity and each relationship in the model were used, and then the model was compared with the real world.

Step 6: Identifying and specifying the required changes: This includes changes that are possible in the real world from the participants' perspective and should be corrected in the model.

Step 7: In this step, the necessary changes specified in the previous step were applied, and the final model of Market-Oriented Agricultural Extension was extracted.

The initial rich picture was collaboratively drawn on paper during the workshop. Subsequently, an AI-assisted tool (GPT-4 with image processing) was used solely to digitize and enhance the legibility of the hand-drawn picture, without altering any of its structural elements or symbols.

## Results and Discussion

### *Participant demographic and professional profile*

The available demographic and professional information showed that the workshop combined substantial field experience with diverse organizational responsibilities (Table 2). Of the 29 participants, 24 (82.8%) held a bachelor's degree or higher. Professional experience was reported by 29 participants and averaged 19.2 years (SD = 7.7), with a median of 22 years and a range of 3–30

years. The group included extension and agricultural experts, heads of county extension offices, managers of rural service centers, provincial planning personnel, and crop and livestock specialists. This combination of participants provided the opportunity to analyze issues from the perspectives of various levels, including executive, managerial, county, and provincial levels.

The long-standing participation of the participants and the simultaneous presence of executive staff and managers enhanced the credibility of the workshop for identifying institutional procedures and operational challenges. At the same time, the composition of the participants reflected the perspectives of experts and managers within the government system of agricultural extension and services. Therefore, the findings should be viewed less as a reflection of the views of all farmers or other market actors in Yazd province, and more as the perceptions and professional experiences of the system's experts.

**Table 2.** Demographic and professional characteristics of workshop participants (N = 29)

| Characteristic                  | Category/statistic       | n              | %    |
|---------------------------------|--------------------------|----------------|------|
| Education                       | Secondary-school diploma | 2              | 6.9  |
|                                 | Associate degree         | 3              | 10.3 |
|                                 | Bachelor's degree        | 12             | 41.4 |
|                                 | Master's degree          | 8              | 27.6 |
|                                 | Doctoral degree          | 4              | 13.7 |
| Employment status               | Permanent                | 20             | 69.0 |
|                                 | Contractual              | 9              | 31   |
| Professional experience (years) | Mean $\pm$ SD            | 19.2 $\pm$ 7.7 | —    |
|                                 | Median (range)           | 22 (3–30)      | —    |

In the first step, all the viewpoints raised in the workshop were recorded separately as concerns, needs, and practical suggestions. Then, these statements were analyzed based on conceptual similarities and categorized into eight overlapping analytical themes. This two-stage process, while preserving the authenticity of the workshop's experiential data, also maintained the connection between participants' initial statements and their systemic interpretation. The final results of this analysis are presented in Table 3.

Table 3 shows that the identified concerns were not isolated service deficiencies. Needs assessment and contextualization were connected to decentralization; market and value-chain development were connected to price risk and investment; and governance problems were connected to institutional continuity, knowledge integration, and collective capacity. This interdependence justified treating the situation as an ill-structured multi-actor problem and provided the empirical basis for the rich picture, change pathways, CATWOE analysis, and three-subsystem conceptual model.

**Table 3.** Integrated thematic analysis of workshop concerns, empirical statements, and implications for the proposed market-oriented agricultural extension system

| Analytical theme                              | Selected workshop statements                                                                                                | Recorded frequency (n) | Systemic interpretation                                                                                       | Connection to the proposed model              |
|-----------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------|------------------------|---------------------------------------------------------------------------------------------------------------|-----------------------------------------------|
| <b>Needs assessment and contextualization</b> | Assess extension needs; identify local capacities and constraints; map high-value products and target markets               | 19; 12; 11             | Start planning at the county level and avoid one-size-fits-all policies                                       | Figs. 4, 6, and 7                             |
| <b>Market and value-chain development</b>     | Create markets; understand markets and produce accordingly; develop high-value chains and clusters                          | 18; 16; 16             | Extend the mission from production technology to market intelligence, quality, packaging, and buyer linkages. | Interaction subsystem; Fig. 5                 |
| <b>Risk and investment</b>                    | Severe price volatility; inadequate investment in production and packaging                                                  | 17; 11                 | Include price information, insurance, finance, transparent contracts, and risk reduction.                     | Cross-cutting element; Figs. 5 and 7          |
| <b>Governance and coordination</b>            | Coordinate all organizations; address inconsistency caused by changing policies; reduce duplication                         | 15; 16; 11             | Clarify responsibility, authority, information flows, and accountability                                      | Policy and support subsystem; Fig. 6          |
| <b>Human and social capital</b>               | Build farmer trust; maintain close farmer contact; develop farmer organizations                                             | 15; 14; 13             | Strengthen trust, collective action, bargaining power, and local leadership.                                  | Interaction and research–education subsystems |
| <b>Institutional constraints</b>              | Limited senior-management commitment; program discontinuity after managerial change; uniform policies for different regions | 14; 13; 12             | Secure program continuity, budgets, local authority, and managerial support                                   | CATWOE ownership; Fig. 6                      |
| <b>Knowledge, information, and innovation</b> | Use Indigenous knowledge; develop climatic and topographic databases; support new ideas                                     | 10; 7; 10              | Combine scientific, local, and market knowledge through continuous learning.                                  | Research and education subsystem              |
| <b>Private sector and entrepreneurship</b>    | Strengthen advisory firms; engage agricultural graduates; provide packaging and innovation workshops                        | 9; 8; 9                | Diversify service providers and develop value-chain enterprises                                               | All three subsystems                          |

*Note.* Frequencies refer to the number recorded for each workshop statement, not to mutually exclusive thematic categories. Because participants could raise more than one concern and individual statements could inform more than one theme, frequencies should not be summed across rows or interpreted as a statistical ranking of themes.

The concerns and requirements identified in the workshop were synthesized into a rich picture of the current agricultural extension situation (Fig. 3). The figure does not illustrate the proposed system but rather represents the challenging real-world scenario. It highlights issues such as centralized, production-focused extension, fragmented institutional links, limited feedback from farmers and markets, policy instability, price fluctuations, underinvestment, and environmental restrictions typical

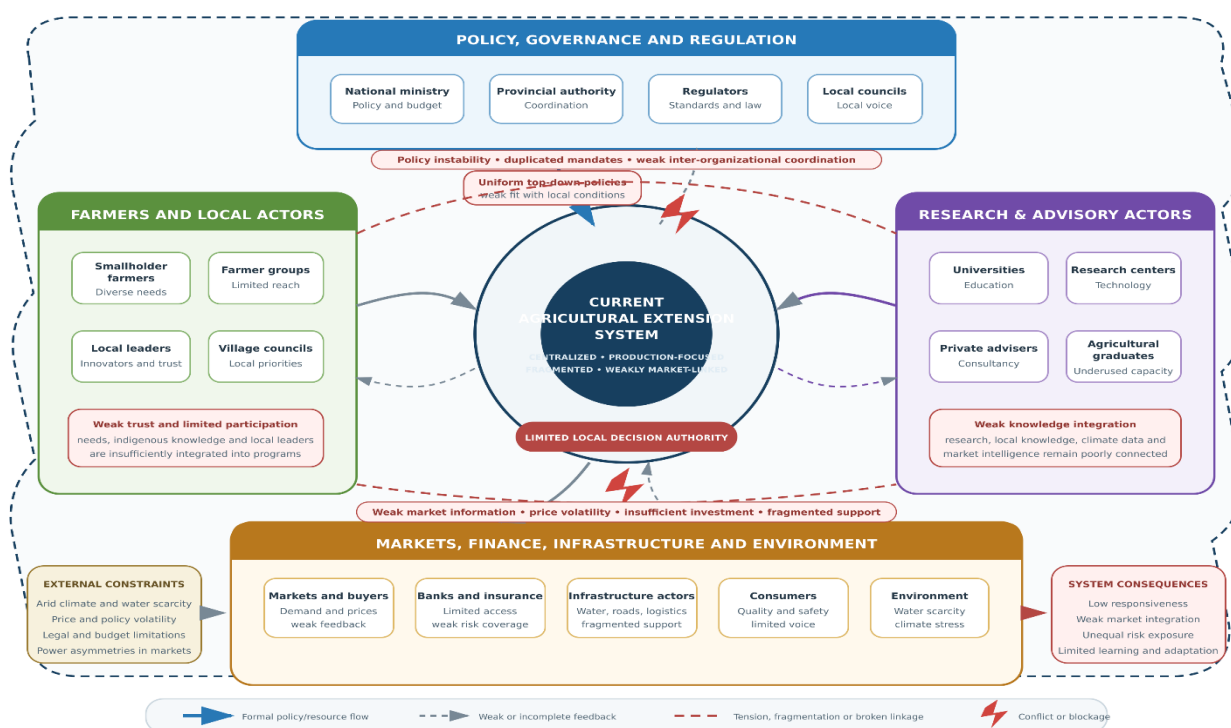
of an arid region. Formal policy and resource flows mainly follow a top-down approach, while feedback from farmers, research, markets, and consumers remains incomplete. These interacting constraints explain the system's low responsiveness, weak market integration, unequal risk exposure, and limited capacity for learning and adaptation. Figure 4 translates these problems into six feasible and desirable change pathways by linking each current-system weakness to a required systemic change and an expected outcome.

**Clients:** The core clients of this system are farmers, individually and collectively, consumers of agricultural products, agricultural extension systems and markets, national and provincial executive agencies, investigative, educational, and legislative authorities, banks, and all the actors referred to in Figure 3.

**Actors:** As mentioned in the methodology section, actors are individuals whose activities are in the framework of this system and participate in it. In relation to this subject, stakeholders and active actors within the market-oriented extension system are included.

**Transformation process:** This includes implementing activities through an interactive process to obtain a win-win result among the different actors, using their potential to become productive practices in extension activities and, consequently, the development of agriculture and access to health products based on consumer demand.

**Worldview:** The underlying worldview is that market-oriented extension can simultaneously improve productivity, equity, and sustainability, provided that information, bargaining power, and risk management are distributed more evenly among actors.



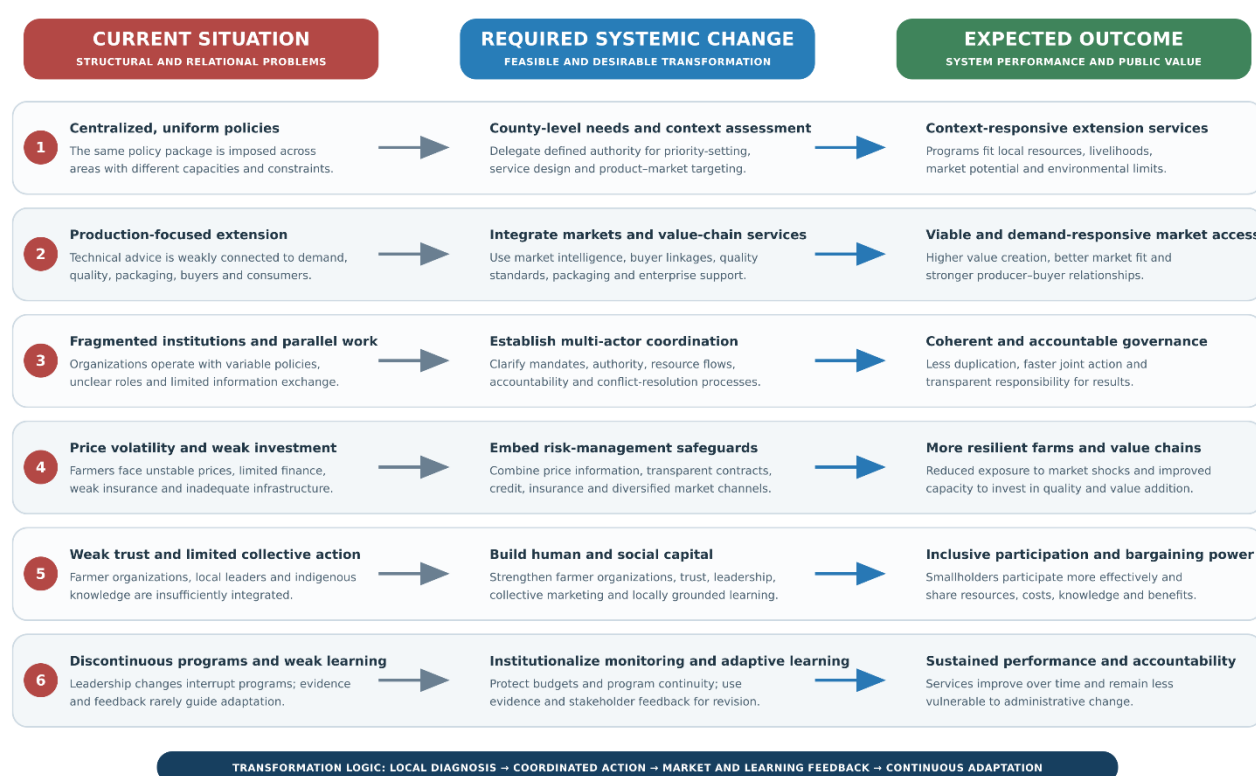
**Fig. 3-** Rich picture of the current agricultural extension situation in Yazd province, illustrating the principal actors, fragmented relationships, institutional tensions, weak feedback loops, and market and environmental constraints identified by workshop participants.

**Ownership:** The system is owned by the institutions with formal authority to authorize, finance, fundamentally change, or terminate it. In the present context, these include the Ministry of Agriculture

Jihad, the provincial Agricultural Organization, and other competent authorities responsible for allocating mandates and budgets. Farmers, consumers, market actors, and extension organizations are customers or actors unless formal decision authority has been delegated to them.

**Environmental constraints:** The obstacles that lead to the use of capabilities and potentials of market-oriented extension face problems and challenges, such as institutional, cultural, political, legal, and knowledge capacities to implement them.

Next, the root definition of market-oriented agricultural extension obtained from the two-day workshop by considering the CATWOE elements was: a decentralized extension system in accordance with the actual needs of farmers, agricultural extension, and consumers to achieve an interactive and accountable process with other actors to achieve healthy food, preserve natural resources, and human and social capital development in a synergistic and win-win approach for all actors.



**Fig. 4-** Pathway from the current extension situation to a context-specific market-oriented agricultural extension system, based on the problems identified by workshop participants.

The conceptual model derived from the root definition is presented in Fig. 5. It comprises three interacting subsystems: (1) extension–farmer–market–consumer interaction; (2) policy, regulation, and support; and (3) research, education, and learning. The first subsystem co-produces value through continuous feedback among farmers and their organizations, extension services, value-chain actors, and consumers. The second provides rules, decentralized authority, finance, insurance, infrastructure, coordination, and oversight. The third undertakes context and needs assessment, combines scientific, local, and market knowledge, develops stakeholder capacities, and supports monitoring and adaptive learning. Risk management, smallholder inclusion, transparency, and accountability operate as cross-cutting safeguards across all three subsystems.

In this section, the network of policy and legislation codifies and monitors the implementation of laws and regulations in contracts between different organizations and farmers to share activities, resources, costs, and revenues, and also monitors standards of food production and healthy products, and natural resource conservation and sustainability. In addition, in this subsystem, support networks such as banks and insurance, and organizations such as the Regional Water Authority and Road Construction play an important role in providing facilities to support farmers, especially in the onset and maintenance of activities. In the third subsystem, the education and research network include research and educational activities of various organizations to study market needs, consumer preferences, market development, new inputs and machinery, and training farmers and experts who are active in this area.

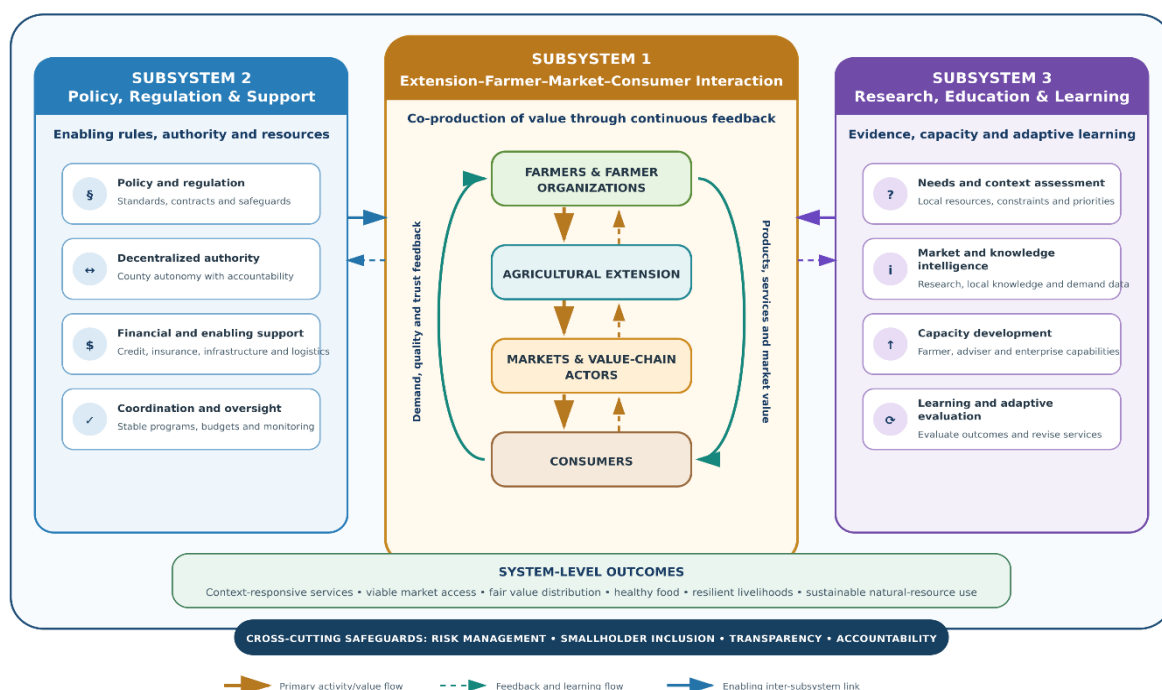


Fig. 5- Conceptual model of a context-specific market-oriented agricultural extension system, comprising three interacting subsystems and cross-cutting safeguards.

A multilevel organizational structure was developed to operationalize the conceptual model (Fig. 6). The national level provides the enabling mandate, stable resources, standards, safeguards, and national knowledge infrastructure. The provincial level coordinates public, private, and civil-society actors, pools technical and financial support, removes implementation barriers, and facilitates cross-county learning. The county level is the principal operational arena, where a joint market-oriented extension network—with farmer representation—diagnoses local conditions, sets priorities, co-designs services, coordinates delivery, and adapts activities using implementation evidence.

Five mutually reinforcing principles are essential for implementation (Fig. 7): human and social capital development; market responsiveness and value-chain orientation; decentralized and accountable governance; multi-actor networking and adaptive learning; and risk management and smallholder inclusion. These principles require enabling foundations, including policy continuity, sustainable finance, data and technology, legitimate stakeholder representation, and capacity to

evaluate outcomes, equity, and learning. The principles should operate together rather than as separate interventions.

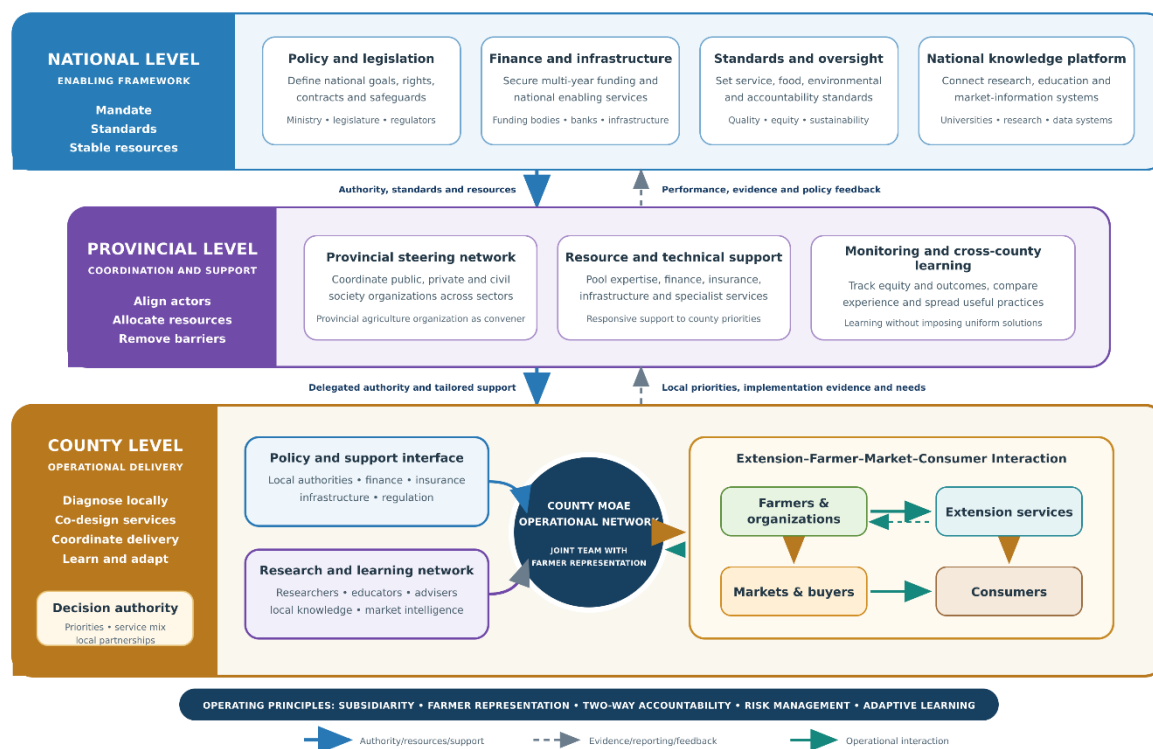


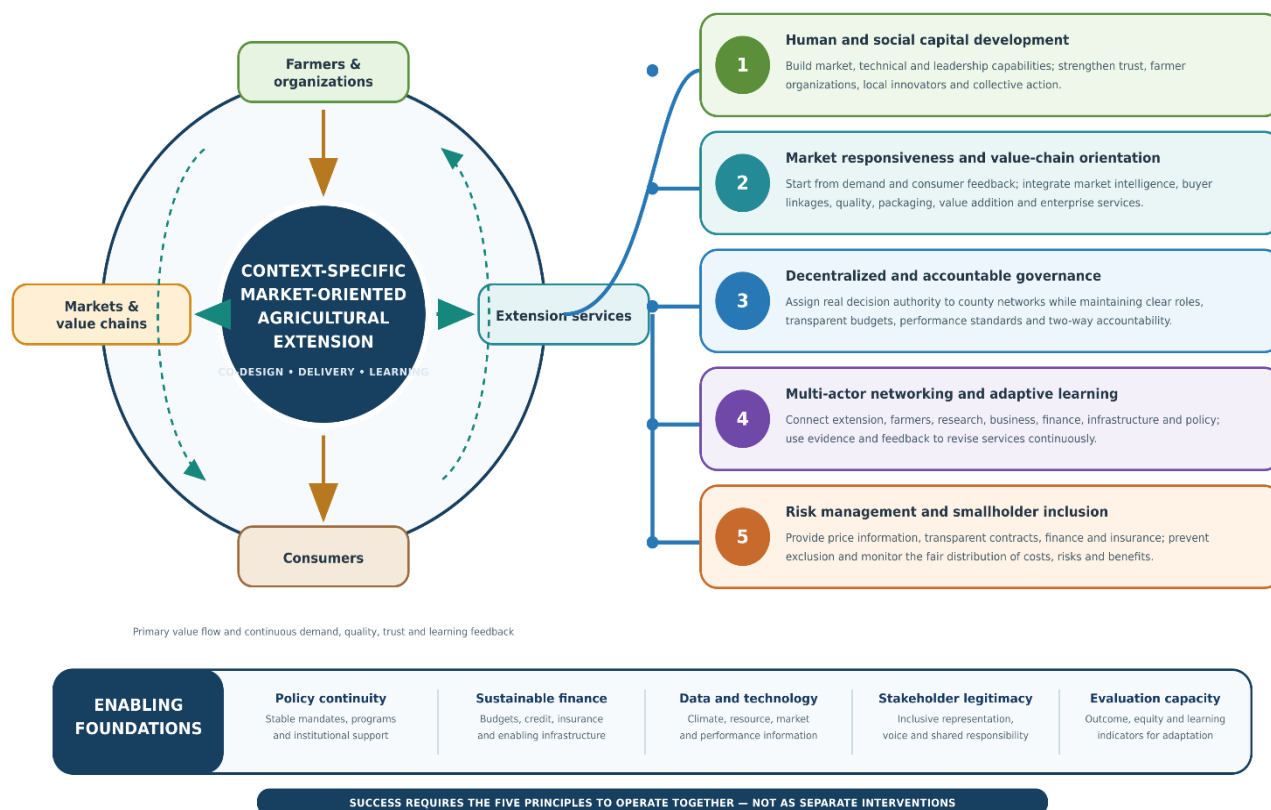
Fig. 6- Proposed multilevel organizational structure for a decentralized market-oriented agricultural extension system, showing the differentiated functions and two-way relationships among national, provincial, and county levels.

## Discussion

Analysis of the two-day workshop involving 29 agricultural extension and development experts revealed a set of challenges and requirements for moving from a production-oriented extension system to a MOAE system. Thematic analysis of the recorded statements identified seven interrelated domains: (1) needs assessment and contextualization; (2) market and value-chain development; (3) governance and interorganizational coordination; (4) human and social capital development; (5) knowledge and information systems; (6) the role of the private sector and entrepreneurship; (7) institutional constraints, (8) market risk, and investment. Rather than operating independently, these themes depict an ill-structured, multi-actor problem in which weak market linkages, administrative centralization, policy instability, information gaps, and limited trust reinforce one another.

Professional experience was legible in 29 forms. Among these respondents, the mean work experience was 19.2 years, with a range of 3–30 years. Participants were mainly selected from among experts, managers of agricultural service centers, heads of extension departments, and managers or deputies of various units of the Jihad Agriculture Organization. Their areas of specialization also covered a diverse range of fields, including agricultural extension and education, crop production, animal sciences, plant pathology, forestry, and agricultural mechanics. This diversity of expertise provided valuable insight into the internal mechanisms of the extension system and its challenges. However, farmers, buyers, active businesses in the value chain, and consumers were not directly involved in this study. Therefore, the results should be considered reflective of the perspectives of

specialists in agricultural extension and development, rather than all stakeholders in Yazd province's food system. In the following section, we describe the identified themes across six categories.



**Fig. 7-** Essential and mutually reinforcing principles for implementing a context-specific market-oriented agricultural extension system.

### 1. Needs assessment, contextualization, and decentralization

The most frequently mentioned topic by participants was the need to conduct a needs assessment for agricultural extension programs, which was emphasized by 19 people. Other important topics included understanding the capacities and limitations of each region (12 people), criticizing the ministry's uniform policies for areas with different conditions (12 people), and identifying products with economic advantages and target markets (11 people).

From the participants' perspective, the main issue is not just the lack of agricultural extension services, but also the mismatch of these services with the environmental, production, institutional, and market conditions of each county. In Yazd province, true localization is achieved when decision-making authority and program implementation are delegated to the county level, rather than merely collecting local needs and sending them to higher levels. Accordingly, county networks should have sufficient authority to prioritize products, select target groups, design agricultural extension services, identify buyers, and plan educational activities; meanwhile, the provincial level should be responsible for coordination among organizations and resource allocation, and the national level should provide legal frameworks, standards, and sustainable resources. Otherwise, decentralization will be superficial, and decision-making will still be carried out in a top-down structure.

This finding is consistent with the results of [Goodluck et al. \(2024\)](#). They showed that although there are multiple providers in Tanzania offering a variety of services, from production counseling to

market information, these services still do not meet farmers' actual needs. Therefore, merely having organizational diversity or multiple service providers is not enough; the extension system must be based on continuous needs assessment, a thorough understanding of local conditions, and the provision of appropriate and responsive services at the local level.

## **2. Market development, value chains, and risk management**

Creating markets for agricultural products (18 participants), understanding markets and producing accordingly (16), establishing high-value chains and clusters (16), conducting packaging and innovation workshops (9), and improving the extension of crop and livestock products (8) show that participants understood market orientation as more than increased production. Extension should accordingly expand from technical recommendations to demand information, quality standards, packaging, buyer linkages, and enterprise development.

The importance of connecting extension with markets is supported by [Kiriimi et al. \(2022\)](#): the reliability of local extension providers in enabling access to market information, and farmers' use of that information, were positively associated with banana commercialization. [Ma et al. \(2023\)](#) likewise found that participation in agricultural value chains was associated with higher household income and consumption expenditure, while farmer-group membership and extension visits influenced participation. Together, these findings support the integration of market intelligence, farmer organization, and extension within one interaction subsystem.

However, the prominence of price volatility (17 participants) shows that market orientation should not mean exposing farmers to markets without safeguards. Without timely price information, insurance, access to credit, transparent contracts, and diversified sales channels, smallholders may become more vulnerable to powerful buyers, price shocks, and transaction costs. Risk management and smallholder inclusion should therefore operate across all three subsystems and constitute a core implementation principle in Figure 7.

## **3. Multi-actor governance and interorganizational coordination**

Poor coordination among units because of different and changing policies (16 participants), the need to coordinate all organizations involved in extension and agricultural development (15), organizational duplication (11), and coordination between county and village councils (10) place governance at the center of the model. Multiple actors do not automatically constitute a network; a functional network requires clear responsibilities, authority, resources, information flows, accountability, and conflict-resolution mechanisms.

The revised rich picture, therefore, depicts cross-connections, information and resource flows, points of blockage, and direct relationships among farmers and buyers, organizations and financial institutions, extension and research, consumers, and standard-setting bodies. The organizational model similarly distinguishes formal authority, knowledge flows, financial support, and market feedback. This representation better reflects SSM because the situation consists of interdependent relationships and different worldviews, rather than a list of organizations arranged around one central institution.

## **4. Human capital, social capital, and collective action**

Building farmers' trust (15 participants), maintaining close relationships with them (14), developing farmer organizations (13), recognizing Indigenous knowledge and practices (10), and identifying local leaders, progressive farmers, and innovators (8) indicate that implementation depends on social relationships and collective capacity. Trust is not simply a positive attitude toward extension personnel; it enables the exchange of sensitive information on costs, prices, quality, contracts, and risk.

Farmer organizations can reduce the costs of accessing information and inputs, facilitate product aggregation and quality control, and strengthen smallholders' bargaining power. [Ma et al. \(2023\)](#) similarly identified farmer-group membership and extension contact as important factors in value-chain participation. The extension–farmer–market–consumer interaction subsystem should therefore

include explicit activities for organization building, local leadership development, collective negotiation, and conflict management.

#### **5. Knowledge, research, education, and pluralistic services**

Proposals to establish topographic and climatic databases (7 participants), recognize Indigenous knowledge (10), engage agricultural graduates effectively (8), strengthen private advisory companies (9), and support new ideas (10) point to a multi-source, learning-oriented knowledge system. The research and education subsystem should not be limited to one-way transfer of research findings. It should integrate climate and resource data, prices, demand, and local experience, and translate them into usable decisions for farmers and county networks.

[Goodluck et al. \(2024\)](#) caution that pluralistic provision does not necessarily produce services that meet farmers' demands. The participation of private firms and agricultural graduates should therefore be accompanied by service-quality standards, transparent responsibilities, referral arrangements, user-satisfaction assessment, and equitable smallholder access. Otherwise, pluralism may create further fragmentation, overlapping mandates, or exclusion of less-resourced groups.

#### **6. Institutional constraints and requirements for sustainability**

Limited senior-level commitment to extension development (14 participants), program abandonment following changes in ministers or managers (13), the weakened role of extension in major organizational programs (12), insufficient investment in production and packaging (11), weak support for new ideas (10), and diversion of extension budgets to other activities (6) indicate that a conceptual design will not be sustainable without institutional guarantees. The model must specify not only responsibilities but also funding sources, decision authority, program continuity, accountability indicators, and monitoring arrangements.

Accordingly, the policy, regulation, and support subsystem should perform four distinct functions: stabilize rules for cooperation and contracting; provide finance, insurance, and infrastructure; delegate appropriate authority to the county level; and monitor performance and equity of access. Separating these enabling functions from the county network's daily operations allows national and provincial institutions to support and remain accountable to local implementation without prescribing identical solutions for different areas.

### **Synthesis and contribution**

The findings indicate that creating MOAE for arid areas goes beyond simply adding marketing training to existing extension programs. It involves a comprehensive transformation that is institutional, informational, social, and economic. Market orientation becomes effective when production decisions are driven by demand and local-resource assessments, multiple organizations work together through accountable structures, farmers are prepared for collective action and negotiation, and risks related to prices, contracts, and investments are actively managed.

The main contribution of this study is showing how SSM can facilitate the context-specific design of an MOAE system. The three-subsystem model it develops connects agricultural innovation networks' logic with market demands and decentralization of administration. Unlike previous research that primarily measures the results of market or value-chain involvement, this study focuses on the institutional structures necessary to support such participation. Currently, however, the model is still conceptual, and its practical effectiveness needs to be tested in one or more counties using indicators like access to market information, sales channel stability, smallholder inclusion, stakeholder satisfaction, and income or value-added changes.

### **Limitations and future research**

In interpreting the findings of this study, attention to four limitations is essential. First, most participants were selected from the agricultural extension and management system of the agricultural sector; therefore, the proposed model primarily reflects the knowledge and organizational experience

of this group. Second, some of the completed forms were handwritten, incomplete, or insufficiently readable, so the professional characteristics extracted from them need to be re-verified against the original records. Third, the frequency of repeating a topic merely indicates how many times it was raised and does not necessarily reflect its importance or priority, as it may have been influenced by the workshop's management style or the data recording method. Fourth, the proposed model has not yet been validated through direct participation of small farmers, producer organizations, buyers, processing units, banks, insurance companies, and consumers.

Therefore, future research involving these groups should compare the proposed model with real-world conditions and identify modifications that are feasible both from a systemic perspective and in terms of cultural and operational considerations. Utilizing methods such as Delphi studies, stakeholder network analysis, pilot implementation on a limited scale, and inter-provincial comparisons can also help evaluate the validity, transferability, and generalizability of this model.

### Data Availability Statement

“Not applicable”

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### Ethical considerations

The authors avoided data fabrication, falsification, plagiarism, and misconduct.

### Conflict of interest

The author declares no conflict of interest.

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## طراحی یک سیستم ترویج کشاورزی بازارمحور در استان یزد

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#### کلیدواژه‌ها:

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مناطق خشک؛ استان یزد.

نظام‌های ترویج کشاورزی در مناطق خشک ناگزیرند به‌طور هم‌زمان به چالش‌هایی همچون کمبود منابع، پراکندگی نهادی، نوسانات بازار و قدرت چانه‌زنی محدود بهره‌برداران خرد پاسخ دهند. پژوهش حاضر با بهره‌گیری از روش‌شناسی سیستم‌های نرم ((SSM، به طراحی یک نظام ترویج کشاورزی بازارگرای متناسب با شرایط استان یزد پرداخت. داده‌های پژوهش از طریق یک کارگاه مشارکتی دو روزه با حضور ۲۹ نفر از متخصصان ترویج و توسعه کشاورزی که به صورت هدفمند و بر اساس تجربه حرفه‌ای انتخاب شده بودند، گردآوری شد. داده‌های حاصل از کارگاه پس از سازمان‌دهی موضوعی، با استفاده از مراحل توسعه تصویر غنی ((Rich Picture، تحلیل CATWOE، تدوین تعریف ریشه‌ای ((Root Definition، مدل‌سازی مفهومی، مقایسه با وضعیت ادراک شده دنیای واقعی و شناسایی تغییرات مطلوب و امکان‌پذیر مورد تحلیل قرار گرفت. یافته‌ها نشان داد که طراحی یک نظام ترویج بازارگرا مستلزم توجه هم‌زمان به مجموعه‌ای از نیازهای به‌هم‌پیوسته است؛ از جمله نیازسنجی محلی، توسعه بازار و زنجیره ارزش، هماهنگی میان ذی‌نفعان، تقویت سرمایه انسانی و اجتماعی، یکپارچه سازی دانش، توسعه خدمات مشاوره‌ای بخش خصوصی، تداوم نهادی، سرمایه‌گذاری و مدیریت ریسک بازار. بر اساس این یافته‌ها، الگوی پیشنهادی از سه زیرسامانه تعاملی تشکیل شد: تعامل میان ترویج، کشاورز، بازار و مصرف‌کننده؛ سیاست‌گذاری، مقررات و حمایت؛ و پژوهش، آموزش و یادگیری تطبیقی. این زیرسامانه‌ها از طریق پنج اصل اجرایی به یکدیگر پیوند می‌خورند: توسعه سرمایه انسانی و اجتماعی، پاسخگویی به بازار و جهت‌گیری زنجیره ارزش، حکمرانی غیرمتمرکز و پاسخگو، شبکه سازی میان ذی‌نفعان همراه با یادگیری تطبیقی، و مدیریت ریسک همراه با حمایت از بهره‌برداران خرد. این پژوهش با ارائه یک رویکرد مبتنی بر طراحی نظام، به ادبیات ترویج کشاورزی بازارگرا کمک می‌کند و نشان می‌دهد که چگونه روش‌شناسی سیستم‌های نرم می‌تواند یک مسئله پیچیده و فاقد ساختار روشن در سطح منطقه‌ای را به یک معماری نهادی متناسب با شرایط محلی تبدیل کند. با این حال، مدل ارائه‌شده ماهیتی مفهومی دارد و پیش از اجرای آزمایشی، لازم است با مشارکت کشاورزان، بازیگران زنجیره ارزش، نهادهای مالی و مصرف‌کنندگان اعتبارسنجی شود.

#### استناد:

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