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Original Article

Exploring the Drivers of Artificial Intelligence's Impact on the Development of Technological Entrepreneurship (Case Study: Rural Areas of Shemiranat County)

Aliakbar Anabestani*[1], Behnaz Rahimi[2]

1. Full Prof., in Human Geography & Spatial Planning, Shahid Beheshti University, Tehran, Iran
2. Ph.D. Candidate in Geography & Rural Planning, Shahid Beheshti University, Tehran, Iran

Abstract

Purpose- Technological advancements, particularly Artificial Intelligence (AI), are transforming modern business models and fostering technological entrepreneurship. While AI offers significant potential for sustainable development in rural areas through increased productivity and innovation, these regions often benefit less due to weak digital infrastructure and institutional constraints. This study aims to identify and analyze the key drivers of AI's impact on the development of technological entrepreneurship in the rural areas of Shemiranat County.

Design/methodology/approach- This applied research employs a descriptive-analytical approach and a mixed-methods (qualitative-quantitative) design. Data collection involved documentary studies and fieldwork. In the qualitative phase, data were gathered through semi-structured interviews with 18 experts selected via purposive sampling. Data were analyzed using qualitative content analysis with open, axial, and selective coding. In the quantitative phase, the causal relationships among the identified drivers were analyzed using Interpretive Structural Modeling (ISM) and MICMAC software. The research was conducted in the rural areas of Shemiranat County in 2025.

Finding- The analysis identified 18 key drivers, categorized into five groups: technological, economic, social, policy-related, and environmental. Results indicate that AI can effectively contribute to rural socio-economic sustainability by enhancing productivity, creating innovative employment opportunities, and strengthening environmental resilience. Key challenges include a gap between physical access to technology and commercial utilization, low digital literacy, and a lack of supportive legal frameworks tailored for rural micro-businesses.

Practical Implications- To leverage AI for rural technological entrepreneurship, policymakers should prioritize: 1) expanding high-speed internet and digital infrastructure; 2) establishing rural-focused innovation centers and accelerators; 3) developing supportive policies including low-interest loans and tax exemptions for AI-based ventures; and 4) implementing targeted training programs to enhance digital literacy and practical AI skills among local communities. These actions will help bridge the existing digital divide and translate infrastructure into productive economic outcomes.

Originality/value– This research is novel in its comprehensive and systemic analysis of drivers for AI-based technological entrepreneurship in Iranian rural areas. By employing a mixed-method approach combined with ISM and MICMAC structural analysis, it moves beyond simple descriptive studies to identify causal and hierarchical relationships among the drivers. The study provides a contextualized framework for policymakers, highlighting the foundational role of government support and digital infrastructure in fostering a dynamic and inclusive entrepreneurial ecosystem in rural regions.

Keywords- Artificial Intelligence, Technological Entrepreneurship, Key Drivers, Rural Development, Structural Analysis, Shemiranat County.

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Corresponding Author:
Anabestani, Aliakbar, Ph.D.
Address: Department of Human Geography and Spatial Planning, Faculty of Earth Sciences, Shahid Beheshti University, Tehran, Iran.
Tel: +989155719016
E-mail: a_anabestani@sbu.ac.ir

1.Introduction

Entrepreneurship plays a pivotal role in the economic and social development of rural areas and can function as an effective instrument for increasing employment, reducing poverty, and preventing rural-to-urban migration. However, the development of entrepreneurship in these regions faces numerous challenges, particularly those related to innovation and technology. The lack of access to technology and innovation in rural areas, especially in the field of entrepreneurship, is one of the main barriers to the economic and social development of these regions (Darban Astaneh et al., 2022). This situation not only intensifies poverty and regional inequalities but also increases incentives for migration from rural areas to cities, thereby threatening the social and economic sustainability of rural communities. One of the key strategies for addressing inequality in rural areas and achieving spatial justice in entrepreneurship is the utilization of innovation in rural regions, particularly in the field of entrepreneurship (Mousavi et al., 2016). In fact, innovation, as a main driver of economic and social development, plays a crucial role in transforming rural areas. In these regions, the use of modern methods and technologies can enhance productivity in agriculture, livestock production, handicrafts, and tourism. Innovation not only creates new employment opportunities but also improves the quality of life of rural residents, reduces migration to urban areas, and strengthens environmental sustainability (Khosravani et al., 2024). One of the innovative approaches in entrepreneurship is the use of advanced technologies in this field. Technological entrepreneurship is a concept that has attracted significant attention from economists and policymakers in recent years. It refers to the process of identifying and exploiting business opportunities through the use of advanced technologies to create innovative products, services, or business models (Mhlanga, 2021). This type of entrepreneurship is a combination of creativity, technical knowledge, and business management aimed at solving complex problems, increasing productivity, and responding to the needs of dynamic markets. Technological entrepreneurs not only develop new technologies but also implement them operationally across various industries, thereby generating added value (Moradzadeh, 2022). This concept, especially in the digital era with technologies such as artificial intelligence, the Internet of Things, and blockchain, has become a key driver of economic and social growth (Rahimi Kolur & Akbari Arbatlan, 2023). In this context, technological entrepreneurship can serve as a strategy for diversifying rural economies and reducing dependence on natural resources (Sadeghi Ordoubadi et al., 2022). In fact, technological entrepreneurship and artificial intelligence (AI) have a mutually reinforcing relationship that can lead to significant transformations in businesses and industries. Artificial intelligence, as one of the most advanced technologies, provides entrepreneurs with powerful tools for data analysis, trend forecasting, process optimization, and the creation of innovative products and services (Vlachová, 2024). On the other hand, technological entrepreneurship, by leveraging the capabilities of artificial intelligence, creates new opportunities for designing innovative business models that can meet customer needs in a more intelligent and efficient manner (Chatterjee et al., 2021). This interaction, particularly in areas such as smart agriculture, digital health, e-commerce, and education, can lead to the emergence of businesses that are not only highly productive and profitable but also effective in addressing social and economic challenges (Rastegari et al., 2018). Despite these developments, rural areas continue to face multiple challenges, including limited access to advanced technologies, inadequate technological infrastructure, and insufficient knowledge for exploiting new opportunities. This situation has not only constrained the economic growth of these regions but has also intensified the disparity between urban and rural areas (Mousizadeh et al., 2022). The necessity of examining the impact of artificial intelligence on the development of technological entrepreneurship in rural areas arises from the considerable potential of this technology to address part of these challenges, as artificial intelligence can create new opportunities for rural communities through process optimization, cost reduction, improved market access, and the creation of innovative business models, while the precise identification of its influencing drivers can assist policymakers and planners in designing

targeted strategies to effectively utilize these capacities (Mokhtari Kerchgani, 2024). However, an examination of the country's entrepreneurial ecosystem reveals that the realization of technological entrepreneurship objectives in rural areas faces significant gaps in both hard and soft infrastructure dimensions; in terms of hard infrastructure, although official statistics from the Ministry of Information and Communications Technology indicate an increase in internet penetration in rural areas, the quality, stability, and bandwidth required for data-intensive applications and artificial intelligence- and big data-based processing remain limited and uneven, particularly in mountainous regions, thereby constraining the establishment of sustainable platform-based businesses, while in terms of soft infrastructure the challenges appear even more restrictive, as existing supportive regulations such as the Law on Supporting Knowledge-Based Companies are largely designed with a centralized and urban-oriented approach and lack the flexibility required to support the nature of small-scale rural enterprises; moreover, the low level of digital literacy and the shortage of specialized skills among the local workforce necessary to interact with artificial intelligence algorithms—as a critical soft infrastructure component—has created a profound gap between physical access to technology and the capacity for its commercial exploitation; this dual condition, consisting of structural deficiencies in both hard and soft dimensions, has not only limited the economic development of these regions but also emphasizes the main focus of this research, which is to identify the factors that determine the positive or negative effects of artificial intelligence on the development of technological entrepreneurship in rural areas, while existing research in this field remains limited and no comprehensive framework has yet been developed for identifying and analyzing these driving forces (Rezaei et al., 2013). Shamiran County, due to its unique geographical location, proximity to the metropolitan city of Tehran, and significant natural, cultural, and human capacities, has considerable potential to strengthen rural entrepreneurship and contribute to population stabilization in the region; however, challenges such as rural-to-urban migration, environmental degradation, and lack of sustainable employment have led rural areas of this county to be mainly considered seasonal tourist destinations, resulting in demographic imbalance and increasing trends in second-home development and villa construction; therefore, addressing these issues requires special attention to sustainable and innovative entrepreneurship that can contribute to productive and stable job creation, as technological entrepreneurship in the rural areas of Shamiran, particularly in Lavasanat and Rudbar-e Qasran, can foster sustainable development and employment opportunities, and one of the key areas in this regard is rural tourism, which can be strengthened through the application of modern technologies; overall, the integration of technology and entrepreneurship, particularly through emerging technologies such as artificial intelligence, can play a significant role in population stabilization and sustainability, and accordingly, the present study aims to clarify these drivers and provide a deeper understanding of the interaction between artificial intelligence technologies and the development of technological entrepreneurship in rural areas, with the main research question focusing on which drivers can influence the development of AI-based technological entrepreneurship in rural areas and what challenges play a determining role in this process.

2. Research Theoretical Literature

Artificial intelligence refers to the simulation of human intelligence processes by systems and machines that are capable of learning, reasoning, problem-solving, natural language understanding, and decision-making. Through algorithms and data, this technology acquires capabilities such as learning from experience, pattern recognition, and event prediction. As one of the core pillars of modern technologies, artificial intelligence has had profound impacts on economic and social development worldwide. By transforming decision-making processes, data management, and operational automation, it has become a key tool for improving efficiency and fostering innovation across various domains (Ahmadi et al., 2013). The application of artificial intelligence in business dates back to the 1950s, when researchers explored the possibility of developing intelligent systems to solve complex problems. In the 1980s, with the emergence of expert systems and their commercial applications, AI entered the business domain more seriously. In recent years, significant advancements in machine learning, natural language processing,

and big data analytics have enabled the wider application of this technology (Rahimi Kolur & Akbari Arbatlan, 2023). Prominent applications of AI in business include supply chain optimization, customer behavior analysis, targeted marketing, and production process automation. In technological businesses, AI plays a critical role in developing products, services, and business models by analyzing big data and providing actionable insights, enabling firms to respond more rapidly to market changes and optimize their processes (Khosravi & Seyd Moradi, 2020). In rural contexts, artificial intelligence can particularly enhance agricultural productivity, improve supply chains, and facilitate access to new markets.

The integration of artificial intelligence with entrepreneurship has led to the emergence of the concept of technological entrepreneurship, which refers to the creation and development of businesses based on advanced technologies that leverage technological innovation to introduce new products or services to the market (Anabestani & Tolabi, 2023). This form of entrepreneurship combines technical knowledge and creativity to solve existing problems and generate added value in society. As one of the leading technologies, artificial intelligence plays a significant role in transforming technological businesses, particularly in rural areas, by offering innovative solutions that improve processes, increase productivity, and create new opportunities for rural communities. In rural regions, the use of artificial intelligence can contribute to the development of technological entrepreneurship and the improvement of economic conditions. AI can be effectively applied in agricultural process optimization, natural resource management, healthcare and education services, and even rural tourism development. For instance, the use of AI in analyzing soil and water data can assist farmers in optimizing agricultural production. In other words, the applications of artificial intelligence in rural businesses can be evaluated across multiple sectors (Mohammadian, 2021).

In agriculture, artificial intelligence can support farmers in increasing production and reducing costs by analyzing environmental data, forecasting weather conditions, and managing resources efficiently. For example, the use of intelligent irrigation systems can optimize water consumption and increase crop productivity. Similarly, in livestock farming, AI can contribute to improving the quality and quantity of animal production by monitoring animal health and predicting diseases (Anabestani et al., 2024). Moreover, artificial intelligence can facilitate the creation and management of digital businesses in rural areas, thereby contributing to employment generation and wealth creation. Studies have shown that the use of digital (smart) businesses in rural regions of less developed areas has had a positive impact on job creation and wealth generation. This can increase rural incomes and contribute to sustainable rural development by eliminating intermediaries and enabling direct connections between rural producers and consumer markets (Mohammadi, 2024). In the field of education and empowerment, information and communication technologies (ICT) and artificial intelligence can support rural residents by providing virtual education and access to learning resources. These educational opportunities can cover areas such as entrepreneurship, digital marketing, and technological business management, ultimately improving quality of life and increasing local economic participation.

Research on the role of intelligent technologies and artificial intelligence in the development of entrepreneurship has attracted growing attention since the early 2010s. Fitriaana, Ariyanto, and Djatna (2011), in a comprehensive review study, examined the development of business intelligence systems in organizations and demonstrated that the use of data-driven technologies and intelligent systems plays a significant role in improving decision-making, knowledge management, and enhancing the competitive advantage of firms. This study is considered one of the earliest foundational works linking artificial intelligence and business. Cavallo, Ghezzi, Dell'Era, and Pellizzoni (2019) emphasized the role of innovation ecosystems and technological investment in the development of digital entrepreneurship, showing that advanced technologies can accelerate the growth trajectory of start-ups. Chatterjee et al. (2021) in an empirical study, demonstrated that the adoption of artificial intelligence in small and medium-sized enterprises, through improving strategic planning and customer relationship management, leads to the strengthening of entrepreneurial processes and enhanced organizational performance. Stahl (2022) investigated the role of artificial intelligence in the

development of entrepreneurial ecosystems and concluded that AI accelerates economic growth and innovation by facilitating networking, attracting investment, and reducing barriers to market entry. Lee and Wang (2022), in a study with a sustainable development approach, showed that artificial intelligence can serve as an effective tool for improving economic and social sustainability, particularly in less-developed regions. In recent years, research has increasingly focused on structural and forward-looking analyses. Gjucili and Pellegrini (2023), through a systematic literature review, identified artificial intelligence as a key enabler of entrepreneurs and emphasized its role in business model innovation. Vlachová and Binder (2024) also demonstrated that artificial intelligence, by creating innovative opportunities, plays an important role in transforming entrepreneurial activities at local and regional levels and can act as a driver of balanced development. Fossan et al. (2024) argue that AI influences entrepreneurial opportunity creation, decision-making under uncertainty, technology adoption, and labor market/productivity outcomes, while also highlighting the ambiguity surrounding the definition of AI in empirical research. Botten et al. (2024) further showed that highly cited papers often lack strong theoretical frameworks, with literature reviews and conceptual analyses dominating empirical research; when theoretical foundations are present, multiple theories are often combined, leading to fragmented conceptual structures. Consequently, their review highlights multiple future research directions in this field. From a practical perspective, their integrative effort provides a coherent understanding of the central role of artificial intelligence in entrepreneurship by synthesizing fragmented insights. Abshonga et al. (2025) emphasize the need for theoretical and methodological development in studying "entrepreneurship in the AI era," highlighting issues such as shifts in entrepreneurial practices, methodological ambiguity, and emerging research boundaries. In Iran, studies related to emerging technologies and entrepreneurship have been conducted since the early 2010s. Ahmadi, Darei, Salamezadeh, and Jafari (2013), in a pioneering study, examined the role of artificial intelligence in creating competitive advantage for technology-based businesses and showed that intelligent customer behavior analysis and data-driven planning have a significant impact on firm performance. Rastegari, Mohammadi Tamari, and Sharifzadeh (2018) emphasized the importance of technological skills and innovation in the development of rural entrepreneurship and identified modern technologies as an effective factor in reducing spatial inequalities. Khosravipoor and Seyd Moradi (2020) highlighted the role of information technology in improving and developing rural businesses and identified weak digital infrastructure as one of the main barriers to entrepreneurial development. Hajjarian et al. (2021), using grounded theory in the context of home-based business development, identified causal conditions (including managerial factors and comprehensive policy systems), intervening conditions (educational-promotional factors, motivational factors, and attitudinal factors), and contextual conditions (infrastructure, marketing, skill-related factors, and financial and credit resource development). Momeni Helali et al. (2022) found that among the components of the rural entrepreneurial ecosystem, "support" ranked the highest while the "financial" component ranked the lowest, highlighting the importance of institutional support and the challenges of financing rural businesses. Anabestani et al. (2022) identified key drivers for the formation of smart growth in rural areas, including the use of existing infrastructure to increase employment and income, improvement in land and housing prices, and rural residents' satisfaction with increased external connectivity. Rahimi Kolur and Akbari Arbatlan (2023) examined the opportunities and challenges of artificial intelligence in entrepreneurship development and found that the shortage of skilled human resources, weak technological training, and institutional constraints are among the main barriers to effective AI utilization in Iran. Anabestani and Tolabi-Nejad (2023) introduced technological entrepreneurship as an effective strategy for diversifying rural economies and reducing dependence on traditional resources. Mohibi et al. (2025) analyzed the impact of artificial intelligence on technology-based businesses in Iran and found that AI-based tools play an important role in enhancing innovation, competitiveness, and organizational strategic alignment. Finally, Mokhtari Kerchgani et al. (2024), adopting an endogenous development

approach, emphasized the necessity of linking modern technologies with local, institutional, and social contexts in rural areas (Figure 1).



Figure 1. Initial Conceptual Model of the Study

A systematic review of the literature indicates that although numerous international studies have examined the role of artificial intelligence in entrepreneurship, within domestic research, structural analysis of the drivers influencing the impact of artificial intelligence on the development of technological entrepreneurship in rural areas—particularly using integrated approaches and tools such as ISM and MICMAC—has received limited attention. Therefore, the present study seeks to address this research gap by focusing on the rural areas of Shemiranat County and aims to contribute to filling this scientific void.

3. Research Methodology

3.1 Geographical Scope of the Research

Shemiranat County is located in the northern part of Tehran Province. It is bordered by Mazandaran Province to the north, Tehran County to the south, Damavand and Pardis counties to the east, and Alborz Province to the west. With an area of approximately 1,111 square kilometers, it ranks eighth among the thirteen counties of Tehran Province. This area constitutes about 5.9% of the total area of Tehran Province and nearly 0.06% of the total area of Iran. According to the 2016 Population and Housing Census (Table 1), Shemiranat County has a population of 47,279 people, with the majority residing in the Lavasanat district, which accounts for 29,860 inhabitants. Among the cities of this county, Lavasan, with a population of approximately 18,146 people, is the most populous urban center. In addition, among the rural districts, Rudbar-e Qasran, with a population of 7,051 people, is the most populated rural district. The largest village in the county is Niknamdeh, with a population of 3,441, located in Lavasan-e Bozorg rural district, while the smallest village is Ahangarak, with only 4 inhabitants (Figure 2). Due to its proximity to the capital and its rich natural and cultural attractions, the rural areas of Shamiran have consistently attracted both domestic and international tourists, representing a significant potential for regional development. However, the conversion of agricultural and orchard lands into villas, along with declining

employment opportunities, has led to the outmigration of young and economically active populations from rural areas, contributing to continued negative population growth and an increase in very small settlements with fewer than twenty inhabitants. For a more precise assessment of the feasibility of the research objectives, the regional context can be described through three key dimensions:

Economic and Market Conditions: The rural economy of Shemiranat is primarily based on two main poles, Lavasanat and Rudbar-e Qasran. According to the 2016 census, Rudbar-e Qasran with a population of 17,419 and Lavasanat with 29,860 inhabitants together form a consumer and producer base of approximately 16,000 households. This population size generates substantial demand for local products such as honey, horticultural products, and medicinal plants. However, the seasonality of tourism-based economic activities and high overhead costs in the region make the adoption of technology essential for reducing operational costs and enabling direct access to Tehran's markets.

Technological and Digital Infrastructure: Unlike the general pattern observed in many rural areas, villages in Shemiranat —particularly more populated settlements such as Niknamdeh with 3,441 residents—benefit from adequate mobile internet coverage (4G). Field results indicate that a significant proportion of the population has access to basic digital devices such as smartphones. The existence of preliminary infrastructure for implementing smart irrigation systems in orchards, along with the increasing use of digital platforms for product marketing, indicates a relatively high level of technological readiness in the region. However, a notable skill gap remains in the commercial utilization of these infrastructures.

Entrepreneurship Conditions: The entrepreneurial ecosystem in this region represents a hybrid structure composed of "traditional businesses in transition" and "emerging innovations." Entrepreneurial activity is gradually shifting away from subsistence agriculture toward value-creating and technology-oriented models. Case studies identified in the research, such as online marketing of organic products and smart water resource management, indicate that entrepreneurial potential exists among the active population (including a large share of the 24,645 male and 22,634 female population). However, the absence of a coherent support network and weaknesses in technological commercialization have hindered the full maturation of this ecosystem.

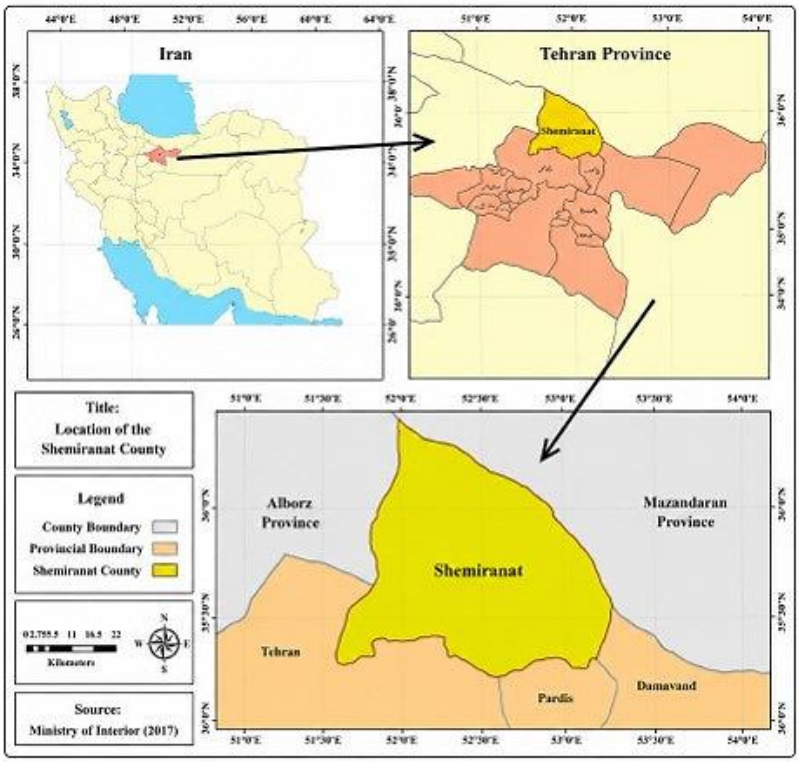


Figure 2. Geographical Location of Shemiranat County within Tehran Province, Iran

Table 1. Population of Shemiranat County by District, City, and Rural District

County	District	City	Rural District	Households	Population	Male	Female
Shamiran	Rudbar-e Qasran	—	—	16,107	47,279	24,645	22,634
	Rudbar-e Qasran	—	—	5,969	17,419	9,071	8,348
	Rudbar-e Qasran	Rudbar-e Qasran	Rudbar-e Qasran	2,478	7,051	3,657	3,394
	Rudbar-e Qasran	Fasham	—	2,294	6,945	3,664	3,281
	Rudbar-e Qasran	Shemshak	—	1,197	3,423	1,750	1,673
	Lavasanat	—	—	10,138	29,860	15,574	14,286
	Lavasanat	Lavasan-e Bozorg	—	2,045	6,034	3,171	2,863
	Lavasanat	Lavasan-e Kuchak	—	1,963	5,680	3,085	2,595
	Lavasanat	Lavasan	—	6,130	18,146	9,318	8,828

3.2. Methodology

The present study is applied in terms of its objective, as it seeks to identify and analyze the driving forces influencing artificial intelligence and to provide a practical framework for the development of technological entrepreneurship as well as to support policymaking and development planning in rural areas. In terms of nature and research design, the study is descriptive–analytical and examines the causal and structural relationships among factors affecting the development of AI-based technological entrepreneurship in rural areas. From a methodological perspective, the study adopts a mixed-methods (qualitative–quantitative) approach. In the first phase, a qualitative approach was used to identify and localize the influencing drivers. Data collection in this phase was based on the Data Triangulation strategy to ensure the validity and reliability of the results. Accordingly, two independent data sources were used: (1) documentary and library research, including a systematic review of previous studies and scientific documents, which led to the extraction of an initial comprehensive list of drivers (as the first independent source), and (2) field study, including semi-structured interviews with 18 experts responsible for localizing, refining, and validating the indicators extracted from the literature. The participants in the qualitative phase consisted of 18 experts in the fields of technological entrepreneurship, rural development, and emerging technologies, who were selected through purposive sampling. The selection criteria included at least five years of academic or executive experience related to the subject, specialized knowledge of artificial intelligence applications in business or development planning, relevant research or practical experience, and familiarity with rural conditions and issues in Shemiranat County or similar regions. Interviews continued until theoretical saturation was achieved, and the collected data were analyzed using qualitative content analysis through coding and categorization (Table 2).

Table 2. Characteristics of Interview Participants

Code	Gender	Education Level	Professional Position
E1	Male	PhD	University Faculty Member
E2	Male	PhD	University Faculty Member
E3	Male	PhD	University Faculty Member
E4	Male	PhD	University Faculty Member
E5	Male	PhD	University Faculty Member
E6	Male	PhD	University Faculty Member
E7	Female	MSc	Smart Systems Specialist
E8	Female	PhD	Smart Systems Specialist
E9	Male	PhD	Smart Systems Specialist

Code	Gender	Education Level	Professional Position
E10	Male	PhD	Tourism Expert
E11	Male	PhD	Cultural Heritage Expert
E12	Male	PhD	University Faculty Member
E13	Male	PhD	Tourism Management and Policy Expert
E14	Male	PhD	University Faculty Member
E15	Male	PhD	University Faculty Member
E16	Male	MSc	Entrepreneurship Specialist
E17	Male	MSc	Entrepreneurship Specialist
E18	Female	MSc	Entrepreneurship Specialist

In the second phase, a quantitative approach was employed to analyze the causal relationships among the identified drivers. In this stage, Interpretive Structural Modeling (ISM) was used, and MICMAC software was applied to assess the level of influence and dependence among the variables. Based on the results of the qualitative phase, a structured questionnaire was designed and distributed among the same group of experts. The results categorized the drivers into four groups: autonomous, dependent, linkage, and key drivers. The spatial scope of the study includes the rural areas of Shemiranat County, while the temporal scope corresponds to the year 2025 (1404 in the Iranian calendar). This methodological framework enables a comprehensive, systematic, and context-based analysis of the drivers influencing the role of artificial intelligence in the development of technological entrepreneurship in rural areas.

To ensure research rigor, the validity and reliability of the instruments were assessed in both qualitative and quantitative phases. The content validity of the semi-structured interviews and the questionnaire was confirmed through expert evaluation in the fields of technological entrepreneurship and rural development, and necessary revisions were applied before final implementation. For reliability assessment of the qualitative content analysis, a portion of the interview transcripts was independently coded by two coders, and inter-coder reliability was measured using Cohen's Kappa coefficient. The obtained Kappa value was 0.78, indicating an acceptable level of agreement and satisfactory reliability of the qualitative analysis.

4. Research Findings

Grounded Theory, as a qualitative approach, provides a powerful framework for examining the driving forces influencing artificial intelligence on the development of rural technological entrepreneurship by extracting concepts from data and building theory. This method consists of three main stages—open coding, axial coding, and selective coding—each of which contributes to the identification of key factors. Based on this approach, the driving forces are analyzed as follows:

4.1. Technological Drivers

In the open coding stage, concepts related to emerging technologies were identified. In the context of artificial intelligence, factors such as access to advanced machine learning algorithms, automation of agricultural and production processes, and the development of rural data analytics tools were identified as key drivers. In axial coding, the effects of these factors on productivity enhancement and cost reduction became more evident.

Table 3. Outcomes of Technological Drivers

Interview Excerpt	Open Coding	Axial Coding	Interview Output
"In the orchards of Lavasan, we use smart irrigation systems that have significantly reduced water consumption and improved efficiency. These systems analyze weather and soil data to determine the timing and amount of irrigation. However, more advanced tools, such as AI-based plant disease detection systems, are still rarely used. This indicates a need for specialized training so that farmers can properly utilize these technologies."	Access to advanced machine learning algorithms, automation of agricultural and production processes, development of rural data analytics tools	Productivity and cost reduction	Data analysis (65%), process automation (55%), access to technology (40%).

These technologies enhance entrepreneurial capacity by facilitating innovation in products and services. The rural areas of Lavasanat, due to their proximity to the capital and better access to internet and digital infrastructure, have relatively high potential for the application of artificial intelligence technologies. Some local farmers are already using smart systems for precision irrigation and weather forecasting; however, public awareness of more advanced applications of AI—such as agricultural data analytics and production automation—remains limited (Table 3).

4.2. Economic Drivers

In the open coding stage, factors such as reducing operational costs, increasing the efficiency of local resources, and accessing new markets through smart platforms were identified. In the axial coding stage, the relationships between these factors and the development of employment and value-added creation in rural areas were examined. The role of artificial intelligence in optimizing supply chain processes and enabling new business models was also identified as one of the key results at this stage. The Lavasanat region, due to its natural attractions and tourism potential, represents a significant potential market for local products and services. The use of smart platforms, such as online sales applications, has enabled some rural businesses to market their products in urban markets. However, limited investment in advanced artificial intelligence technologies remains a major barrier to cost reduction and the optimization of economic processes (Table 4).

Table 4. Outcomes of Economic Drivers

Interview Excerpt	Open Coding	Axial Coding	Interview Output
"The use of online sales applications in Lavasanat has enabled local products such as honey and medicinal plants to reach Tehran and even other cities. This has increased producers' income; however, challenges such as high digital advertising costs and lack of familiarity with smart marketing tools still exist. Moreover, the use of artificial intelligence for price forecasting or supply chain management could further enhance productivity, which has not yet been sufficiently addressed."	Reduction of operational costs, increased efficiency of local resources, access to new markets	Employment development and value-added creation	Cost reduction (70%), access to new markets (60%), increased efficiency of local resources (50%).

4.3. Social Drivers

In the open coding stage, factors such as increased access to AI-based skill training, strengthening of social networks and local cooperation, and enhanced awareness of technological opportunities among rural communities were identified. In the axial coding stage, these factors were linked to the development of social capital, trust in technology, and improved interactions between local communities and technology experts. In the Lavasanat region, social awareness of new technologies is relatively higher than in many other rural areas due to its close proximity to Tehran. Local educational and awareness-raising programs related to artificial intelligence, particularly in youth skill development, have had a positive impact. However, many individuals still refrain from using AI in their daily lives due to concerns about technological complexity or insufficient trust (Table 5).

Table 5. Outcomes of Social Drivers

Interview Excerpt	Open Coding	Axial Coding	Interview Output
"In Lavasan, some young people have become familiar with artificial intelligence tools, but cultural acceptance of these technologies is still at a low level. Organizing educational workshops, both online and in-person, such as training on smart farm management tools, has had a positive effect on increasing trust and adoption. Furthermore, strengthening rural social networks and creating experience-sharing groups can be effective in expanding awareness and trust in these technologies."	Increased access to AI-based skill training, strengthening of social networks and local cooperation, increased awareness of technological opportunities in rural communities	Social capital, trust in technology, and improved interactions between local communities and technology experts	Skills training (75%), increased social interaction (50%), trust in technology (40%).

4.4. Policy-Making Drivers

In the open coding stage, factors such as government support for technological innovation, the formulation of supportive regulations for the use of artificial intelligence in rural businesses, and the encouragement of investment in digital infrastructure were identified. In the axial coding stage, these factors were recognized as key drivers for the sustainable development of rural areas. Despite the high potential of the Lavasanat region for the development of technology-based businesses, the lack of clear policies and sufficient governmental support remains one of the main challenges. The government can facilitate broader adoption of artificial intelligence by providing financial incentives and free training programs. Although some initial steps have been taken to develop digital infrastructure, more comprehensive and integrated policymaking is still required (Table 6).

Table 6. Outcomes of Policy-Making Drivers

Interview Excerpt	Open Coding	Axial Coding	Interview Output
"Government support such as subsidies and loans for purchasing smart equipment has started in Lavasanat, but the lengthy and complicated application process has discouraged many entrepreneurs. Creating a simple platform for registration and local consultation could remove these barriers. In addition, clear policymaking for expanding technological infrastructure in these areas is necessary to improve access to the internet and equipment."	Government support for technological innovation, formulation of supportive laws for AI use in rural businesses, encouragement of investment in digital infrastructure	Key drivers for sustainable rural development	Government support (60%), technology-oriented regulations (50%), infrastructure investment (40%).

4.5. Environmental Drivers

In the open coding stage, factors such as intelligent management of natural resources, reduction of environmental impacts of production processes, and increasing the resilience of rural communities against climate change through artificial intelligence were identified. In the axial coding stage, these factors were associated with the enhancement of sustainability and environmental efficiency in rural communities. The Lavasanat region, with its rich natural resources including orchards and rangelands, requires smart management of these resources to prevent environmental degradation. The use of artificial intelligence technologies for monitoring water consumption and soil management can contribute significantly to the preservation of natural resources. Although some initial efforts have been made in this regard, the widespread implementation of these technologies has not yet been realized (Table 7).

Table 7. Outcomes of Environmental Drivers

Interview Excerpt	Open Coding	Axial Coding	Interview Output
"Lavasan, with its rich natural resources, has a strong need for smart management. The use of intelligent water and soil monitoring systems has reduced water consumption in orchards and improved soil fertility. However, the large-scale implementation of these technologies requires financial and educational support. If training workshops are organized for farmers, they can effectively benefit from smart monitoring systems."	Intelligent management of natural resources, reduction of environmental impacts of production processes, increasing resilience of rural communities to climate change	Enhancement of environmental sustainability and efficiency in rural communities	Resource management (70%), reduction of environmental impacts (50%), rural resilience (45%).

After identifying 18 influential drivers across five domains—technological, economic, social, policy-making, and environmental—the relationships among these factors were evaluated in a pairwise manner based on expert judgments. The resulting data were entered into MICMAC software for

analysis. This software enables the classification of variables by calculating their driving power (the extent to which a factor influences other variables) and dependence (the extent to which a factor is influenced by other variables), thereby allowing the categorization of factors into four main clusters:

1. **Key drivers:** high driving power and low dependence, which determine the overall direction of the system.
2. **Linkage drivers:** high driving power and high dependence, which are highly unstable and require careful management.
3. **Dependent drivers:** low driving power and high dependence, which represent the outcomes of the system.
4. **Autonomous drivers:** low driving power and low dependence, which have limited influence on the overall system.

The results of the direct influence matrix revealed that environmental policies and the role of technology in resource management, access to emerging technologies (such as artificial intelligence), and governmental support policies exert the highest driving power over other factors. In contrast, factors such as legal and regulatory frameworks, economic growth, and social interactions exhibited higher levels of dependence on other drivers, while still maintaining a degree of influence within the system (Table 8).

Table 8. Key Drivers Based on Driving Power and Dependence

No.	Key Factor	Driving Power	Dependence	Initial Position
1	Environmental policies and the role of technology in resource management	33	25	Key
2	Access to emerging technologies (artificial intelligence)	28	30	Linkage
3	Government support policies (incentives and subsidies)	28	17	Key
4	Social awareness and cultural promotion policies	28	23	Linkage
5	Governmental legal frameworks and regulations	26	25	Linkage
6	Economic growth and social interactions	25	26	Linkage

These results indicate that governmental policies and technological infrastructures are positioned as the most influential driving forces, and any changes in these domains can lead to significant transformations across other dimensions of the system. Based on the MICMAC analysis, the drivers are classified into four main groups (Table 9):

Table 9. Direct and Indirect Influence of Drivers

Variable	Influence	Dependence	Net Influence	Type
Environmental policies in resource management	33	25	+8	Key
Access to emerging technologies	28	30	-2	Linkage
Government support policies and incentives	28	17	+11	Key
Legal and regulatory frameworks	26	25	+1	Linkage
Development of digital infrastructure	27	20	+7	Key
Economic growth and social interactions	25	26	-1	Linkage
Social awareness and cultural promotion	24	28	-4	Linkage
Digital skills of local communities	20	30	-10	Dependent
Social networks and social capital	18	27	-9	Dependent
Public awareness	17	26	-9	Dependent
Micro and local environmental factors	15	16	-1	Autonomous

Key drivers exhibit the highest level of influence over other factors while showing the lowest level of dependence. According to the quantitative MICMAC results, environmental policies in resource management, government support policies and incentives, and the development of digital infrastructure achieved the highest driving power scores. The qualitative interview results also emphasized that these factors constitute the main driving engine of technological entrepreneurship development in rural areas, and any change in them triggers a cascading effect across other variables Linkage drivers demonstrate both high influence and high dependence, indicating their instability and dynamic nature. This category includes access to emerging technologies, legal

and regulatory frameworks, economic growth and social interactions, and social awareness and cultural promotion. Qualitative results revealed that these factors are deeply interdependent, and changes in one can generate reciprocal and cascading effects in others. The MICMAC results confirmed this interdependency, highlighting the need for integrated and coordinated management to avoid unpredictable fluctuations. Dependent drivers have low influence but high dependence on other variables. This group includes digital skills of local communities, social networks and social capital, and public awareness. The MICMAC results indicated that these factors are primarily outcomes of key policy interventions. Qualitative results further confirmed that improvements in infrastructure and strategic policies directly enhance these indicators Autonomous drivers represent factors with both low influence and low dependence. These micro and local environmental factors were positioned in the low-impact quadrant in the MICMAC analysis, and qualitative results suggested that they do not significantly affect the system in the short term. Overall, this analysis demonstrates that for the development of technological entrepreneurship in rural areas, priority should be given to key drivers. Specifically, governmental support policies and the development of technological infrastructure form the fundamental foundation for systemic change across other dimensions. In the second stage, linkage drivers should be managed through an integrated and coordinated approach to minimize instability and prevent negative reciprocal effects. Finally, dependent drivers should be monitored as outcome indicators to evaluate the effectiveness of implemented policies. This framework provides a clear causal chain of drivers and offers valuable insights for policymakers regarding which areas of investment yield the highest systemic impact (Table 10).

Table 10. Final Interpretation and Classification of Variables

Variable Group	Characteristics	Example Variables	Description
Key	High influence, low dependence	Environmental policies, government support policies, digital infrastructure	These variables act as the main driving forces of development, and changes in them lead to cascading systemic effects.
Linkage	High influence, high dependence (unstable)	Emerging technologies, legal frameworks, economic growth, cultural promotion	Changes in this group generate instability and bidirectional effects; therefore, they require integrated management.
Dependent	Low influence, high dependence	Digital skills, social capital, public awareness	These variables are outcomes of key drivers and reflect the final performance of the system.
Autonomous	Low influence, low dependence	Micro-level environmental factors	These variables have limited impact on the system, and their changes are short-term and marginal.

4.6. Stability and Sensitivity Analysis of the Model

To assess the robustness and stability of the identified causal structure among the drivers, in addition to confirming the reliability of qualitative coding through Cohen's Kappa coefficient (0.78), the quantitative stability of the model was examined from two perspectives. First, the analysis of net influence (Table 9) indicated that key drivers such as "government support policies" and "development of digital infrastructure," with the highest net influence values (+11 and +7, respectively), exhibit the lowest dependence on other variables and function as fundamental independent variables that determine the overall direction of the system. In other words, changes in these variables generate cascading effects across lower-level components, whereas changes in dependent variables (such as digital skills or social capital) do not exert reverse effects on these core driving forces. This asymmetry reflects the high stability of the causal structure. Second, based on the hierarchical levels derived from the ISM model (Table 11), it is observed that fourth-level (base) drivers are sufficiently stable such that even under hypothetical removal of some intermediate or dependent variables in analytical scenarios, their position at the top of the causal hierarchy remains unchanged, due to their minimal dependence on other variables. Although a formal stepwise quantitative sensitivity analysis through variable elimination was not prioritized in the present study due to the expert-based nature of the data and the

limited sample size (18 experts), the high convergence of expert opinions and the stability of key variable positions in both direct and indirect influence matrices indicate the robustness of the model against minor variations in individual judgments. Nevertheless, as a methodological suggestion, future research with a quantitative approach and larger sample sizes could conduct sensitivity analysis through scenario-based elimination of variables with near-zero net influence (such as micro-level environmental factors), in order to more precisely quantify the extent to which the model structure is affected by marginal variables. Such an approach would not only enhance the robustness of results but also enable the development of more resilient managerial scenarios. Overall, the results confirm that the extracted causal structure possesses acceptable stability and can serve as a reliable foundation for policymaking in the field of rural technological entrepreneurship.

Table 11. ISM-Based Hierarchical Classification of Drivers Influencing AI-Based Technological Entrepreneurship Development

ISM Level	Driver Type	Driver Title	Role in the Causal Structure
Level IV (Base)	Key	Government support policies and incentives	Institutional foundation and main driver of technological entrepreneurship development
		Environmental policies and the role of technology in resource management	Establishing sustainability foundations and long-term system orientation
		Development of digital and communication infrastructure	Enabling access to and utilization of AI-based technologies
Level III (Intermediate)	Linkage	Access to emerging technologies (artificial intelligence)	Transferring effects from policies and infrastructure to the operational level
		Legal and regulatory frameworks related to technology	Regulating interactions between government, market, and entrepreneurs
Level II (Intermediate)	Linkage	Social culture building and technology acceptance	Facilitating effective use of technology at the societal level
		Local economic growth and social interactions	Strengthening innovation cycles and local cooperation
Level I (Outcome)	Dependent	Improvement of digital skills in local communities	Direct result of institutional and technological investments
		Strengthening social networks and social capital	Social outcome of technological entrepreneurship development
		Increasing public awareness of AI opportunities	Final output of the causal structure and indicator of policy success
Autonomous variables	Autonomous	Micro and local environmental factors	Limited and non-systemic influence

Source: Research results, 2025

5. Discussion and Conclusion

Rapid technological transformations in recent decades have significantly highlighted the role of artificial intelligence (AI) across economic, social, environmental, and institutional domains. In this context, rural areas face a dual challenge: on the one hand, an urgent need for economic development, social improvement, and environmental sustainability, and on the other, technological backwardness and weak digital infrastructure. The present study, using a mixed-methods approach and focusing on Shemiranat County, systematically examined the drivers influencing AI's role in fostering technological entrepreneurship in rural areas. The results indicate that the impact of AI on rural technological entrepreneurship can be categorized into five main groups of drivers: technological, economic, social, policy-related, and environmental. In the technological dimension, access to advanced machine learning algorithms, development of data analytics tools, smart agricultural systems, and

production automation play a significant role in reducing costs, increasing productivity, and creating innovative opportunities for local businesses. These results are consistent with studies such as Vlachová (2024) and Giuggioli (2023), which identify AI as a key tool for improving decision-making, innovation, and forecasting within entrepreneurial ecosystems. In the economic dimension, the study confirmed that AI contributes to employment development, income growth, and productivity improvement in rural areas through supply chain optimization, price forecasting, market identification, and facilitation of digital sales. These results align with the work of Anabestani (2022) and Chatterjee et al. (2021), who emphasize AI's role in economic empowerment and access to new markets in the social dimension, AI indirectly influences the formation of social capital and the enhancement of interactions by improving access to technological skills training, strengthening local communication networks, increasing trust in technology, and raising public awareness. This finding is consistent with Mohammadian (2020) and Rahimi Kloor (2023), who reported that technological education and access to digital platforms enhance local participation in development processes. In the policy and governance dimension, the results show that government support, enabling regulatory frameworks, financial incentives, and the development of digital infrastructure are among the most important institutional drivers for implementing AI in rural areas. This finding is supported by studies such as Ahmadi et al. (2013) and Basaki & Duffy (2021), which emphasize the critical role of government in strengthening innovative ecosystems through policy-making and investment. In the environmental dimension, the application of AI in natural resource management, monitoring water and soil consumption, forecasting climate risks, and enhancing rural resilience plays a crucial role in environmental sustainability. These results are consistent with Lee et al. (2022), who highlighted the contribution of AI to sustainable development in underprivileged regions. From an analytical perspective, the use of the MICMAC method enabled the identification and classification of key, linkage, dependent, and autonomous drivers. Environmental policies, access to technology, and government support emerged as key drivers with the highest influence on other factors, shaping the overall trajectory of technological entrepreneurship development. This analytical framework enables policymakers to focus on leverage points that generate cascading effects across multiple dimensions. In comparison with the existing literature, the present study offers several key contributions. Based on the identified drivers, it is recommended that policymakers and local institutions prioritize the development of rural digital infrastructure. Expanding high-speed internet coverage, establishing public digital access centers, and equipping local administrations with smart systems can facilitate the effective use of AI-based tools by rural entrepreneurs. To strengthen technological drivers, it is suggested that rural innovation hubs and specialized accelerators focused on AI applications be established in areas such as smart agriculture, rural tourism, and local creative industries. These centers can reduce entry barriers for rural entrepreneurs by providing technical consultancy, business mentoring, and initial financial support. Given the role of institutional and policy drivers, it is essential to design targeted incentive frameworks for rural technology-based businesses, including low-interest loans, temporary tax exemptions, and support for the commercialization of AI-driven ideas. Such measures can enhance private sector investment and encourage youth participation in rural entrepreneurship. In terms of human capital, specialized training and empowerment programs in digital literacy, practical AI applications, and technological entrepreneurship skills should be developed in collaboration with universities, vocational training centers, and the private sector. These programs must be aligned with local market needs and regional capacities. From a social and cultural perspective, awareness-raising initiatives regarding the adoption of emerging technologies should be strengthened through local workshops, dissemination of successful rural entrepreneurial cases, and use of local media platforms. Such efforts can reduce resistance to new technologies and facilitate broader acceptance of AI. Finally, the results of this study indicate that artificial intelligence is not merely a complex imported technology, but rather a transformative tool that, through proper management, training, targeted policymaking, and local participation, can become a dynamic foundation for sustainable and inclusive rural development. Achieving this transformation

requires an integrated, long-term, and cross-sectoral approach involving government, academia, civil society, and the private sector.

Author Contributions

The authors contributed equally to the development and preparation of this research.

Conflict of Interest

The authors declare that there is no conflict of interest regarding the authorship or publication of this article.

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Reference

1. Ahmadi, S. A., Darei, M. R., Salamzadeh, A., & Jafari, M. R. (2013). Artificial intelligence and business opportunities: Identifying the functions of AI in creating competitive advantages for tech-based businesses (Case study: Video game industry). *Journal of Entrepreneurship Development*, 6(2), 7–26. https://doi.org/10.22059/jed.2013.36257 [In Persian]
2. Anabestani, A. A., & Toulabinejad, M. (2023). Competitive Advantages of Indigenous Rural Entrepreneurship in Iran (Case Study: South of Lorestan Province). *Spatial Planning*, 13(3), 1-28. https://doi.org/10.22108/sppl.2023.135985.1684 [In Persian]
3. Anabestani, A., Bahadori Amjaz, F. L. & Tavakolinia, J. (2022). Analyzing the Key Drivers of the Effect of Smart Growth Approach on Sustainable Development of Iranian Rural Settlements. Journal of Research and Rural Planning, 11(3), 91-113. https://doi.org/10.22067/jrrp.v11i3.2208.1059
4. Anabestani, A., Tavakolinia, J., & Niknami, N. (2024). The Role of Artificial Intelligence in Improving Citizens' Quality of Life with a Future Study Approach (Case Study: Mashhad Metropolis). *Urban Economics and Planning*, 5(1), 6-21. https://doi.org/10.22034/uep.2024.442663.1461 [In Persian]
5. Basaki, B., & Duffy, T. (2021). The role of AI in enhancing entrepreneurial ecosystems. *Journal of Sustainable Tourism*, 34(2), 342–542. https://doi.org/10.1080/09669582.2021.1874399
6. Boateng, S. L., Penu, O. K. A., Budu, J., et al. (2024). Mapping the Research on Artificial Intelligence and Entrepreneurship: A Bibliometric Review from Scopus Database. *International Journal of E-Entrepreneurship and Innovation* (IJEEI). DOI: 10.4018/IJEEI.343790
7. Cavallo, A., Ghezzi, A., Dell'Era, C., & Pellizzoni, E. (2019). Fostering digital entrepreneurship from startup to scaleup: The role of venture capital funds and angel groups. *Technological Forecasting and Social Change*, 145, 24–35. https://doi.org/10.1016/j.techfore.2019.04.022
8. Chatterjee, S., Chaudhuri, R., Vrontis, D., & Basile, G. (2021). Digital transformation and entrepreneurship process in SMEs of India: A moderating role of adoption of AI-CRM capability and strategic planning. *Journal of Strategy and Management*. https://doi.org/10.1108/JSMA-08-2020-0221
9. Darban Astaneh, M. R., Shayan, H., Anabestani, A. A., & Sajasi Gheydari, H. (2022). Analyzing the impact of structural innovation factors on rural entrepreneurship process (Case study: Farooj County). *Geographical Studies of Arid Regions*, 12(45), 58–77. https://jargs.hsu.ac.ir/article_161549.html [In Persian]
10. Fitriana, R., Eriyatno, T. D., & Djatna, T. (2011). Progress in Business Intelligence System research: A literature review. *International Journal of Basic & Applied Sciences (IJBAS-IJENS)*, 11(3), 118-124.
11. Fossen, F. M., McLemore, T., & Sorgner, A. (2024). Artificial intelligence and entrepreneurship. *Foundations and Trends® in Entrepreneurship, 20*(8), 781-904. https://docs.iza.org/dp17055.pdf
12. Giuggioli, G., & Pellegrini, M. M. (2023). Artificial intelligence as an enabler for entrepreneurs: A systematic literature review and an agenda for future research. *International Journal of Entrepreneurial Behavior & Research*, 29(4), 816–837. https://doi.org/10.1108/IJEBR-03-2022-0222
13. Hajarian, A. , Taghdisi, A. and Barghi, H. (2021). Presenting a Paradigm Model of Home Business Development in Rural Areas of Counties in Isfahan Province Based on Grounded Theory. Journal of Research and Rural Planning, 10(4), 43-58. https://doi.org/10.22067/JRRP.V10I4.2102.1004
14. Khosravani, R., Vosoughi, M., Baghaei Sarabi, A., & Mousaei, M. (2024). The impact of entrepreneurial and innovative personality in economic activities on improving rural quality of life (Case study: Villages of Nazarabad County). *Social Welfare Quarterly*, 24(93), 301–338. https://doi.org/10.32598/refahj.24.93.4156.1 [In Persian]
15. Khosravipour, B., & Seyedmoradi, A. (2020). The role of information technology in the development and improvement of rural businesses. In *1st International Conference on New Challenges and Solutions in Industrial Engineering, Management and Accounting*, Sari. https://civilica.com/doc/1045598 [In Persian]

16. Li, H., & Wang, H. (2020). Research on the application of artificial intelligence in education. In *2020 15th International Conference on Computer Science & Education (ICCSE)* (pp. 589–591). https://doi.org/10.1109/ICCSE49874.2020.9201743
17. Mhlanga, D. (2021). Artificial intelligence in Industry 4.0, and its impact on poverty, innovation, infrastructure development, and the sustainable development goals: Lessons from emerging economies? *Sustainability*, 13(11), 5788. https://doi.org/10.3390/su13115788
18. Mohammadi, R., Mousavifard, S. R., Rezaei, B., & Hoseinpour, M. (2024). The impact of artificial intelligence technology on entrepreneurship development with the mediating role of entrepreneurship education. *New Approaches in Management and Marketing*, 3(1), 86–105. https://doi.org/10.22034/jnamm.2024.454730.1052 [In Persian]
19. Mohammadian, A. (2021). Investigating the impact of digital (smart) businesses on job creation and wealth generation in deprived rural areas. In *4th National and 1st International Conference on New Models of Management and Business*, Tehran. https://civilica.com/doc/1394291 [In Persian]
20. Mohebbi, H., & Tarfi, S. (2025). Foresight of AI development in Iran using scenario planning approach. *Studies in Smart Business Management*, 14(53), 159–204. https://doi.org/10.22054/ims.2025.84715.2597 [In Persian]
21. Mokhtari Karchgani, A., Tavakoli, M., & Pourtaheri, M. (2024). A new paradigm of endogenous rural development: A thematic analysis. *Journal of Rural Research*, 15(2), 208–225. https://doi.org/10.22059/jrur.2024.367453.1880 [In Persian]
22. Moradzadeh, M. (2022). Investigating the role of artificial intelligence in entrepreneurship and entrepreneurial activities. In *2nd International Conference on Science, Engineering, and the Role of Technology in New Businesses*. https://civilica.com/doc/1512064 [In Persian]
23. Moumenihelali, H., Abbasi, E. & Kroesen, O. (2022). A Regional Analysis of the Entrepreneurship Ecosystem in Rural Areas of Northern Iran (Case Study: Watershed of the Haraz Plain). Journal of Research and Rural Planning, 11(2), 61-79. https://doi.org/10.22067/jrrp.v11i2.2112-1035
24. Mousazadeh, N., Khoshnavaaz, Z., Pashaee, P., & Shateri, M. (2021). The role of information and communication technology in sustainable development of rural settlements (Case study: Villages of Beshiva Patagh, Kermanshah Province). *Journal of Economic Geography Research*, 2(5), 65–82. https://dor.isc.ac/dor/20.1001.1.27173747.1400.3.2.5.6 [In Persian]
25. Obschonka, M., Gregoire, D. A., Nikolaev, B., Ooms, F., Lévesque, M., Pollack, J. M., & Behrend, T. S. (2025). Artificial intelligence and entrepreneurship: a call for research to prospect and establish the scholarly AI frontiers. *Entrepreneurship Theory and Practice, 49*(3), 620-641. https://doi.org/10.1177/10422587241304676
26. Rahimi Kaloor, H., & Akbari Arbatān, G. (2023). Exploring the challenges and opportunities of artificial intelligence for entrepreneurship development and startup growth. *Information Management Sciences and Technologies*, 9(4), 205–232. https://doi.org/10.22091/stim.2023.9411.1952 [In Persian]
27. Rastegari, H., Mohammadi Tamari, Z., & Sharifzadeh, M. (2018). Identifying and prioritizing rural entrepreneurship skills: Application of artificial neural network technique. *Rural Development Strategies*, 5(4), 547–565. https://doi.org/10.22048/rdsj.2019.117563.1707 [In Persian]
28. Rezaei, R., Tohidlou, Sh., & Arabion, A. (2013). Investigating barriers to the development of nanotechnology-based entrepreneurship. *Journal of Entrepreneurship Development*, 6(1), 105–124. https://doi.org/10.22059/jed.2013.36252 [In Persian]
29. Sadeghi Ordoubadi,B. , Mohammadkazemi,R. and Hosseininia,G. (2023). Designing a conceptual model for the development of digital business ecosystem based on scientometric studies. *Iranian journal of management sciences*, *17*(68), 133-155. https://journal.iams.ir/article_392.html?lang=en [In Persian]
30. Stahl, B. C. (2022). Responsible innovation ecosystems: Ethical implications of the application of the ecosystem concept to artificial intelligence. *International Journal of Information Management, 62*, 102441. https://doi.org/10.1016/j.ijinfomgt.2021.102441
31. Vaghar-Mousavi, M., Ghods Alavi, A., & Abbasi, M. (2016). Investigating the role of social entrepreneurship in the development of social justice. *Entrepreneurship and Sustainable Agricultural Development Studies*, 3(2), 21-38. https://doi.org/10.22069/jead.2016.3076 [In Persian]
32. Vlachová, M., & Binder, A. (2024). Driving change in the energy sector: Evaluating entrepreneurial opportunities provided by artificial intelligence. *Journal of Cleaner Production*, 431, 139590. https://doi.org/10.1016/j.jclepro.2023.139590

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Original Article

تبیین پیشران‌های اثرگذاری هوش مصنوعی بر توسعه کارآفرینی فناورانه (مطالعه موردی: نواحی روستایی شهرستان شمیرانات)

علی‌اکبر عنابستانی[1]، بهناز رحیمی[2]

۱. استاد گروه جغرافیای انسانی و آمایش، دانشگاه شهید بهشتی، تهران، ایران.

۲. دانشجوی دکترای جغرافیا و برنامه‌ریزی روستایی، دانشگاه شهید بهشتی، تهران، ایران.

چکیده مبسوط

۱. مقدمه

در دهه‌های اخیر، فناوری‌های نوین، به‌ویژه هوش مصنوعی(AI)، به‌عنوان موتور محرک تحول در الگوهای کسب‌وکار و توسعه کارآفرینی شناخته شده‌اند. هوش مصنوعی با قابلیت‌هایی نظیر تحلیل داده‌های کلان، پیش‌بینی روندها، خودکارسازی فرآیندها و بهینه‌سازی تصمیم‌گیری، بستری مناسب برای شکل‌گیری کسب‌وکارهای نوآورانه و کارآفرینی فناورانه فراهم می‌کند. کارآفرینی فناورانه، که بهره‌گیری خلاقانه از فناوری‌های نوین برای خلق محصولات، خدمات و مدل‌های کسب‌وکار جدید است، می‌تواند نقش مهمی در توسعه پایدار، به‌ویژه در نواحی روستایی ایفا کند. این نوع کارآفرینی با افزایش بهره‌وری، ایجاد اشتغال مولد و کاهش وابستگی به منابع سنتی، می‌تواند به پایداری اقتصادی-اجتماعی جوامع روستایی کمک شایانی نماید. پژوهش حاضر، با تمرکز بر نواحی روستایی شهرستان شمیرانات، به‌دنبال پاسخ به این سوال اصلی است که "پیشران‌های کلیدی اثرگذاری هوش مصنوعی بر توسعه کارآفرینی فناورانه در این مناطق کدام‌اند و این پیشران‌ها چه روابط علی و ساختاری با یکدیگر دارند؟" شناسایی این پیشران‌ها می‌تواند به سیاست‌گذاران و برنامه‌ریزان در طراحی استراتژی‌های هدفمند و کارآمد برای بهره‌گیری از ظرفیت‌های هوش مصنوعی در راستای توسعه روستایی کمک کند.

۲. مبانی نظری تحقیق

هوش مصنوعی، به‌عنوان شاخه‌ای از علوم رایانه، به شبیه‌سازی فرآیندهای هوش انسانی توسط ماشین‌ها می‌پردازد. این فناوری با بهره‌گیری از الگوریتم‌ها و داده‌ها، توانایی یادگیری، استدلال، درک زبان طبیعی و تصمیم‌گیری را به سیستم‌ها می‌دهد. از سوی دیگر، کارآفرینی فناورانه، فرآیند شناسایی و بهره‌برداری از فرصت‌های کسب‌وکار از طریق خلق محصولات، خدمات یا مدل‌های تجاری نوآورانه مبتنی بر فناوری است. ادبیات نظری نشان می‌دهد که رابطه هوش مصنوعی و کارآفرینی فناورانه، رابطه‌ای متقابل و تقویت‌کننده است. هوش مصنوعی با ارائه ابزارهای تحلیلی قدرتمند، امکان شناسایی فرصت‌های جدید، بهینه‌سازی فرآیندها و کاهش هزینه‌ها را برای کارآفرینان فراهم می‌آورد و کارآفرینان نیز با خلق کاربردهای نوآورانه از هوش مصنوعی، به توسعه و تکامل این فناوری کمک می‌کنند. مرور نظام‌مند پیشینه نشان می‌دهد که علی‌رغم غنای پژوهش‌های بین‌المللی و داخلی، یک خلأ علمی در تحلیل ساختاری و سیستمی پیشران‌های اثرگذاری هوش مصنوعی بر کارآفرینی فناورانه در نواحی روستایی ایران، به‌ویژه با رویکرد ترکیبی و استفاده از تکنیک‌هایی مانند مدل‌سازی ساختاری تفسیری (ISM) وجود دارد که پژوهش حاضر درصدد پر کردن آن است.

۲. روش تحقیق

پژوهش حاضر از نظر هدف، کاربردی و از نظر ماهیت، توصیفی-تحلیلی است که با رویکردی ترکیبی (کیفی-کمی) انجام شده است. در مرحله کیفی، به‌منظور شناسایی و بومی‌سازی پیشران‌ها، از روش تحلیل محتوای کیفی مبتنی بر استراتژی تثلیث داده‌ها استفاده شد. داده‌های این بخش از دو منبع گردآوری گردید: ۱) مطالعات اسنادی و کتابخانه‌ای برای استخراج فهرست اولیه پیشران‌ها، و ۲) مصاحبه‌های نیمه‌ساختاریافته با ۱۸ نفر از خبرگان حوزه‌های کارآفرینی فناورانه، توسعه روستایی و فناوری‌های نوین که به‌صورت هدفمند انتخاب شدند. معیارهای انتخاب خبرگان شامل داشتن حداقل پنج سال سابقه علمی یا اجرایی مرتبط و آگاهی از شرایط مناطق روستایی بود. مصاحبه‌ها تا دستیابی به اشباع نظری ادامه یافت و داده‌ها با استفاده از کدگذاری باز، محوری و گزینشی تحلیل شدند. برای تأمین روایی، از نظر خبرگان و برای پایایی، از ضریب

*. نویسندهٔ مسئول:
دکتر علی‌اکبر عنابستانی
آدرس: گروه جغرافیای انسانی و آمایش، دانشکده علوم زمین، دانشگاه شهید بهشتی، تهران، ایران.
پست الکترونیکی: Email: a_anabestani@sbu.ac.ir

کاپای کوهن (با مقدار ۰.۷۸) استفاده شد که نشان‌دهنده توافق مناسب است. در مرحله کمی، برای تحلیل روابط علّی میان پیشران‌های شناسایی‌شده، از تکنیک مدل‌سازی ساختاری تفسیری (ISM) و نرم‌افزار MICMAC استفاده گردید. قلمرو مکانی پژوهش، نواحی روستایی شهرستان شمیرانات (با دو بخش اصلی لواسانات و رودبار قصران) در استان تهران و قلمرو زمانی آن سال ۱۴۰۴ است.

۴. یافته‌های تحقیق

یافته‌های بخش کیفی منجر به شناسایی ۱۸ پیشران اثرگذار در پنج حوزه اصلی گردید: پیشران‌های فناورانه، اقتصادی، اجتماعی، سیاست‌گذاری و محیطی. نتایج مصاحبه‌ها نشان داد که با وجود پتانسیل‌های بالا در منطقه لواسانات، چالش‌هایی نظیر محدودیت سرمایه‌گذاری، نبود سیاست‌های حمایتی مشخص و شکاف مهارتی، موانع اصلی بهره‌گیری از هوش مصنوعی محسوب می‌شوند. نتایج بخش کمی از تحلیل ISM و MICMAC نشان داد که پیشران‌های کلیدی با بالاترین قدرت نفوذ و کمترین وابستگی، عبارتند از :سیاست‌های زیست‌محیطی و نقش فناوری در مدیریت منابع، سیاست‌های حمایتی دولتی و توسعه زیرساخت‌های دیجیتال . این عوامل به‌عنوان موتور محرک اصلی سیستم معرفی شدند و در سطح چهارم (پایه‌ای) مدل قرار گرفتند. پیشران‌های پیوندی با نفوذ و وابستگی بالا، شامل دسترسی به فناوری‌های نوین، قوانین حقوقی، فرهنگ‌سازی اجتماعی و رشد اقتصادی محلی بودند که در سطوح دوم و سوم (میانی) جای گرفتند و نشان‌دهنده ناپایداری و نیاز به مدیریت هماهنگ هستند. پیشران‌های وابسته که پیامد اقدامات کلیدی محسوب می‌شوند، شامل مهارت‌های دیجیتال، سرمایه اجتماعی و آگاهی عمومی بودند و در سطح اول (پیامدی) قرار گرفتند. همچنین، برخی عوامل محیطی خرد در گروه مستقل با تأثیرگذاری محدود قرار گرفتند. سطح‌بندی مدل نشان‌دهنده یک ساختار سلسله‌مراتبی است که در آن پیشران‌های نهادی و زیربنایی، جهت‌گیری کل سیستم را تعیین می‌کنند.

۵. بحث و نتیجه‌گیری

این پژوهش با ارائه یک چارچوب جامع، نشان داد که توسعه کارآفرینی فناورانه مبتنی بر هوش مصنوعی در نواحی روستایی، نتیجه تعامل پیچیده و سلسله‌مراتبی از پیشران‌های پنج‌گانه است. مهم‌ترین نتیجه، نقش محوری و بنیادین **سیاست‌گذاری و حکمرانی** به‌عنوان زیربنای اصلی تحول است. حمایت‌های دولتی، قوانین تسهیل‌گر و سرمایه‌گذاری در زیرساخت‌های دیجیتال، نه‌تنها به‌عنوان پیشران‌های کلیدی با بیشترین قدرت نفوذ شناسایی شدند، بلکه به‌عنوان پایه‌های ساختار علّی، تمامی سطوح دیگر را تحت تأثیر قرار می‌دهند. در مقابل، عواملی مانند مهارت‌های دیجیتال و سرمایه اجتماعی که غالباً در کانون توجه برنامه‌های توسعه قرار دارند، در این مدل به‌عنوان متغیرهای وابسته یا پیامدی ظاهر شدند. این به آن معناست که آموزش و توانمندسازی به‌تنهایی نمی‌توانند موتور محرک توسعه باشند، بلکه پس از فراهم شدن بسترهای نهادی و زیرساختی، به‌عنوان حلقه‌های تکمیل‌کننده و نتیجه‌بخش عمل می‌کنند. این یافته، دیدگاه‌های رایج در توسعه روستایی را به چالش کشیده و تأکید می‌کند که اقدامات آموزشی باید به‌موازات و پس از اصلاحات ساختاری انجام شوند.

از منظر نوآوری مفهومی، این پژوهش با تفکیک پیشران‌ها به سطوح مختلف و شناسایی روابط علّی آن‌ها، درک عمیق‌تری از پویایی‌های سیستم ارائه می‌دهد. برخلاف مطالعات پیشین که بیشتر به توصیف کاربردها پرداخته‌اند، این پژوهش با رویکرد سیستمی، نقطه‌ی اهرمی تأثیرگذاری را معرفی می‌کند. در نهایت، این پژوهش نشان داد که هوش مصنوعی، فارغ از پیچیدگی‌های فنی، می‌تواند با یک رویکرد یکپارچه و نهادی، به ابزاری کارآمد برای توانمندسازی جوامع روستایی، کاهش نابرابری‌ها و دستیابی به توسعه پایدار تبدیل شود.

کلیدواژه‌ها: هوش مصنوعی، کارآفرینی فناورانه، توسعه روستایی، پیشران‌های کلیدی، تحلیل ساختاری، شهرستان شمیرانات.

تشکر و قدردانی

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Original Article

A Comparative Analysis of the Legal Mechanisms for Determining the Registration Status of Lands and Buildings Lacking Official Title Deeds in Iranian and German Law, with Emphasis on the Institutional Efficiency of the Land Registration System

Mehid Jadidi[1], Mahdi Zolfaghari[2*], Ahmadreza Behniafar[3]

1. Ph.D. Candidate in Law, Da. C, Islamic Azad University, Damghan, Iran.
2. Assistant Prof., in Law, Da. C, Islamic Azad University, Damghan, Iran.
3. Associate Prof., in Law, Da. C, Islamic Azad University, Damghan, Iran.

Abstract

Purpose- The registration status of lands and buildings lacking official title deeds constitutes a significant challenge for land governance, ownership security, and the efficiency of registration systems. This study aims to examine the legal mechanisms for determining the registration status of undocumented properties through a comparative analysis of Iranian and German legal systems, with particular emphasis on the institutional efficiency of land registration mechanisms and the assurance of tenure security.

Design/methodology/approach- This research employs a descriptive-analytical method with a comparative legal approach. Data were collected through library-based research, including the analysis of statutory provisions, jurisprudential principles, legal doctrines, and institutional structures governing land registration in Iran and Germany. The study focuses on the mechanisms adopted by each legal system for formalizing ownership, correcting registration deficiencies, and balancing legal certainty with the need to resolve undocumented property situations.

Findings- Iran adopts a facilitative, corrective approach influenced by Imami jurisprudence, recognizing possessory evidence and enabling integration of informal properties into formal registration systems. Germany emphasizes registration conclusiveness, public reliance on the Grundbuch, and preventive legal certainty, applying restrictive mechanisms for registration corrections while ensuring stronger transactional predictability. The comparative analysis reveals that institutional efficiency requires balancing ownership formalization flexibility with registration reliability. Iran demonstrates greater adaptive capacity for historically accumulated informal ownership, while Germany provides superior informational coherence and third-party protection.

Research limitations/implications- This study is limited to a comparative doctrinal analysis of the legal frameworks of Iran and Germany and does not include empirical assessments of administrative performance or quantitative evaluation of registration outcomes. Future research may incorporate field studies and comparative institutional assessments to examine the practical effectiveness of registration reforms.

Originality/value- This research contributes to comparative property law by analyzing the relationship between mechanisms for formalizing undocumented properties and institutional efficiency. It demonstrates that effective registration systems require balanced approaches combining procedural flexibility with registration certainty, providing insights for improving registration governance while maintaining compatibility with jurisprudential foundations.

Keywords- Properties without official title deeds, Land registration system, Ownership formalization, Imami jurisprudence, Tenure security.

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Corresponding Author:
Zolfaghari, Mahdi, Ph.D.
Address: Department of Law, Da. C, Islamic Azad University, Damghan, Iran.
Tel: +989121131721
E-mail: Mzolfaghari@iau.ir

1. Introduction

In the contemporary era, land registration systems represent one of the fundamental pillars for ensuring ownership security, organizing economic relations, and facilitating real estate transactions. By creating informational transparency, reducing proprietary conflicts, and strengthening public trust, efficient registration systems contribute to the stability of property markets and economic efficiency (Nazari & Ahmari, 2021). Nevertheless, the existence of lands and buildings lacking official title deeds remains a significant challenge, particularly in societies with a historical accumulation of informal possession. Accordingly, legal systems have developed specific mechanisms for determining registration status and integrating informal ownership situations into the formal legal framework (Zheng, 2024; Wegerif et al., 2025).

Determining the registration status of properties lacking official title deeds functions as a legal and institutional mechanism for transforming possessory situations and informal evidence into recognized ownership statuses (Masoumi et al., 2024). The importance of these mechanisms becomes more apparent when the absence of official titles creates ownership insecurity, increases legal disputes, limits the use of property as collateral, and affects land management policies (Haghaeighi et al., 2025). However, legal systems do not adopt identical approaches toward such properties. Some systems emphasize restorative and facilitative mechanisms to formalize informal ownership, while others prioritize registration certainty, institutional coherence, and public reliance on official records (Mghase, 2025). Comparative analysis of these approaches provides valuable insight into the relationship between ownership foundations and registration system efficiency.

Previous studies have primarily examined properties lacking official title deeds within individual legal systems. Research on jurisdictions affected by informal possession has emphasized the restorative and social functions of ownership formalization and demonstrated that facilitative mechanisms can improve access to official titles and economic integration (Assfaw Wolde, 2025; Manara & Regan, 2024; Abbasi et al., 2022; Masoudi Lamraski & Ghari Fatemi, 2021). In contrast, studies concerning structured registration systems have highlighted the importance of registration reliability, public confidence in land registers, and informational coherence in ensuring legal certainty and reducing property disputes (Wegerif et al., 2025; Adechian, 2025; Haddad Rahmati et al., 2024; Khezrian et al., 2023). Despite these contributions, comparative studies simultaneously examining ownership foundations, mechanisms for determining registration status, and institutional efficiency remain limited.

The present study addresses this research gap by comparatively analyzing the legal mechanisms for determining the registration status of lands and buildings lacking official title deeds in Iranian and German law. These two systems reflect distinct legal approaches: Iran, influenced by Imami jurisprudential principles and the necessity of resolving historical possessory situations, adopts a facilitative and remedial approach toward ownership formalization; whereas Germany, based on the principle of registration conclusiveness and the institutional coherence of the Grundbuch system, emphasizes legal certainty and public reliance on registration records.

The significance of this research lies in explaining how different approaches to ownership formalization influence transparency, dispute reduction, transactional security, and institutional efficiency. By examining the balance between "facilitation of formalization" and "preservation of registration certainty," this study seeks to provide a theoretical and practical framework for improving land registration governance. Accordingly, the main research question is: "What similarities and differences exist between the legal mechanisms for determining the registration status of properties lacking official title deeds in Iran and Germany, and how do these differences affect the institutional efficiency of the registration system and the security of ownership?"

2. Research Methodology

This study adopts a descriptive–analytical and comparative legal research methodology to examine the mechanisms for determining the legal status of lands and buildings lacking official title deeds in Iranian and German law. Unlike a purely descriptive comparison, the research applies a functional comparative approach by analyzing how each legal system addresses similar challenges, including ensuring legal certainty, protecting

ownership rights, and integrating informal property situations into formal registration frameworks.

Iran and Germany were selected as comparative cases due to their fundamentally different approaches toward land registration and ownership formalization. The Iranian legal system has developed various mechanisms to recognize and formalize possessory situations arising from the historical prevalence of undocumented properties. Conversely, the German system is based on a highly institutionalized registration model centered on the reliability of the Grundbuch, legal certainty, and protection of third-party reliance. This comparison enables an assessment of the institutional consequences of flexible and formalized registration approaches.

The analysis was conducted through five main dimensions: (1) legal foundations and normative principles, (2) competent authorities and procedural mechanisms, (3) evidence and criteria for ownership verification, (4) protection of good-faith third parties and compensation mechanisms, and (5) institutional efficiency and registration information infrastructure. These dimensions reflect the essential elements affecting the effectiveness of registration systems in resolving ownership uncertainty.

The research relies on primary and secondary legal sources. Primary sources include Iranian legislation, including the Civil Code, Registration Law, and regulations concerning undocumented properties, as well as the German Civil Code (Bürgerliches Gesetzbuch—BGB), Land Register Code (Grundbuchordnung—GBO), and related provisions. Secondary sources consist of legal commentaries, academic studies, and comparative legal literature.

The study employs structured analysis of legal rules, institutional arrangements, and procedural mechanisms without seeking to declare the superiority of either system. Its limitations include differences in legal history, institutional structures, socio-economic conditions, and the availability of quantitative performance data between the two jurisdictions. Nevertheless, the adopted comparative framework provides a systematic basis for identifying institutional strengths, weaknesses, and possible implications for improving land registration efficiency.

3. Properties Lacking Official Title

Properties lacking official title refer to lands and buildings that, despite possession or a claim of ownership, have not been registered in the formal registration system in the name of a specific person or for which no official title document has been issued (Pierri, 2025). This situation may result from a history of customary possession, informal transfers, institutional deficiencies in registration, or historical developments in land policy. The legal consequences of such a situation extend beyond private relations among individuals and affect areas such as security of ownership, enforceability of real rights against third parties, the ability to use property as collateral, and the efficiency of economic transactions. The absence of formal registration reduces transparency of ownership information and increases the likelihood of conflicting claims, growth of litigation, and transactional instability (Chigbu, 2023: 861-862). In response to this challenge, legal systems attempt to integrate informal situations into the framework of formal registration by designing specific mechanisms for determining registration status. These mechanisms may be based on acceptance of evidence of possession, presumptions arising from control, quasi-judicial proceedings, or administrative processes (Fredrick et al., 2025). In some systems, the primary objective of these instruments is to remedy historical gaps in registration and facilitate access to official title; by contrast, systems emphasizing certainty of registration restrict recognition of situations outside the register and rely on informational coherence and public trust in the land register (Alhola & Gwaindepi, 2024).

4. Ownership Formalization and Determination of Registration Status

Ownership formalization is a legal and institutional process through which ownership claims based on possession or informal documents, upon verification of legal conditions, are stabilized within the formal registration system (Dieterle, 2025). Determination of registration status, as the core of this process, encompasses a set of formal and substantive rules that enable identification of the owner, verification of property boundaries, resolution of conflicting claims, and final entry of the right in the land register (Movahhed Moghaddam, 2025). The importance of this process lies in transforming uncertain situations into registered rights, thereby enhancing

enforceability against third parties, enabling economic utilization of property, and improving the effectiveness of land management policies (Adechian, 2025). However, designing mechanisms for formalization requires balancing "facilitation of access to registration" with "preservation of certainty and trust in registration." Facilitative approaches, aimed at broader integration of untitled properties, expand the range of admissible evidence and procedural pathways; in contrast, approaches grounded in registration certainty protect legal stability and transactional predictability by limiting exceptions and strengthening the evidentiary authority of registered entries. Differences in this balance have direct consequences for the level of proprietary disputes, transaction costs, and the degree of public trust in the registration system (Manara & Pani, 2023).

5. Institutional Efficiency of the Land Registration System

Institutional efficiency of a registration system refers to its capacity to achieve objectives such as transparency of ownership information, certainty of real rights, protection of good-faith third parties, reduction of conflicts, and facilitation of economic transactions (Dixon, 2024). This efficiency is not determined solely by substantive rules of ownership but also depends on organizational coherence, integration of information databases, transparency of procedures for correcting registration, mechanisms for compensation arising from registration errors, and the level of digitalization (Odoyi, 2025). Coherent registration systems, relying strongly on the evidentiary authority of land register entries and on limited but transparent mechanisms for correcting registration, provide higher levels of transactional predictability and control of legal risks (Wegerif et al., 2025). By contrast, systems confronted with an accumulation of informal situations may provide broader mechanisms for determining registration status in order to achieve restorative justice and economic integration; if not accompanied by informational integration and effective oversight, such expansion may lead to heterogeneity of registration data and an increased administrative burden (Ndugwa & Omusula, 2025). Accordingly, a comparative evaluation of institutional efficiency in registration systems requires simultaneous assessment of the degree of facilitation of formalization, the level of registration certainty, and the quality of institutional and informational infrastructures.

6. Legal Mechanisms for Determining the Registration Status of Lands and Buildings Lacking Official Title in Iranian Law with Emphasis on Institutional Efficiency of the Registration System

In Iran, the issue of properties lacking official title represents one of the most complex and challenging aspects of the land registration system, directly affecting ownership security, information transparency, and the efficiency of the real estate market. To address this challenge, multiple legal mechanisms have been designed, combining principles from Islamic jurisprudence, statutory law, and administrative–quasi-judicial procedures. These mechanisms, in addition to formalizing ownership, aim to reduce historical ownership disputes, strengthen public trust, and prevent economic instability arising from the absence of official title. A detailed analysis of each component of Iran's legal framework shows that institutional efficiency in registration depends on balancing restorative justice, procedural transparency, and information coherence.

6.1. Legal and Jurisprudential Basis for Registration Determination

Mechanisms for determining the registration status of lands and buildings without official title deeds in Iran are significantly influenced by Twelver Shi'a jurisprudential principles and traditional ownership theories. Concepts such as the validity of possession, evidences of control (emarat-e yad), and priority rights arising from long-term possession provide a legal basis for recognizing and formalizing ownership based on factual circumstances. Accordingly, registration authorities and determination commissions may verify ownership in the absence of official documents by relying on continuous possession, practical use, physical presence, and property maintenance activities (Beheshtian, 2019). This approach reflects restorative justice by recognizing actual ownership, preventing infringement of legitimate claims, and integrating undocumented properties into the formal registration system. It also contributes to resolving historical accumulation of informal properties, local disputes, and intergenerational ownership complexities, thereby strengthening public

confidence in ownership security (Mashhadi, 2025).

Nevertheless, the flexibility of jurisprudential principles and the diversity of accepted evidence create significant challenges. While broad evidentiary acceptance facilitates the formalization of numerous undocumented properties, the absence of unified standards for evaluating evidence may generate conflicting claims, increase judicial burdens, and undermine registration data consistency (Sohrabi Derakhshani, 2021). Moreover, reliance on jurisprudential principles alongside local customs enables responses to complex rural ownership conditions; however, such flexibility requires effective supervision by registration authorities and commissions to prevent abuse, overlapping claims, and contradictory ownership determinations (Emamverdi, 2022). Without adequate oversight, restorative mechanisms may intensify registration instability and legal uncertainty rather than promote justice (Saki, 2024).

Although Iran's jurisprudential foundations emphasize recognition of actual ownership and social justice, they also involve certain limitations. Ambiguity in evidentiary assessment may increase dependence on individual judgment, while extensive recognition of informal evidence can contribute to overlapping ownership and litigation. Therefore, clear guidelines, professional training, and institutional coordination are necessary to improve registration efficiency (Ahmadzadeh & Khalilzadeh, 2023). Overall, Iran's approach provides a flexible and restorative model, but achieving institutional efficiency requires balancing flexibility with standardized criteria, effective supervision, and procedural coherence to enhance ownership security and public trust.

6.2. Competent Authority and Nature of the Process

In Iran, the process of determining the registration status of lands and buildings without official title is a hybrid of administrative and quasi-judicial authorities. This combination allows the authorities to make swift and practical decisions for formalizing ownership while adhering to jurisprudential and legal rules (Karkhaneh, 2024). Determination commissions, usually composed of legal and registration experts, surveying specialists, and local representatives, are authorized to examine evidence, verify ownership, and issue official rulings. These authorities can adopt restorative and flexible decisions that ensure social justice while enabling integration of untitled properties into the formal registration system (Sharifi, 2025).

One of the main advantages of this structure is the reduction of judicial case load and prevention of prolonged proceedings. Many ownership disputes are resolved at the commission level before reaching the judiciary, allowing flexible solutions to be applied. Additionally, the integration of administrative and quasi-judicial processes allows acceptance of diverse evidence and precise expert evaluation, which is vital for properties lacking official title. This hybrid structure enables the restorative approach to be implemented more rapidly and flexibly than rigid formal registration procedures (Sohrabi Derakhshani, 2021).

However, significant challenges exist within this structure:

1. Lack of standardized procedures and comprehensive guidelines means that each commission may base decisions on individual experience and evaluation, leading to inconsistent outcomes across different regions;
2. Variations in expertise and training of staff in different commissions can reduce the quality of decisions and accuracy of ownership verification;
3. Supervisory and quality control issues, including the absence of a central monitoring system and performance evaluation mechanisms, may allow errors or conflicting decisions to go uncorrected (Abdi, 2022).

Therefore, the success of this process depends on the system's ability to implement clear guidelines, train experts, and exercise effective oversight. In other words, while flexibility and restorative orientation provide significant advantages, inadequate supervision can lead to increased disputes, prolonged formalization procedures, and diminished public trust in the registration system (Beheshtian, 2019).

In summary, the process of registration determination in Iran, through the integration of administrative and quasi-judicial authorities, offers a practical and flexible approach to formalizing ownership and covers many limitations of traditional registration. Nevertheless, uniformity of

procedures, continuous expert training, and strong oversight mechanisms are prerequisites for enhancing efficiency and reducing legal risks. Therefore, the success of these mechanisms depends not only on jurisprudential and administrative flexibility but also on the quality of management, coordination among authorities, and procedural transparency; without these factors, the restorative benefits may be compromised by practical challenges.

6.3. Admissible Evidence and Verification Criteria

One of the main characteristics of mechanisms for determining the registration status of properties in Iran is the acceptance of diverse evidence, including continuous possession, emarat-e yad (presumptive indications of possession), private documents, local certificates, and witness testimony. These forms of evidence can establish ownership in the absence of official titles (Mashhadi, 2025). This approach reflects jurisprudential and administrative flexibility, facilitating the integration of undocumented properties into the formal system while protecting individual rights and expanding access to legal ownership and registration (Yousefi, 2024).

The broad acceptance of evidence, particularly in rural areas and locations with complex ownership histories, enables authorities to identify actual ownership and prevent violations of legitimate claims. It also supports restorative justice by reducing accumulated informal properties and public dissatisfaction (Bashiri, 2025). However, excessive flexibility without structured criteria may produce inconsistent registration records, ownership disputes, and increased litigation. Unregulated acceptance of evidence can create conflicts between claims, complex commission decisions, and reduced transactional predictability (Alizadeh Sabet, 2021).

Furthermore, evidence such as local certificates and witness testimony may involve subjective evaluations and therefore requires careful verification. Registration experts must assess credibility and establish appropriate evidentiary weight, highlighting the necessity of standardized procedures, continuous training, and clear operational guidelines (Khezrian et al., 2023).

Accordingly, broad evidentiary acceptance enhances restorative justice and ownership access but may weaken registration efficiency and transaction security without effective supervision. The balance between flexibility and standardization is essential. Establishing clear evaluation criteria, operational guidelines, and continuous monitoring of commission decisions can preserve the advantages of restorative justice while preventing litigation and data instability (Sharifi, 2025). Overall, Iran's evidentiary mechanism provides a facilitative approach, yet its effectiveness depends on standardized frameworks, expert training, and institutional supervision. Balancing evidentiary flexibility with procedural coherence remains crucial for strengthening legal certainty, public trust, and registration efficiency within Iran's contemporary land registration system.

6.4. Protection of Good-Faith Third Parties and Compensation

Protection of good-faith third parties is a fundamental pillar of justice in the mechanisms for determining the registration status of properties in Iran. This protection ensures that individuals who engage in transactions without knowledge of the informal status of a property and with legitimate intent are not harmed by registration reforms. In other words, Iran's registration system, by recognizing third-party rights, seeks to balance the restoration of untitled ownership with the security of economic transactions (Masoudi Lamraski & Ghari Fatemi, 2021).

In addition, compensation mechanisms for registration errors play a critical role in reducing transactional risk and enhancing public trust. For example, in the case of erroneous rulings or registration mistakes, registration authorities are obliged to provide compensation for those adversely affected. Such a mechanism not only supports social justice but also strengthens public confidence in the registration system and stabilizes the real estate market (Abdi, 2022).

Nevertheless, several practical challenges exist:

1. Dispersed procedures and decision-making authorities: Each commission may use different criteria for identifying good-faith third parties, leading to inconsistent and conflicting decisions;
2. Limited compensatory resources: Financial budgets and capacities of authorities to provide compensation are constrained, sometimes preventing full restitution for damages caused by registration errors;

3. Lack of process standardization: The absence of clear guidelines for evaluating good faith, determining compensation amounts, and implementing restitution reduces the efficiency of this protection (Yousefi, 2024).

Therefore, to enhance the effectiveness of this mechanism, clear and comprehensive guidelines are necessary. These should include: first, specific criteria for identifying good-faith third parties; second, standardized methods for damage assessment; and third, effective and transparent compensation mechanisms (Mashhadi, 2025). It should be noted that protection of good-faith third parties and compensation mechanisms ensure a balance between restorative justice and transactional security. In Iran, this legal pillar plays a crucial role in reducing transactional risks and reinforcing public trust; however, procedural dispersion and lack of standardization may limit its effectiveness (Alizadeh Sabet, 2021). Therefore, improving performance requires the registration system to implement uniform guidelines and continuously monitor their application. This approach not only preserves third-party rights but also strengthens the coherence, predictability, and security of the registration system sustainably.

6.5. Institutional Efficiency and Information Infrastructure

Institutional efficiency of Iran's registration system is directly influenced by organizational coherence, data integration, and the quality of information infrastructure. Policy focusses on resolving the historical accumulation of informal properties requires coordination among various registration authorities, digitization of processes, and management of extensive and complex information. This focus not only helps reduce ownership disputes but also facilitates faster, more accurate, and transparent decision-making (Bashiri et al., 2025).

Recent advances in digitization and development of information systems have played a significant role in increasing the speed of case handling, reducing human error, and integrating data (Abdi, 2022). Nevertheless, practical challenges remain:

1. Multiplicity of authorities and dispersed decision-making: Numerous organizations and commissions with different powers lead to process repetition and reduced efficiency;
2. Lack of unified data standards: Registration information across different authorities is often stored in varying formats and criteria, reducing coherence and quick data retrieval;
3. High administrative burden and complexity of information management: The large volume of untitled property cases and the need to review diverse evidence impose significant pressure on experts and systems, potentially slowing case processing (Ahmadzadeh Bazzaz & Khalilzadeh, 2020).

To enhance institutional efficiency, it is necessary to develop integrated digital infrastructure based on national standards and subsequently standardize registration processes and procedures. This ensures that authority decisions are executed in a coordinated and predictable manner, while continuous training of registration experts improves their ability to evaluate evidence and use digital systems effectively (Bashiri, 2025).

Thus, data integration, organizational coherence, and standardized digital infrastructure are key pillars of institutional efficiency. Proper management of these factors not only increases processing speed and accuracy but also sustainably strengthens public trust in the registration system, security of ownership rights, and predictability of real estate transactions (Saki, 2024). In summary, institutional efficiency in Iran's registration system results from a combination of smart policymaking, data integration, and expert empowerment. Practical challenges such as dispersed authorities, data heterogeneity, and high administrative burden can impede full exploitation of digitization and standardization benefits. Therefore, achieving institutional efficiency requires a unified, transparent, and intelligent system, clear operational guidelines, and continuous, supervised training of experts. This approach, in addition to facilitating ownership formalization, ensures sustainable public trust, restorative justice, and security in property transactions, transforming the registration system into an effective tool for property and economic policymaking.

7. Legal Mechanisms for Determining the Registration Status of Lands and Buildings Lacking Official Title in German Law, with Emphasis on the Institutional Efficiency of the Registration System

In the German legal context, lands and buildings lacking official title deeds cannot be understood as equivalent to undocumented ownership situations in Iran. Since German property law relies on the

constitutive effect of registration, absence of registration generally indicates that a real right has not achieved full legal effectiveness within the land registration system (Meier & Bühler, 2024). Therefore, this analysis examines mechanisms addressing incomplete, inaccurate, disputed, or inconsistent ownership information rather than broad legalization of informal possession. This distinction is essential because Iran and Germany attach different legal meanings to possession, ownership, and registration. The German land registration system is based on legal certainty, reliability of registration, and public reliance on the contents of the land register (Grundbuch) (Walter & Walter, 2025: 803-805). Unlike systems that address historical informal ownership through broad recognition, Germany emphasizes protection and stability of formally registered rights. Its mechanisms primarily aim to preserve transactional security, accuracy of registered information, and stability of real rights (Fischer & Janssen, 2023).

The German registration framework is founded on the interaction between substantive property law, procedural rules, and judicial supervision. Its main statutory foundations are the German Civil Code (Bürgerliches Gesetzbuch BGB) and Land Register Code (Grundbuchordnung GBO). Within this framework, registration functions as a central mechanism for establishing, transferring, and protecting immovable property rights. Consequently, the German model demonstrates how institutional coherence, information reliability, and registration certainty contribute to land registration efficiency and provide a comparative basis for evaluating different approaches to ownership formalization mechanisms.

7.1. Legal Basis and the Principle of the Reliability of Registration

The German registration system is founded upon the constitutive role of registration in real property law and the principle of public reliance on the accuracy of the land register. Under §873(1) BGB, ownership transfer requires both a substantive agreement and registration, making registration a constitutive legal act rather than merely evidence of ownership (Notarkasse München & Kell, 2025). Furthermore, §925 BGB establishes the formal requirements of the declaration of transfer (Auflassung), confirming the formal nature of the system and its objective of preventing uncertainty through legally controlled procedures (Palandt et al., 2024). A fundamental feature of German property law is the separation principle (Trennungsprinzip) and abstraction principle (Abstraktionsprinzip). The contractual obligation and the transfer of the real right are legally independent, allowing the land register to function as an autonomous mechanism for determining rights rather than simply recording contractual relations (Bauer & Schaub, 2025).

Another central principle is the protection of good-faith reliance on registered information. According to §892 BGB, a person acquiring a right based on the land register is protected when acting in good faith, even if registered information differs from the actual legal situation. This principle transforms the land register into a legally authoritative institution that reduces uncertainty and strengthens transactional security (Hügel, 2024). German law also provides corrective mechanisms for inaccurate registration. Under §894 BGB, a person whose right is incorrectly reflected may request correction. However, correction does not constitute a general method for recognizing informal ownership; rather, it restores consistency between registration records and the actual legal situation while preserving stability of registered rights. The procedural framework is governed by the Grundbuchordnung (GBO), which regulates applications, documentary requirements, examinations, and responsibilities of registration authorities. The examination principle requires authorities to verify legal requirements before modifying the register, ensuring that substantive property rules operate through a reliable institutional process (Meikel & Böttcher, 2024). Although commentaries such as Palandt, Meikel, Bauer/Schaub, and Hügel clarify practical applications, the authority of the system derives primarily from the BGB and GBO rather than administrative practice alone (Kral & Uhl, 2025). The strong reliance on registered information provides institutional advantages, including informational coherence, predictability, and transactional security. Although correction of errors is possible, it remains limited and subject to defined procedures and judicial supervision, thereby preserving confidence in registration stability (Kühn, 2024).

Nevertheless, formal registration may create challenges for historically established possession lacking documentation. Unlike facilitative systems recognizing diverse possessory evidence, German law generally requires informal situations to be transformed into legally effective rights through formal procedures. Thus, the German model prioritizes prevention of uncertainty rather than extensive correction of historical informality (Walter & Walter, 2025). Overall, the German registration system reflects an institutional choice favoring certainty and reliability of registered rights over flexibility in recognizing informal ownership. Its effectiveness derives from three elements: the constitutive effect of registration under the BGB, procedural discipline under the GBO, and protection of reliance through mechanisms such as §892 BGB. Together, these elements establish registration as a central legal institution for maintaining certainty, reducing transactional risks, and stabilizing real property relations (Kratzlmeier, 2023). From an institutional efficiency perspective, the German experience demonstrates that reliable registration depends on coordinated substantive rules, procedural standards, and controlled correction mechanisms (Wellstein, 2023; Hügel, 2024).

The German approach therefore differs from legal systems that seek to integrate large numbers of undocumented properties through flexible recognition mechanisms. Instead, it maintains a strict distinction between ownership formation and evidence of possession, ensuring that real rights acquire legal effect only through compliance with registration requirements. This structure enhances institutional reliability but may impose procedural burdens when historical property relations do not correspond with registered information. Consequently, the German model represents a balance between formal certainty and limited corrective capacity, where legal stability remains the primary objective of the registration framework. Therefore, comparative evaluation with Iran reveals how different legal philosophies shape registration efficiency, dispute prevention, protection of third parties, and the management of uncertain property relations in practice.

7.2. Competent Authority and the Nature of the Procedure

The institutional structure of the German land registration system is based on an allocation of responsibilities among authorities, including land registry offices (Grundbuchämter), courts, notaries. Unlike systems relying on broad discretion to recognize informal ownership, the German model operates within a legality-based framework where each institution performs functions according to statutory requirements (Meier & Bühler, 2024).

The Grundbuchamt is responsible for maintaining the land register, examining applications, verifying legal requirements, and recording effective rights. However, it does not independently determine ownership based on possession or informal claims; rather, it examines compliance with the BGB and GBO requirements, preserving the distinction between factual possession and legally recognized real rights (Meikel & Böttcher, 2024). The procedural framework established by the GBO requires authorities to verify submitted documents through the examination principle (Prüfungsprinzip), ensuring objective and registration decisions.

Judicial supervision is another element of the German system. Courts resolve ownership disputes, review complex legal situations, and address inaccurate entries through controlled correction mechanisms such as §894 BGB (Neumann, 2024). This supervision prevents arbitrary modifications and maintains confidence in registration stability. Notaries further enhance reliability by ensuring that ownership transfers, including the Auflassung, comply with legal requirements before registration. From an institutional perspective, this distribution of responsibilities creates procedural standardization, predictability, and accuracy. Specialized institutions applying uniform legal criteria reduce inconsistencies and strengthen public trust in registration outcomes (Walter & Walter, 2025; Hügel, 2024). However, strict legal boundaries may reduce flexibility in cases involving historical possession, incomplete documentation, or informal claims. Unlike facilitative systems, Germany prioritizes legal certainty and procedural accuracy. Therefore, German registration efficiency depends not merely on speed but on the quality, durability, and predictability of decisions. The interaction of specialized authorities, judicial oversight, notarial verification, and standardized procedures enables management of ownership uncertainty while preserving the authority of the land register (Kral & Uhl, 2025).

7.3. Admissible Evidence and Criteria of Verification

The German approach to evidence and ownership verification is based on the principle that legally effective rights in immovable property must be established through formally recognized procedures and reliable documentary foundations. Unlike legal systems that permit extensive reliance on factual possession, customary evidence, or informal documentation for the purpose of formalizing ownership, the German system assigns primary importance to the information contained in the Grundbuch and the legally prescribed requirements for registration. Under §29 of the Grundbuchordnung (GBO), registrable facts must generally be proven through public documents or publicly certified documents. This requirement represents a fundamental component of the examination principle governing German land registration. The land registry authority (Grundbuchamt) is therefore required to verify whether the legal prerequisites for registration have been satisfied before making any entry or modification in the land register. Consequently, the evidentiary process is not based on broad discretionary evaluation but on a structured legal assessment of formally valid documents and legally recognized proof (Lenz, 2025).

The restrictive evidentiary framework serves several institutional objectives. First, it preserves the accuracy and consistency of registration data by ensuring that registered information is derived from reliable legal sources. Second, it enhances transactional security because third parties can rely on the assumption that registered information accurately reflects legally effective rights. Third, it reduces administrative discretion and promotes uniformity in registration decisions across different jurisdictions. German legal commentaries, including Meikel, Bauer/Schaub, and Hügel, emphasize that this strict evidentiary approach is inseparable from the principle of reliability of registration and the objective of maintaining public confidence in the land register (Dreier & Schmidt, 2024).

However, the formal character of evidence requirements also demonstrates one of the principal limitations of the German model. Where ownership relations have developed historically through informal possession, undocumented transfers, or incomplete documentation, integration into the formal registration system may require complex legal procedures. Mere factual possession does not generally create a registrable right; rather, such situations must be transformed into legally recognized rights through the mechanisms provided by substantive and procedural law (Kühn, 2024).

This feature reveals a fundamental difference between the Iranian and German approaches. While the Iranian system generally emphasizes corrective mechanisms aimed at incorporating existing factual ownership situations into the formal registration framework through broader evidentiary recognition, the German system follows a preventive model that seeks to avoid uncertainty by ensuring that only formally verified rights obtain full legal protection. Accordingly, the German evidentiary system strengthens institutional efficiency through accuracy, predictability, and informational coherence, although it provides comparatively limited flexibility for absorbing historically accumulated informal ownership situations (Walter & Walter, 2025; Böttcher & Meikel, 2023).

7.4. Protection of Good-Faith Third Parties and Compensation

Protection of good-faith third parties constitutes one of the central pillars of the German land registration system and directly derives from the principle of public reliance on the contents of the Grundbuch. According to §892 BGB, a person acquiring a right in reliance on registered information is protected when acting in good faith, even where the registered information subsequently proves inconsistent with the actual legal situation. The importance of this mechanism extends beyond the protection of individual transactions. By allowing market participants to rely on the accuracy of registered information, German law significantly reduces transaction costs and eliminates the need for purchasers to investigate complex historical ownership chains. Consequently, the principle of public reliance transforms the land register from a simple information database into a legally authoritative institution that supports economic activity and market stability (Kratzlmeier, 2023).

Where discrepancies exist between registered information and the actual legal position, German law provides corrective mechanisms, particularly through §894 BGB. Nevertheless, correction

procedures are carefully structured to avoid undermining the security of existing transactions. The purpose of correction is not to weaken reliance on registration but to restore consistency between the legal reality and the registered situation while preserving acquired rights and protecting legitimate expectations (Braun & Schmidt, 2025)

Compensation mechanisms within the German framework are therefore closely connected with the preventive structure of registration law. Rather than relying primarily on extensive post-registration remedies, the system seeks to minimize losses through accurate registration procedures, strict verification requirements, and protection of reliance interests. The combination of registration reliability, judicial supervision, and institutional coordination ensures that errors are addressed without compromising the overall stability of the system (Dreier & Schmidt, 2024).

From an institutional perspective, the German model demonstrates that effective third-party protection depends not only on substantive legal rules but also on the coherence between registration procedures, judicial oversight, and information reliability. Nevertheless, this approach reflects the broader limitation of highly formalized registration systems: where historical ownership situations have never been incorporated into the Grundbuch, priority remains with maintaining the reliability of registered information rather than broadly recognizing informal claims. Therefore, Germany achieves a high level of transactional security and public trust through strong protection of good-faith third parties, although this stability is accompanied by reduced flexibility in resolving historically accumulated undocumented ownership situations (Palandt et al., 2024; Kühn, 2024).

7.5. Institutional Efficiency and Information Infrastructure

Institutional efficiency in the German land registration system results from the interaction between statutory clarity, specialized institutions, standardized procedures, and reliable information infrastructure. The Grundbuch operates as the central and authoritative source of information regarding registered rights in immovable property and provides a unified informational basis for owners, purchasers, financial institutions, and public authorities. A fundamental feature of this system is the integration between substantive property law, registration procedures, and judicial supervision. The BGB establishes the legal consequences of ownership and transfer, while the GBO provides procedural discipline for registration activities. This institutional coordination reduces uncertainty, limits inconsistent practices, and ensures that registration decisions are based on uniform legal standards.

Another significant factor contributing to efficiency is the digital transformation of registration procedures. The modernization of electronic land registers has improved accessibility, information management, and administrative supervision. Digital registration infrastructure enables faster retrieval of property information, reduces human errors, and enhances transparency. Consequently, technological development reinforces the traditional strengths of the German model, namely reliability, predictability, and institutional coherence (Böttcher, 2025).

The German system also demonstrates a controlled balance between certainty and flexibility. Although the stability of registered rights remains the primary objective, legal mechanisms exist for correcting inaccurate entries and addressing exceptional situations where the registered information does not correspond with the actual legal position. However, these mechanisms operate within strict boundaries and do not undermine the fundamental reliability of registration.

From a comparative perspective, the German experience demonstrates that institutional efficiency is not merely the result of strict legal rules. Rather, it emerges from the coordinated functioning of legal norms, specialized institutions, judicial supervision, and information technology. The effectiveness of the system depends on the ability to maintain reliable information while providing limited corrective mechanisms for exceptional cases. Nevertheless, the German model also reveals an inherent trade-off. The same institutional features that generate high levels of certainty and predictability may make the formalization of historically undocumented ownership situations slower and more complex. Therefore, an efficient registration system must balance two objectives: preserving the authority and reliability of registered information while maintaining sufficient mechanisms for correcting exceptional inaccuracies (Notarkasse München & Kell, 2025).

The German legal framework for determining the registration status of lands and buildings lacking official title reflects a preventive model centered on registration certainty, institutional coherence, and protection of reliance on officially recorded information. Unlike systems that primarily seek to integrate informal ownership situations through flexible recognition mechanisms, German law emphasizes the creation and preservation of legally effective rights through formal registration procedures. The effectiveness of the German system derives from the interaction of four principal elements: first, the constitutive legal effect of registration under the BGB; second, the procedural discipline established by the GBO; third, the protection of good-faith reliance through mechanisms such as §892 BGB; and fourth, the institutional integration of registration authorities, courts, notaries, and digital information infrastructures.

This structure produces significant advantages, including high informational coherence, strong transactional security, predictable decision-making, and public confidence in the land register. However, the same characteristics may limit flexibility in incorporating historically established informal ownership situations. Consequently, the German model demonstrates that institutional efficiency requires not only accurate registration but also an appropriate balance between certainty and controlled correction mechanisms. In comparative terms, Germany represents a model of preventive legal certainty, whereas Iran represents a corrective approach aimed at formalizing existing informal property relations. The German experience suggests that improving registration efficiency requires strengthening institutional coordination, digital infrastructure, evidentiary standardization, and mechanisms for protecting reliance on registered information while maintaining limited and legally controlled avenues for correction.

8. Comparative Analysis of Legal Mechanisms for Determining the Registration Status of Lands and Buildings Lacking Official Title in Iranian and German Law, with Emphasis on the Institutional Efficiency of the Registration System

8.1. Legal and Jurisprudential Foundations / Statutory Principles

In Iran, the legal foundation for determining the status of lands and buildings lacking official title is influenced by principles derived from Imami jurisprudence, particularly the legal significance of possession and presumptions arising from factual control over property. These principles enable legal authorities to recognize ownership claims based on actual possession, existing circumstances, and available evidence. Consequently, the Iranian framework provides a corrective mechanism through which historically established but undocumented ownership situations can be incorporated into the formal registration system.

The principal advantage of this approach lies in its flexibility. By allowing consideration of various factual and evidentiary circumstances, the Iranian system is capable of addressing complex ownership situations that may have developed outside formal registration channels. However, this flexibility may also create challenges regarding uniform evidentiary standards, consistency of decisions, and coherence of registration information.

By contrast, the German legal system is structured around codified statutory principles and the reliability of registered information. Ownership and real rights in immovable property acquire legal effectiveness primarily through registration in the Grundbuch. The constitutive role of registration, combined with strict procedural requirements and judicial supervision, ensures a high level of legal certainty and predictability.

The German approach therefore provides stronger stability and informational coherence, but its formal structure limits the possibility of recognizing informal ownership situations that have not been transformed into legally registered rights. Unlike the Iranian model, which seeks to correct historical informality through flexible mechanisms, Germany primarily prevents uncertainty by ensuring that only legally verified rights obtain full registration protection.

Accordingly, the two systems reflect different priorities. The Iranian model emphasizes restorative justice and inclusion of existing ownership realities, whereas the German model emphasizes legal certainty, registration reliability, and preventive reduction of disputes. From an institutional efficiency perspective, Iran demonstrates greater corrective capacity, while

Germany achieves higher levels of predictability and informational stability.

8.2. Competent Authority and Nature of the Process

In Iran, determination procedures regarding lands and buildings lacking official title generally involve a combination of administrative and quasi-judicial mechanisms. Specialized commissions and competent authorities examine ownership claims, evaluate available evidence, and determine whether conditions exist for formal recognition and registration. This institutional design provides flexibility and facilitates the resolution of historically accumulated informal situations.

However, the involvement of multiple authorities and the possibility of variation in administrative practices may reduce procedural uniformity. Differences in interpretation of evidence, institutional coordination challenges, and the absence of a single conclusive source of ownership information may affect predictability and increase administrative burdens.

In Germany, the determination process is primarily organized around specialized registration authorities operating within a unified legal framework. The Grundbuchämter examine registration applications according to statutory requirements established by the BGB and GBO, while judicial supervision ensures that corrections or modifications occur only within legally justified circumstances. The involvement of notaries and courts further strengthens procedural reliability.

This institutional structure enhances consistency, transparency, and decision quality. Although the German system may require more formal procedures and therefore may not always provide the fastest solution for historically informal ownership situations, it produces decisions with greater legal durability and predictability.

From a comparative perspective, Iran achieves greater procedural flexibility and capacity for resolving undocumented ownership, whereas Germany achieves stronger institutional coherence through standardized procedures and strict legal control. Therefore, the institutional challenge for Iran is not eliminating flexibility but improving coordination and standardization, while the German experience demonstrates the importance of procedural discipline and quality control.

8.3. Evidence and Standards of Verification

The Iranian system adopts a relatively broad evidentiary approach in determining ownership status. Continuous possession, informal documents, local certifications, witness testimony, and other factual indicators may contribute to establishing ownership claims. This approach enables the formalization of a wide range of undocumented properties and reflects the corrective objective of the Iranian registration framework.

Nevertheless, extensive reliance on diverse forms of evidence may create difficulties in ensuring uniform evaluation standards. Where precise criteria are absent or inconsistently applied, conflicting ownership claims and inconsistencies in registration information may emerge.

The German system follows a substantially different evidentiary philosophy. Ownership verification relies primarily on registered information contained in the Grundbuch and legally recognized documentary evidence. The requirements established by the BGB and GBO limit reliance on informal evidence and ensure that registration entries are based on verified legal acts.

This strict evidentiary framework produces significant institutional benefits. It enhances informational coherence, reduces administrative discretion, and allows third parties to rely confidently on registered information. However, it also reduces flexibility in recognizing historically established possession or informal ownership situations.

Therefore, the Iranian model prioritizes inclusion and corrective formalization, while the German model prioritizes accuracy, predictability, and reliability of registered information. The comparison demonstrates that effective registration systems must balance two competing objectives: the ability to incorporate legitimate but undocumented ownership situations and the necessity of maintaining the certainty of registered rights.

8.4. Treatment of Intermediate and Ambiguous Ownership Situations: Beyond the Documented–Undocumented Dichotomy

A significant limitation of a simple classification between documented and undocumented ownership is the existence of intermediate property situations. These include incomplete documentation, informal transactions, uncertain documents, conflicting possession claims,

inconsistencies between occupation and registration, or disputed legal status. Therefore, comparative analysis must examine how legal systems manage transitional and ambiguous ownership conditions.

In Iran, intermediate cases are generally addressed through mechanisms aimed at identifying factual ownership foundations and transforming possession-based situations into legally recognized rights. Flexible evidentiary rules allow authorities to consider informal documents, possession history, witness testimony, and local evidence. This approach provides capacity to resolve complex ownership situations outside formal registration channels. However, such flexibility may create institutional challenges. Dependence on multiple forms of evidence rather than a single authoritative source can increase inconsistent interpretations, competing claims, and variations in decisions. Thus, while Iran demonstrates corrective capacity, maintaining uniformity and informational coherence remains challenging.

Germany approaches intermediate cases differently. Since the Grundbuch represents the authoritative source for registered rights, uncertainty is managed by preserving registration reliability. Correction mechanisms such as §894 BGB address inconsistencies between registered information and actual legal situations within a controlled framework. The objective is restoration of accuracy, not broad recognition of informal claims. These approaches reflect different philosophies: Iran emphasizes transforming uncertain factual situations into legal rights, whereas Germany prioritizes preventive certainty through reliable registration. Neither model is universally superior. Efficient systems require both reliable information structures and corrective mechanisms capable of addressing exceptional cases while preserving legal certainty. This balanced approach enhances institutional efficiency, ownership security, trust, and stability within registration systems.

8.5. Protection of Good-Faith Third Parties and Compensation Mechanisms

Protection of good-faith third parties is a fundamental indicator of the effectiveness of property registration systems because it demonstrates the extent to which transactional reliance is secured. Although both Iran and Germany recognize third-party protection as an important objective, their institutional mechanisms differ significantly.

In Iran, protection of good-faith third parties operates through ownership recognition procedures, registration rules, and judicial assessment of competing claims. Since undocumented properties require evaluation of factual circumstances and diverse evidence, determining priority between interests may involve complex assessments. This approach supports substantive justice and recognition of genuine ownership but may increase uncertainty for parties relying on incomplete information. Accordingly, the Iranian system emphasizes corrective justice by preventing the loss of legitimate ownership claims resulting from historical informality. However, the absence of a single conclusive source of ownership information may increase transactional risks.

By contrast, Germany places third-party protection at the core of its registration framework. Under §892 BGB, good-faith reliance on the accuracy of the Grundbuch is legally protected, allowing third parties to depend on registered information without independently examining ownership history. Furthermore, correction mechanisms under §894 BGB balance restoration of legal accuracy with protection of acquired interests. Thus, the German system prevents transactional harm through reliable registration, institutional supervision, and protection of reliance.

Comparatively, Iran prioritizes recognition of genuine ownership situations, whereas Germany emphasizes transactional stability and market confidence. From an institutional efficiency perspective, Germany provides stronger preventive protection mechanisms, while Iran offers greater capacity to resolve historically accumulated ownership issues. An effective registration system may therefore combine Iran's focus on substantive fairness with Germany's emphasis on predictable protection of third-party reliance.

8.6. Institutional Efficiency, Information Infrastructure, and Procedural Standardization

Institutional efficiency in land registration cannot be evaluated solely by the number of resolved cases or administrative speed; rather, it depends on the interaction of legal rules, institutional coordination, information quality, procedural standardization, and the ability to produce reliable outcomes.

In Iran, mechanisms for determining the status of properties lacking official title deeds primarily address historically accumulated informal ownership situations. Specialized authorities and flexible evidentiary mechanisms facilitate integration of properties outside the formal registration framework. This corrective function represents an institutional advantage by enabling responses to social and historical realities. However, efficiency is challenged by multiple decision-making bodies, variations in administrative practices, complex evidence evaluation, and limited information integration. Improving efficiency therefore requires enhanced coordination, unified information systems, standardized procedures, and greater transparency without eliminating flexibility.

The German registration system reflects a different institutional model. Its efficiency derives from the integration of substantive legal rules, specialized authorities, judicial supervision, and advanced information management. The Grundbuch functions as a reliable institutional database, supported by the BGB, GBO, judicial oversight, and digital infrastructure, producing high predictability and informational coherence. Nevertheless, the German model may complicate recognition of historically informal ownership situations. Its efficiency is achieved through preventive certainty rather than extensive flexibility.

Comparatively, Iran achieves efficiency through corrective capacity and flexible integration of informal ownership, whereas Germany relies on standardization, information reliability, and institutional predictability. An effective institutional model should combine reliable information infrastructure and procedural consistency with mechanisms capable of addressing exceptional ownership situations. Such a balanced approach can enhance ownership security, reduce disputes, improve public trust, and strengthen registration systems by harmonizing legal certainty with solutions for complex property relations.

8.7. Comparative Assessment of Institutional Efficiency Indicators

Because Iran and Germany operate within different legal traditions and institutional structures, direct quantitative comparison of registration performance is difficult. Therefore, institutional efficiency should be evaluated through a structured comparative framework rather than through a single numerical indicator. The following assessment examines key institutional dimensions relevant to land registration effectiveness.

The indicators selected include procedural standardization, flexibility in resolving informal ownership, reliability of registration information, protection of third-party reliance, institutional coordination, digital infrastructure, and predictability of decisions.

The comparative assessment demonstrates that neither system achieves absolute superiority across all dimensions. The German system performs more strongly in areas related to registration reliability, institutional coordination, and transactional predictability. Conversely, the Iranian system demonstrates greater adaptability in addressing historically established ownership situations that have not entered the formal registration framework.

Accordingly, institutional efficiency should be understood as a balance between two competing objectives: legal certainty and social responsiveness (Table 1).

Table 1. Comparative Analytical Matrix of Legal Mechanisms for Determining the Registration Status of Lands and Buildings Lacking Official Title in Iran and Germany

Comparative Dimension	Iran	Germany	Comparative Assessment
Legal Foundation	Combination of statutory law, principles of Imami jurisprudence, and corrective mechanisms for recognizing undocumented ownership.	Registration governed principally by the BGB and GBO; registration has constitutive legal effect.	Iran prioritizes legalization of existing informal ownership, whereas Germany prioritizes legal certainty through constitutive registration.
Institutional Objective	Formalization of historically accumulated undocumented properties and reduction of informal ownership.	Preservation of the reliability of the land register and stability of real rights.	The two systems pursue different institutional objectives: corrective integration versus preventive certainty.
Competent	Registration offices,	Registration authorities	Germany demonstrates greater

Comparative Dimension	Iran	Germany	Comparative Assessment
Authorities	specialized commissions, administrative bodies, and judicial authorities jointly participate in determination procedures.	(Grundbuchämter), notaries, and courts operate within a unified statutory framework.	institutional coordination and procedural standardization, while Iran provides broader administrative flexibility.
Nature of the Procedure	Combination of administrative and quasi-judicial procedures with relatively flexible evidentiary assessment.	Highly formalized judicial-registration procedure based upon statutory verification requirements.	Iran emphasizes accessibility and corrective capacity; Germany emphasizes procedural certainty and legal durability.
Evidence and Verification	Wide range of documentary and non-documentary evidence including possession, witness testimony, local certifications, and judicial assessment.	Registration primarily based on official documents, registered entries, notarized instruments, and documentary proof required by the GBO.	Greater evidentiary flexibility in Iran facilitates legalization but may reduce informational coherence; Germany maximizes reliability through restrictive evidentiary standards.
Treatment of Intermediate Cases	Flexible judicial and administrative assessment permits evaluation of incomplete documentation, disputed evidence, and partially documented ownership.	Intermediate situations are generally resolved through statutory correction procedures while maintaining the reliability of the register.	Iran demonstrates greater adaptive capacity for complex factual situations, whereas Germany preserves legal certainty by limiting departures from registered information.
Protection of Good-Faith Third Parties	Protection exists but depends upon judicial evaluation and the interaction between registration and ownership claims.	Strong statutory protection under §892 BGB based upon public reliance on the land register.	Germany provides significantly greater transactional predictability and market security.
Correction of Registration Errors	Correction may occur through administrative decisions and judicial review depending upon the legal circumstances.	Correction is available through legally regulated procedures (particularly §894 BGB) subject to judicial supervision.	Germany limits corrective intervention to preserve registration stability, whereas Iran allows broader corrective mechanisms.
Information Infrastructure	Digitalization is progressing, although information remains dispersed among multiple authorities.	Highly integrated digital land registration system with standardized information management.	Integrated digital infrastructure substantially enhances institutional efficiency in Germany.
Procedural Predictability	Moderate due to institutional diversity and flexible evidentiary practices.	High because of statutory standardization and uniform procedural rules.	Germany provides greater legal predictability, while Iran provides greater procedural adaptability.
Institutional Efficiency	Efficient in integrating undocumented ownership but affected by administrative overlap and evidentiary complexity.	Efficient in maintaining registration reliability through institutional coordination and standardized procedures.	The systems represent different models of institutional efficiency: corrective efficiency in Iran versus preventive efficiency in Germany.
Overall Comparative Outcome	Corrective and facilitative registration model designed to incorporate existing informal ownership into the formal legal framework.	Preventive registration model designed to preserve certainty, public confidence, and transactional security.	Neither model is universally superior; each reflects different legal priorities and institutional objectives shaped by its broader property law system.

9. Discussion and Conclusion

Legal mechanisms for determining the registration status of lands and buildings lacking official title perform a fundamental function in modern property law by enhancing ownership security, reducing legal uncertainty, strengthening public

confidence in land administration, and facilitating sustainable economic development. Beyond merely formalizing ownership, these mechanisms shape the institutional capacity of registration systems to reconcile legal certainty with equitable recognition of property rights. Their importance is particularly evident in jurisdictions where historical patterns of informal possession, incomplete documentation, or institutional fragmentation continue to influence the legal status of immovable property.

The present study comparatively examined the legal mechanisms governing lands and buildings lacking official title in Iranian and German law through five analytical dimensions: (1) legal foundations; (2) competent authorities and procedural structure; (3) admissible evidence and verification standards; (4) protection of good-faith third parties and corrective mechanisms; and (5) institutional efficiency and information infrastructure. Rather than merely identifying doctrinal differences, the comparative analysis sought to explain how each legal system balances ownership formalization, registration reliability, procedural predictability, and institutional efficiency within its broader legal and historical context.

The findings demonstrate that the Iranian and German registration systems pursue fundamentally different institutional strategies rather than different versions of the same regulatory model. The Iranian system primarily adopts a corrective approach, seeking to incorporate historically established but undocumented ownership into the formal legal order through relatively flexible evidentiary mechanisms and administrative procedures. This flexibility enhances the system's capacity to recognize genuine ownership situations; however, it may also generate challenges relating to procedural consistency, informational coherence, and institutional coordination.

Conversely, the German registration system emphasizes preventive legal certainty through the constitutive legal effect of registration, strict documentary requirements, judicial supervision, and strong protection of public reliance on the Grundbuch. These characteristics produce a highly predictable and coherent registration system that significantly strengthens transactional security and institutional stability. Nevertheless, the same institutional features may reduce flexibility in accommodating historically informal ownership situations that have not yet been transformed into legally recognizable registered rights.

A principal conclusion emerging from the comparative analysis is that institutional efficiency should not be evaluated exclusively in terms of procedural speed or the number of properties successfully formalized. Rather, institutional efficiency represents a multidimensional concept encompassing legal certainty, procedural predictability, evidentiary reliability, institutional coordination, digital information management, protection of good-faith third parties, and the capacity to resolve ownership uncertainty without undermining confidence in the registration system. Consequently, both legal systems demonstrate internal coherence because each seeks to achieve different institutional objectives through different legal techniques.

The comparative analysis further demonstrates that effective land registration systems should not be understood solely through the traditional distinction between documented and undocumented ownership. Contemporary property relations increasingly involve intermediate ownership situations, including partially documented properties, documents of uncertain authenticity, competing informal ownership claims, and other legally complex factual circumstances. The Iranian legal system addresses many of these situations through relatively flexible evidentiary assessment and corrective administrative or judicial mechanisms, whereas the German system manages such complexity primarily through formal statutory procedures designed to preserve the reliability of registered information. Accordingly, the study demonstrates that the capacity to manage intermediate ownership situations constitutes an important dimension of institutional efficiency and should be regarded as an essential component of modern land registration policy rather than an exceptional or peripheral issue.

From a comparative policy perspective, the study suggests that neither unrestricted flexibility nor excessive procedural rigidity provides an optimal institutional solution. Excessive flexibility may undermine informational coherence and increase legal uncertainty, whereas excessive rigidity may delay ownership formalization and restrict access

to legally protected property rights. The comparative experience of Iran and Germany therefore indicates that effective registration systems require a carefully balanced institutional framework capable of combining legal certainty with sufficient procedural flexibility to address exceptional ownership situations while preserving public confidence in the registration system.

The findings also demonstrate that institutional efficiency is closely associated with procedural standardization, integrated digital information infrastructure, clearly defined institutional responsibilities, transparent correction mechanisms, and effective protection of good-faith third parties. These institutional characteristics reduce transaction costs, improve legal predictability, strengthen market confidence, and enhance the overall reliability of property registration.

Overall, this study contributes to the comparative literature by demonstrating that differences between the Iranian and German systems extend beyond doctrinal rules and reflect distinct institutional philosophies regarding the governance of undocumented property rights. Rather than identifying a universally superior model, the research illustrates how different legal traditions pursue different balances between corrective justice and preventive legal certainty. These findings may provide a useful analytical framework for future comparative research and may assist policymakers in designing registration systems that strengthen ownership security while maintaining institutional coherence, legal predictability, and public trust.

Practical Recommendations:

1. **Strengthen the integration and standardization of registration data.** Developing interoperable databases and standardized registration procedures can improve informational coherence, reduce registration errors, and enhance institutional transparency and public confidence.
2. **Expand digitalization and electronic registration procedures.** Greater use of digital technologies for filing applications, examining evidence, correcting registration entries, and monitoring procedures can improve administrative efficiency, reduce processing time, and strengthen institutional accountability.
3. **Maintain an appropriate balance between flexibility and registration certainty.** Legal mechanisms should permit recognition of legitimate undocumented ownership where justified while preserving the reliability and conclusiveness of registered rights through clear statutory criteria and procedural safeguards.
4. **Develop clearer legal mechanisms for intermediate ownership situations.** Registration systems should adopt transparent legal standards for addressing partially documented properties, disputed documentation, conflicting informal claims, and other legally complex ownership situations without undermining transactional security or public reliance on the registration system.
5. **Strengthen the protection of good-faith third parties and compensation mechanisms.** Predictable compensation procedures and effective protection of legitimate reliance interests contribute substantially to legal certainty and market stability.
6. **Enhance institutional coordination and professional capacity.** Continuous training of registration officials, stronger coordination among competent authorities, and the adoption of uniform procedural guidelines can improve decision quality, reduce administrative inconsistency, and increase public confidence in land administration.

Author Contributions

The authors contributed equally to the development and preparation of this research.

Conflict of Interest

The authors declare that there is no conflict of interest regarding the authorship or publication of this article.

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References

1. Abbasi, B., Rajabzadeh Estahbanati, A., & Mazloum Rahni, A. (2022). The evolution of legislation related to the seizure of land by the government before and after the victory of the Islamic Revolution with a brief look at the laws of England and France. *Political Sociology of Iran*, 5(4), 1444-1469. https://www.magiran.com/p2585188 [In Persian]
2. Abdi, H. (2022). *Applied principles of registration law: Regulations on enforcement of official documents and the law on determining the registration status of lands and buildings without official deeds*. Tehran: Edalat. [In Persian]

3. Adechian, S. A. (2025). How does land tenure security contribute to sustainable development? *Frontiers in Sustainable Food Systems*, (9), 55-87. https://doi.org/10.3389/fsufs.2025.1621537
4. Ahmadzadeh, A., & Khalilzadeh, A. (2023). Basics and nature of Land Transfer Contracts under Article 33 of the Conservation and Utilization of Forests and Pastures law. *The Quarterly Journal of Judicial Law Views*, 25(89), 1-20. https://jlviews.ujsas.ac.ir/article_703595.html [In Persian]
5. Alizadeh Sabet, N. (2021). *Law of registration of documents and properties and commentary on the law on determining the registration status of lands and buildings without official deeds. Tehran*: Ghanoon Yar. [In Persian]
6. Alhola, S., & Gwaindepi, A. (2024). Land tenure formalisation and perceived tenure security: Two decades of the land administration project in Ghana. *Land Use Policy*, (143), 229-253. https://doi.org/10.1016/j.landusepol.2024.107195
7. Assfaw Wolde, A. (2025). Assessing the dynamic impact of formal and perceived land rights on fruit tree cultivation: Exploring the moderating role of forest ecology, gender, and land acquisition method. *Trees, Forests and People*, (20), 1-26. https://doi.org/10.1016/j.tfp.2025.100871
8. Bashiri, A. (2025). *Commentary on the law mandating official registration of transactions of immovable property (July 2024) in applied property and land registration law*. Tehran: Khorsandi. [In Persian]
9. Bauer, T., & Schaub, B. (2023). *Grundbuchordnung: Kommentar*. Köln: Verlag Dr. Otto Schmidt. [In German]
10. Beheshtian, S. M. (2019). *Land acquisition by municipalities: A theoretical and applied study of the governing order of property rights in relation to municipal public projects*. Tehran: Majd. [In Persian]
11. Böttcher, R., & Meikel, P. (2023). *Grundbuchordnung: Kommentar*. München: C.H. Beck. [In German]
12. Braun, H., & Schmidt, L. (2025). Digitale Registerintegration und Rechtssicherheit im Grundbuchwesen. *Zeitschrift für Bundes- und Europarecht (ZBR)*, Deutschland: Mohr Siebeck. [In German]
13. Chigbu, U. E. (2023). Unhiding the "land rights" and "land wrongs" in sub-Saharan Africa: Outcomes and challenges of land tenure security interventions. *Land Use Policy*, (127), 855-883. https://doi.org/10.1016/j.landusepol.2025.107576
14. Dieterle, C. (2025). When "best practice" means formalising: foreign large-scale land investments on customary tenure in Uganda and Sierra Leone. *Journal of Agrarian Change, Early View*, 46(1), 1-26.
15. Dixon, M. (2024). *Modern land law* (12th ed.). London: Routledge.
16. Dreier, H., & Schmidt, U. (2024). *Sachenrecht*.Tübingen, Deutschland: Mohr Siebeck. [In German]
17. Hügel, H. (2023). *Grundbuchordnung: Kommentar*. München: C.H. Beck. [In German]
18. Emamverdi, M. H. (2022). *Land and property law*. Tehran: Majd. [In Persian]
19. Fischer, T., & Janssen, R. (2023). *Digitalisierung im Grundbuchwesen: Chancen, Risiken und Rechtsfragen*. München: C.H. Beck. [In German]
20. Fredrick, L. A., Lucian, C., & Urassa, J. (2025). Women and land rights: The impact of formalization in Tanzania's Coastal Region. *Global Studies Journal*, 48(2), 113-131. https://doi.org/10.1016/j.resglo.2025.100288
21. Haddad Rahmati, A., Taheri Bajd, M. A., & Hashemi, S. H. (2024). Ethical and legal analysis of changes in agricultural land and orchard use. *Ethics in Science and Technology*, 19(1), 51-58. [In Persian] http://ethicsjournal.ir/article-1-3227-en.html
22. Haghaeighi, S. M. B., Yazdanpanah, F., & Kenarizadeh, H. R. (2025). Conflict between governing principles of urban land and property rights in Iran's legal system. *Legal Civilization*, (23), 515-525. [In Persian] https://doi.org/10.22034/lc.2025.511991.1610
23. Karkhaneh, M. (2024). *Analysis of international environmental law instruments*. Tehran: Majd. [In Persian]
24. Kral, W., & Uhl, Y. (2025). *Grundbuchrecht: Recht in Ausbildung und Praxis bei den Gerichten und Staatsanwaltschaften*. Pegnitz: Juristischer Verlag Pegnitz. [In German]
25. Khezrian, R., Ghayoomzadeh, M., & Taghavi, S. H. (2023). State acquisition of land and property. *Comparative Studies in Islamic Jurisprudence, Law and Politics*, 5(2), 145-158. [In Persian] https://doi.org/10.61838/csjlp.5.2.11
26. Kratzlmeier, F. (2023). Die, alte "GbR im Grundbuch aktuelle Probleme des intertemporalen Grundbuchrechts nach dem MoPeG. *Zeitschrift für Immobilienrecht (ZfIR)*, (5), 197-210. [In German] https://hdl.handle.net/21.11116/0000-000F-47A6-6
27. Kühn, R. (2024). *Rechtssicherheit im Grundbuch Probleme der Eintragung und Berichtigung nach MoPeG*. München: C.H. Beck. [In German]
28. Lenz, R. (2025). *Grundzüge des Grundstücksrechts: Ein Lehrbuch für Studium und Praxis*. Berlin: De Gruyter. [In German]
29. Manara, M., & Regan, T. (2024). Institutional pluralism and pro-poor land registration: Lessons on interim property rights from urban Tanzania. *Land Use Policy*, (129), 148-163. https://doi.org/10.1016/j.landusepol.2023.106654

30. Mghase, J. R. (2025). Assessment of legal challenges in the customary land formalisation process in Tanzania. *East African Journal of Law and Ethics*, 8(1), 322-335. https://doi.org/10.37284/eajle.8.1.3615
31. Mashhadi, A. (2025). *Collection of fundamental laws and regulations of environmental law*. Tehran: Khorsandi. [In Persian]
32. Masoudi Lamraski, R., & Ghari Fatemi, S. M. (2021). Capacities and shortcomings of Iranian law and Imamiyya jurisprudence in recognizing the right to the city with reference to French law: With emphasis on land ownership rules. *Comparative Research on Islamic and Western Law*, 8(2), 245-278. [In Persian] https://doi.org/10.22091/csiw.2021.6385.1980
33. Masoumi, M. H., Rahmatollahi, H., & Pilvar, R. (2024). Declaration of land as public and its effect on ownership rights and title deeds (with emphasis on decisions of the Supreme Court and the Administrative Justice Court). *Modern Research in Administrative Law*, (21), 63-83. [In Persian] https://doi.org/10.22034/mral.2024.2037902.1643
34. Meikel, G., & Böttcher, R. (Eds.). (2024). *GBO: Grundbuchordnung: Kommentar* (12th ed.). Carl Heymanns Verlag. Publisher information.
35. Meier, P., & Bühler, J. (2024). *Die Hypothek in der Kaufvertragsabwicklung – Risiken und Grundbucheintragung*. Pegnitz: Juristischer Verlag Pegnitz. [In German]
36. Movahhed Moghaddam, S. (2025). Impacts of land tenure security on the conversion of agricultural land to urban use: A meta-analysis. *Land Degradation & Development*, 24(1), 185-207. https://doi.org/10.1016/j.landusepol.2023.106831
37. Nazari, A. A., & Ahmari, H. (2021). Jurisprudential study of the rule of dominion and its relation to the law on preservation of agricultural land and orchards. *Jurisprudence and History of Civilization*, 18(69), 1-10. [In Persian] https://doi.org/10.30513/cjd.2021.266.1053
38. Neumann, F. (2024). *Rechtliche Herausforderungen bei der Eintragung von Grundpfandrechten im elektronischen Grundbuch*. Pegnitz: Juristischer Verlag Pegnitz. [In German]
39. Ndugwa, R. P., & Omusula, C. K. (2025). Institutional Frameworks, Policies, and Land Data: Insights from Monitoring Land Governance and Tenure Security in the Context of Sustainable Development Goals in Kenya, Rwanda, Uganda, and Zambia. *Land*, 14(5), 960-987. https://doi.org/10.3390/land14050960
40. Notarkasse München A. D., & Kell, B. (2025). Grundbuch Rechte in Abt. II. München: Deutscher Notarverlag GmbH & Co. KG. [In German]
41. Odoyi, E. J. (2025). Exploring land policy tools and instruments for formalising informal settlements in Nigeria. *Land Use Policy*, (130), 291-314. https://doi.org/10.1016/j.habitatint.2025.103605
42. Palandt, O., Grüneberg, C., & Weidenkaff, W. (2024). *Bürgerliches Gesetzbuch*. München: C.H. Beck. [In German]
43. Pierri, F. M. (2025). Land tenure for resilient and inclusive rural transformation. *World Development*, (185), 317-344. https://doi.org/10.1016/j.gfs.2025.100835
44. Saki, M. R. (2024). *Land and natural resources law: Introduction to civil and criminal litigation (scientific and applied)*. Tehran: Khorsandi. [In Persian]
45. Sharifi, H. (2025). *Engineering law (land and property and construction violations)*. Tehran: Khorsandi. [In Persian]
46. Sohrabi Derakhshani, M. (2021). Change of agricultural land and orchard use in Iran's legal system: With emphasis on judicial practice. Tehran: Majd. [In Persian]
47. Walter, F., & Walter, C. (2025). Die Entwicklungen im Grundbuchrecht. *Monatsschrift für Deutsches Recht (MDR)*, 79(10), 791-808. [In German] https://doi.org/10.9785/mdtr-2025-791008
48. Wegerif, M., Coulibaly, M., & Ouedraogo, H. (2025). Land tenure governance in the first decades of the 21st century: Progress, challenges, and lessons from 18 countries. *Land*, 14(4), 671- 689. https://ideas.repec.org/a/gam/jlands/v14y2025i4p671-d1617936.html
49. Yousefi, M. H. (2024). *Conflict of the law on determining the status of lands and buildings without official deeds with existing legislation*. Tehran: Ghanoon Yar. [In Persian]
50. Zheng, L. (2024). Those with constant property rights have perseverance: China's land tenure reform promotes environment-friendly farming practices. *Humanities and Social Sciences Communications*, (11), 762-788. https://doi.org/10.1057/s41599-024-03295-9

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تحلیل تطبیقی سازوکارهای حقوقی تعیین وضعیت ثبتی اراضی و ساختمان‌های فاقد سند رسمی مالکیت در حقوق ایران و آلمان، با تأکید بر کارایی نهادی نظام ثبت اراضی

مهدی جدیدی[۱]، مهدی ذوالفقاری[۲*]، احمدرضا بهنیافر[۳]

۱. دانشجوی دکترای حقوق، واحد دامغان، دانشگاه آزاد اسلامی، دامغان، ایران.
۲. استادیار گروه حقوق، واحد دامغان، دانشگاه آزاد اسلامی، دامغان، ایران.
۳. دانشیار گروه حقوق، واحد دامغان، دانشگاه آزاد اسلامی، دامغان، ایران.

چکیده

مبسوط

۱. مقدمه

نظام ثبت املاک به عنوان یکی از مهم‌ترین نهادهای حقوقی تضمین‌کننده امنیت مالکیت، نقش اساسی در تثبیت حقوق عینی، کاهش اختلافات ملکی، تسهیل معاملات و افزایش اعتماد عمومی ایفا می‌کند. کارآمدی این نظام وابسته به توانایی آن در ایجاد هماهنگی میان وضعیت واقعی مالکیت، اطلاعات ثبتی و حمایت از اشخاص ثالث است. با این حال، وجود املاک و ساختمان‌های فاقد سند رسمی یا دارای وضعیت ثبتی نامشخص، یکی از چالش‌های مهم بسیاری از نظام‌های حقوقی محسوب می‌شود. این وضعیت در ایران عمدتاً ناشی از انباشت تاریخی تصرفات غیررسمی، معاملات عادی و فقدان ثبت رسمی در بخش‌هایی از جامعه است؛ در حالی که در نظام حقوقی آلمان، فقدان ثبت بیشتر به معنای عدم تحقق کامل اثر حقوقی حق عینی در نظام ثبت است. بنابراین، مقایسه دو نظام حقوقی ایران و آلمان می‌تواند ابعاد متفاوت مواجهه حقوقی با مسئله مالکیت‌های غیررسمی و کارایی نهادی نظام ثبت را آشکار سازد. بر این اساس، هدف پژوهش حاضر، تحلیل تطبیقی سازوکارهای تعیین وضعیت ثبتی اراضی و ساختمان‌های فاقد سند رسمی در حقوق ایران و آلمان و بررسی تأثیر تفاوت‌های این سازوکارها بر کارایی نهادی نظام ثبت، امنیت مالکیت و حمایت از اعتماد عمومی به اطلاعات ثبتی است. پرسش اصلی پژوهش آن است که تفاوت‌ها و شباهت‌های میان سازوکارهای تعیین وضعیت ثبتی املاک فاقد سند رسمی در دو نظام حقوقی ایران و آلمان چیست و این تفاوت‌ها چگونه بر کارآمدی نهادی نظام ثبت و تضمین امنیت مالکیت تأثیر می‌گذارند؟

۲. روش تحقیق

این پژوهش با روش توصیفی ـ تحلیلی و رویکرد تطبیقی حقوقی انجام شده است. روش مقایسه در این تحقیق، صرفاً توصیف قواعد حقوقی نیست، بلکه بر مبنای رویکرد کارکردی، نحوه پاسخ هر نظام حقوقی به یک مسئله مشترک، یعنی ایجاد قطعیت حقوقی، حمایت از مالکیت و ادغام وضعیت‌های غیررسمی در نظام رسمی ثبت، بررسی شده است. منابع پژوهش شامل قوانین و مقررات اصلی دو کشور، از جمله قانون مدنی، قانون ثبت و مقررات مرتبط با املاک فاقد سند در ایران، و قانون مدنی آلمان و قانون ثبت اراضی آلمان است. همچنین از منابع تفسیری، مطالعات حقوقی و دیدگاه‌های دکترین حقوقی استفاده شده است. تحلیل تطبیقی بر پنج محور شامل مبانی حقوقی و اصول هنجاری، مراجع صلاحیت‌دار و ماهیت فرایند ثبت، ادله اثبات مالکیت، حمایت از اشخاص ثالث با حسن نیت و کارایی نهادی نظام ثبت انجام شده است.

۳. یافته‌های تحقیق

یافته‌ها نشان می‌دهد که نظام حقوقی ایران در مواجهه با املاک فاقد سند رسمی، رویکردی اصلاحی و تسهیل‌گر اتخاذ کرده است. مبانی فقه امامیه، از جمله اعتبار تصرف، اماره ید و توجه به مالکیت ناشی از تصرف طولانی‌مدت، زمینه پذیرش طیف گسترده‌ای از ادله مانند اسناد عادی، شهادت شهود، گواهی‌های محلی و سابقه تصرف را فراهم کرده است. این انعطاف موجب می‌شود بسیاری از وضعیت‌های مالکیتی شکل‌گرفته خارج از چارچوب رسمی ثبت، امکان ورود به نظام حقوقی رسمی را پیدا کنند و از منظر عدالت ترمیمی، از تضییع حقوق واقعی مالکان جلوگیری شود. با این حال، گستردگی ادله قابل پذیرش و نبود معیارهای کاملاً یکسان برای ارزیابی ارزش اثباتی آنها می‌تواند موجب افزایش اختلافات، تفاوت در تصمیم‌گیری، کاهش انسجام اطلاعات ثبتی و افزایش هزینه‌های قضایی شود. بنابراین، کارآمدی نظام ایران نیازمند ایجاد استانداردهای روشن ارزیابی ادله، هماهنگی نهادی و توسعه زیرساخت‌های اطلاعاتی است. در مقابل،

*. نویسندهٔ مسئول:
دکتر مهدی ذوالفقاری
آدرس: گروه حقوق، واحد دامغان،دانشگاه آزاد اسلامی، دامغان، ایران.
پست الکترونیکی: Email: Mzolfaghari@iau.ir

نظام ثبت آلمان بر اصل اثر تأسیسی ثبت، اعتبار دفتر ثبت اراضی و حمایت از اعتماد عمومی به اطلاعات ثبتی استوار است. مطابق مقررات قانون مدنی آلمان، انتقال مالکیت اموال غیرمنقول نیازمند توافق رسمی و ثبت در دفتر املاک است و ثبت صرفاً نقش اثباتی ندارد، بلکه شرط تحقق حق عینی محسوب می‌شود. همچنین اصل حمایت از شخص ثالث با حسن نیت مطابق ماده ۸۹۲ قانون مدنی آلمان، موجب می‌شود اشخاصی که بر اطلاعات ثبت‌شده اعتماد می‌کنند، از حمایت حقوقی برخوردار شوند. سازوکار اصلاح ثبت مطابق ماده ۸۹۴ قانون مدنی آلمان نیز تنها با هدف هماهنگ‌سازی اطلاعات ثبت‌شده با وضعیت حقوقی واقعی و در چارچوبی کنترل‌شده عمل می‌کند و وسیله‌ای برای شناسایی گسترده مالکیت‌های غیررسمی نیست. مقایسه دو نظام نشان می‌دهد که ایران بیشتر بر عدالت اصلاحی و تبدیل وضعیت‌های واقعی مالکیت به حقوق رسمی تأکید دارد، در حالی که آلمان بر پیشگیری از عدم قطعیت، ثبات معاملات و اعتبار اطلاعات ثبت‌شده تمرکز می‌کند. از منظر کارایی نهادی، نظام آلمان با اتکا به تقسیم روشن وظایف میان ادارات ثبت، دادگاه‌ها و دفاتر اسناد رسمی، استانداردسازی رویه‌ها و انسجام اطلاعاتی، سطح بالایی از پیش‌بینی‌پذیری ایجاد کرده است؛ در مقابل، نظام ایران ظرفیت بیشتری برای حل مسائل تاریخی مالکیت‌های غیررسمی دارد.

۴. بحث و نتیجه‌گیری

نتایج پژوهش نشان می‌دهد که هیچ‌یک از دو الگوی حقوقی به‌طور مطلق بر دیگری برتری ندارد، بلکه هر یک بازتاب‌دهنده اولویت‌های متفاوت نهادی است. نظام ایران با تأکید بر انعطاف و عدالت ماهوی، توانایی بیشتری در جذب وضعیت‌های مالکیتی تاریخی دارد، اما برای افزایش کارایی به استانداردسازی و کنترل‌های نهادی نیازمند است. نظام آلمان با اولویت دادن به قطعیت ثبت و حمایت از اعتماد عمومی، امنیت بالایی در معاملات ایجاد می‌کند، هرچند انعطاف کمتری در پذیرش وضعیت‌های غیررسمی دارد. بنابراین، الگوی مطلوب ثبت املاک باید تلفیقی از زیرساخت اطلاعاتی قابل اعتماد، استانداردهای روشن ثبتی و سازوکارهای اصلاحی مؤثر برای مواجهه با وضعیت‌های استثنایی باشد؛ به گونه‌ای که میان «تسهیل رسمی‌سازی مالکیت» و «حفظ قطعیت ثبت» تعادل برقرار شود.

کلیدواژه‌ها: املاک فاقد سند رسمی، نظام ثبت زمین، رسمی‌سازی مالکیت، فقه امامیه، تضمین تصرف.

تشکر و قدردانی

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Original Article

Economic Development and Rural Employment Generation Program in North Khorasan Province (Case Study: Azari Rural District, Esfarayen County)

Hoseein Ghodrati*[1], Masoud Samian[2]
1- Associate Prof., in Sociology, Hakim Sabzevari University, Sabzevar, Iran.
2- Postdoctoral Researcher of Sociology, Hakim Sabzevari University, Sabzevar, Iran.

Abstract
Purpose- This study was conducted with the aim of developing a structured and practical program for economic development and employment generation in the rural areas of Azari Rural District, located in Esfarayen County, North Khorasan Province.
Design/methodology/approach- The present study adopted a mixed-methods approach (quantitative–qualitative). Parts of the research were based on the positivist paradigm and employed quantitative methods relying on numerical and statistical data. Demographic analyses and statistical data collected in the fields of economics, water resources, agriculture, and social dimensions represent this approach. In addition, considering that the primary and ultimate objective of this study was to formulate an economic development and employment generation program for the 23 villages of Azari Rural District in the Central District of Esfarayen County, a qualitative approach was also employed using open-ended and face-to-face interviews. The statistical population consisted of all 23 villages of Azari Rural District in the Central District of Esfarayen County, and the study was conducted using a census method.
Finding- Based on the collected data, agricultural value chains particularly in livestock farming and animal husbandry, as well as the honey production value chain were identified as having the greatest impact on the local economy, livelihoods, and rural employment generation in the study area. Supply chains, or value-creation systems for regional products, constitute interconnected networks of processes designed to provide goods and services. These systems encompass suppliers, producers, distributors, and sellers who collaborate in an integrated manner to enhance customer satisfaction. In essence, supply chain management establishes coordination among production, inventory, location allocation, and transportation processes among stakeholders involved in a product in order to achieve the optimal balance between responsiveness and efficiency for market success. Based on this framework, the supply chain or value-creation process for rural products can be analyzed at three levels. The first level comprises the production links themselves, including required inputs, input provision, production, processing, and marketing. The second level includes the actors and stakeholders involved in the chain, such as governmental institutions, private organizations and enterprises, farmers and local industrial actors, groups of elites and entrepreneurs, financial institutions, and other public organizations. The third level examines the activities carried out within each production link by these stakeholders.
Keywords- Rural Economic Development, Employment Generation, Value Chain Analysis, Agricultural Development, Mixed-Methods Research, North Khorasan Province.

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Corresponding Author:
Ghodrati, Hoseein, Ph.D.
Address: Department of Sociology, Faculty of Letter's & Humanities, Hakim Sabzevari University, Sabzevar, Iran.
Tel: +989155717780
E-mail: h.ghodrati@hsu.ac.ir

1.Introduction

Food security and rural development are deeply intertwined, particularly in agrarian economies where the majority of the population relies on agriculture for their livelihoods. The Food and Agriculture Organization (FAO) defines food security as a condition where all people, at all times, have physical, social, and economic access to sufficient, safe, and nutritious food that meets their dietary needs and food preferences for an active and healthy life (Alawode, 2025).

economy's capacity to absorb human resources but also has profound impacts on social structures, cultural norms, and even the psychological well-being of individuals and households. This phenomenon, as a multifaceted problem, arises from the complex interaction of economic factors such as the structure of production, fiscal and monetary policies, and labor market developments, with social variables like inequality, poverty, and migration in developing economies like Iran, particularly in rural areas, unemployment has become a chronic challenge rooted in issues such as insufficient investment, weak infrastructure, and a lack of productive employment opportunities. From an economic perspective, this situation not only leads to a reduction in the productivity of all production factors but also imposes significant social and welfare costs on governments, thereby weakening the potential for long-term economic growth (Behnia et al., 2021; Pourmohammadi and Yousefi, 2021; Mankiw, 2024; Pourmohammadi et al., 2025).

In recent decades, the focus of economic development policies on the expansion of small rural businesses has been considered as a solution to achieve rural development (Markeson and Deller, 2012). Small businesses (handicrafts) and entrepreneurship are an important factor to reduce poverty, increase productivity and competitiveness (Omri et al., 2015). The rapid changes in communication technology and the relative decrease in the importance of agricultural economy have made it necessary to pay attention to side jobs in villages (Bosworth & Turner, 2018). Therefore, achieving a sustainable livelihood and improving the quality of life is one of the key goals of rural development programs (Harpaa et al., 2016; Bahrami, 2023).

Traditionally, farming households in developing countries usually diversify their incomes through on-farm strategies such as growing different types of grains and cash crops, keeping different livestock, or engaging themselves in contract farming. Nevertheless, they still face significant uncertainties in farm income generation because the sustainability of farm production is constrained and challenged by several factors. Examples of these factors include changing climate, the occurrence of pests and diseases, unavailability of resources (e.g., land, facilities for commodity storage and livestock housing, and skilled labor), incomplete information on input and output markets, and price fluctuations (Watts et al., 2021). To stabilize or improve their well-being, some rural residents seek better income opportunities from non-farm sectors or exit the agricultural industry completely (Zou, 2024; Ma et al., 2025).

Agricultural value chains (AVCs) refer to the full range of activities and actors involved in bringing agricultural products from input supply, production, and processing to final consumption. This includes input providers, farmers, aggregators, transporters, processors, retailers, and consumers. The value chain perspective emphasizes the importance of linkages and coordination across these stages, as well as the governance structures that shape relationships and determine value distribution. Strategically, AVCs serve as conduits through which agricultural productivity gains translate into broader economic development. They enable smallholders to access markets, technologies, and services, thereby improving income stability and investment incentives. In addition, well-functioning value chains reduce postharvest losses, improve product quality, and expand employment opportunities along upstream and downstream nodes (Tian, 2017).

Despite the growing body of literature on rural development, agricultural value chains, and employment generation, relatively limited attention has been paid to developing integrated, place-based employment programs at the rural district level that combine quantitative spatial analysis with qualitative stakeholder participation. Most previous studies have focused either on evaluating individual sectors or on analyzing rural employment from a macroeconomic perspective, while few have translated these findings into

practical development programs tailored to the socioeconomic and environmental characteristics of a specific rural region. Therefore, there remains a significant gap in designing operational value chain–based development frameworks capable of supporting local policymakers in promoting sustainable rural employment.

The present study seeks to address this gap by integrating statistical analysis, GIS-based spatial assessment, and participatory qualitative research to formulate a comprehensive economic development and employment generation program for Azari Rural District in Esfarayen County. The principal innovation of this research lies in proposing a localized value chain framework that identifies priority economic sectors, spatially allocates production and processing activities, and provides an operational roadmap for regional planning based on local capacities and stakeholder participation.

Accordingly, the objectives and research questions of this study are presented below.

Research Objectives:

• To identify the economic potentials and comparative advantages of Azari Rural District.

• To analyze the agricultural and livestock production systems and their associated value chains.

• To identify priority sectors for sustainable rural employment generation.

• To develop an integrated economic development and employment generation program based on local capacities and stakeholder participation.

Research Questions:

• What are the principal economic capacities and comparative advantages of Azari Rural District?

• Which agricultural value chains have the greatest potential for sustainable employment generation?

• How can value chain analysis contribute to the formulation of an effective rural economic development program?

• What institutional, infrastructural, and spatial interventions are required to strengthen rural employment opportunities in the study area?

2. Research Theoretical Literature

Unemployment exhibits significant heterogeneity across different groups of people. Unemployment is commonly categorized into short-term and long-term unemployment. Short-term employment, includes seasonal unemployment, frictional unemployment (due to job transitions), and structural unemployment (unemployment that happens because of economic restructuring, often impacting low-skilled workers due to technological advancements). Long-term unemployment (lasting more than six months, for example), sometimes considered permanent, is particularly detrimental to the economy, leading to financial hardship and decreased job-seeking motivation (Pourmohammadi et al., 2025).

Employment is one of the major issues of macroeconomics, which has a direct impact on the level of well-being and life of people in the society. Unemployment causes a wide range of social and economic issues at the level of societies, its consequences, in addition to the impact it has on the economic environment in any society, are also of particular importance in political and social fields (Malisauskaite et al., 2022).

All these types of unemployment can be classified by their origin: demand-side and supply-side. Demand-side unemployment arises when there's a drop in the demand for goods and services, leading to fewer labor requirements, often influenced by economic recessions or technological changes (Hamermesh, 2021). Supply-side unemployment, however, is related to the labor supply, such as changes due to immigration, education, or retirement, and mismatches in skills or geographic locations relative to job opportunities. Effective policy responses for these types vary, with demand-side solutions focusing on stimulating economic activity and supply-side measures aimed at enhancing labor market flexibility and aligning skills with job market needs (Farajnia et al., 2020).

Governments must carefully consider the specific type of unemployment occurring and then choose the most appropriate policies to effectively address and mitigate it. Macroeconomic stabilization, including monetary policies (whose effects on employment are described by the Phillips curve) and fiscal policies, improves labor market conditions. Labor market policies are further categorized into structural reforms (affecting the business environment), active policies and passive labor market policies. All types of policies can aim to reduce unemployment or achieve redistributive goals; reforms generally impact unemployment rates, active policies often focus on income redistribution and welfare improvements, while passive policies include Income Support Programs for unemployment. These categories are presented in Figure 1.

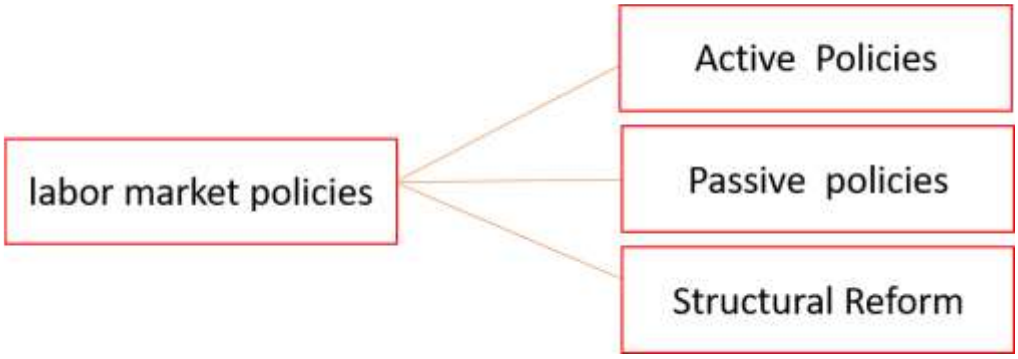


Figure 1. Labor Market Policies

Active policies include fiscal measures (government spending, taxation, and subsidies) and monetary actions (interest rates and money supply management), both of which influence employment by adjusting economic levers. For example, fiscal policies stimulate labor demand through initiatives like increased public spending and tax incentives for hiring, as demonstrated by the U.S. Paycheck Protection Program, which supported businesses in retaining employees (Granja et al., 2022). Monetary policies, managed by central banks, influence employment by affecting borrowing costs and credit availability (Bernanke, 2020).

Passive labor market policies provide financial relief primarily through income support to stabilize individuals during periods of unemployment, focusing on social protection rather than skills development or job placement.

Structural policies aim to reshape the labor market through labor law reforms, tax system adjustments, and enhanced access to labor markets, thereby improving labor market efficiency and workforce quality (Aiginger and Rodrik, 2020).

One of the selected strategies for the development of rural areas that are faced with a surplus population is the development of handicrafts and workshops. Handicrafts are mostly defined as items that are made by hand, often using simple tools, and generally have an artistic or traditional nature. Handicraft refers to a group of industries in which all or most of the manufacturing steps of its products are done by hand (Tripathi, 2022). In this section, views and theories on rural industries and their impact on rural development are discussed. As an economist, Penn Rose states in his theory of marginal economies that "under conditions of prosperity and economic prosperity, creating growth opportunities for small and medium-sized industries is much easier and faster than the development of large industries (Barkhordari et al., 2022).

From Mina2007's point of view, in the current conditions, the agricultural sector alone cannot be a suitable answer to meet the livelihood needs of the rural people, but creating employment in the industrial sector for the rural youth is one of the necessities of the present age; By promoting small-scale industries in villages, the problem of poverty and unemployment can be eliminated. This is while these industries, in addition to having high employment, needless investment.

In terms of research background, we can refer to the results of the studies of Martin L. & Tamara (2013) who in their study on economic growth and economic innovation in small rural companies in rural England in Wales concluded that innovation in small rural businesses should be a way to reduce waste and raw material consumption. Early studies on microcredit impact often showed insignificant results. However, more recent research increasingly demonstrates positive economic effects. These studies have examined micro-level impacts (income, consumption, savings, investment) and macro-level impacts (GDP growth, aggregate consumption and investment) (Ayyagari et al., 2021).

Agricultural value chains are composed of interconnected stages that convert raw farm inputs into consumable food products, traversing several transformation and exchange nodes along the way. Typically, a value chain begins with input provisioning (such as seeds, fertilizers, and equipment), continues through production and

harvesting, and progresses into aggregation, processing, storage, marketing, and finally, consumption (Tian, 2017).

Each stage adds value, either through physical transformation, logistical services, or market linkage. The vertical structure of a value chain refers to these sequential functions, while the horizontal structure includes the network of actors operating at each level such as multiple farmers in the production stage or competing processors in the transformation stage. These structures can be short and simple (as in local vegetable sales) or long and complex, involving multiple intermediaries and international trade (Chukwunweike & Dolapo Salaudeen, 2025).

Critical to the effective operation of value chains are the governance mechanisms that coordinate flows of goods, information, and capital. Governance defines how decisions are made about standards, pricing, input sourcing, and risk allocation. Chains governed by lead firms (e.g., supermarkets or exporters) often impose strict quality and delivery requirements on suppliers. Alternatively, more decentralized governance is observed in informal and subsistence-based markets, where coordination is limited and power imbalances are common (Narrod et al., 2009). Understanding these structural elements is essential for identifying leverage points where interventions such as infrastructure development, policy reform, or financing can enhance performance, reduce losses, and improve equity in agricultural systems.

In summary, the review of the theoretical literature and background research indicates that rural development and sustainable employment generation, as two fundamental components in agrarian economies, are strongly influenced by the functioning and structure of value chains. Despite the widespread emphasis on the role of value chains in reducing inequality, improving food security, and enhancing productivity, there remains a significant gap in developing operational and place-based programs grounded in spatial analysis (GIS), stakeholder participation, and local capacities. Therefore, the present study aims to adopt an integrated approach (combining quantitative, qualitative, and spatial analysis methods) to identify the comparative advantages and economic potentials of Azari Rural District. By analyzing key value chains, this research seeks to provide an operational framework for economic development and sustainable employment creation in the region. The findings of this study can not only fill the existing scientific gap but also offer effective guidance for local policymakers and planners in optimizing resource allocation and designing targeted interventions.

3. Research Methodology

3.1 Geographical Scope of the Research

According to the 2016 national census, the population of North Khorasan Province was 863,092. Among the counties of the province, Esfarayen County ranked as the third most populous county after Bojnord and Shirvan, with a population of 120,513 in 2016. North Khorasan Province has a considerably higher proportion of rural population compared with the national average. While only 25.9% of Iran's total population resides in rural areas, the proportion of rural residents in North Khorasan Province reaches 43.7%. Within the province, Esfarayen County has one of the highest levels of rural settlement, ranking after Raz and Jargalan, Faruj, and Maneh and Samalqan counties.

Esfarayen County consists of six rural districts: Azari, Bam, Safiabad, Milanlu, Daman Kuh, Zarqabad, and Ruin. Azari Rural District is located in the Central District of Esfarayen County and comprises 60 settlements, some of which are currently uninhabited. According to the 2016 Population and Housing Census, Azari Rural District, with a population of 14,230, is the most populous rural district in Esfarayen County (Figure 2).

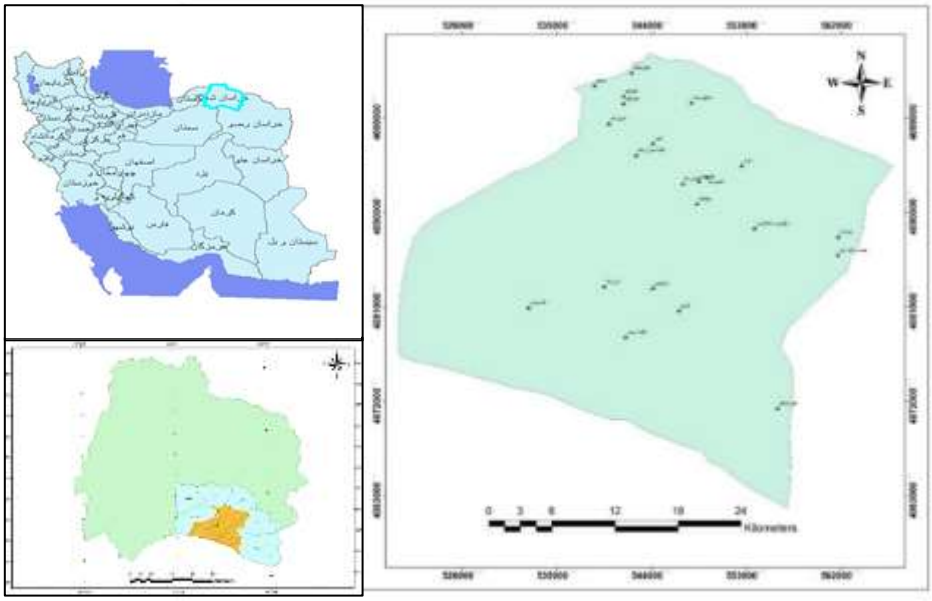


Figure 2. Location of Azari Rural District within North Khorasan Province and the Spatial Distribution of the Target Villages

3.2. Methodology

This study employs a mixed-methods research design, integrating both qualitative and quantitative approaches, with data collected through focus group discussions (FGDs) and semi-structured interviews. The study area encompasses the rural villages of Azari Rural District, located in Esfarayen County, which comprises a total of 23 villages. During the focus group sessions, the problem tree technique was utilized to identify the principal challenges and issues confronting the villages from the perspective of local residents, as well as to delineate their underlying causes and potential consequences. To facilitate this process, a large sheet of paper measuring 2 by 1.5 meters was spread on the ground, and colorful wax crayons were employed to enhance the visibility and clarity of the recorded content. A schematic tree, complete with branches and roots, was then illustrated at the center of the paper.

Participants were seated in a circle around the paper and were subsequently invited to articulate the main problems and issues affecting their communities. Through this participatory approach, an inventory of rural challenges was compiled, while simultaneously identifying the root causes and anticipated repercussions of each identified issue. The facilitators provided the necessary guidance to steer the sessions effectively and employed various interactive techniques to actively engage passive or reticent participants, thereby ensuring inclusive and comprehensive group contributions.

Based on these considerations, the present study employs a combination of these approaches and methods:

Quantitative Approach: Since this study was conducted upon the recommendation of the Management and Planning Organization of North Khorasan Province, and in accordance with both the functional orientation of this organization and the practical nature of applied research, the findings and analyses of this study are intended to serve as a basis for economic development and employment generation planning and policymaking. Given that effective planning and policy formulation require objective, measurable, and quantitative justification, parts of this research were conducted within the framework of the positivist paradigm using methods based on numerical and statistical analysis. Accordingly, analyses related to demographic characteristics, as well as statistical data collected in the fields of economics, water resources, agriculture, social conditions, and related sectors, constitute examples of the quantitative approach adopted in this study.

Qualitative Approach: Given that the primary and ultimate objective of this study was to formulate an economic development and employment generation program for the 23 villages of Azari

Rural District in the Central District of Esfarayen County, and as discussed in the theoretical framework of this project, sustainable rural development cannot be achieved without empowering local communities and local actors, the adoption of a qualitative approach and the use of open-ended, face-to-face interviews were considered essential.

Accordingly, in addition to utilizing existing statistical data, efforts were made to obtain a deeper and more comprehensive understanding of both the villages and the research subject through interviews with informed individuals, knowledgeable stakeholders, and actors directly involved in the study context. As emphasized within interpretive paradigms, designing an effective development program is not possible without the participation of local actors and communities in the planning process; understanding their perceptions, attitudes, and viewpoints is therefore essential.

Furthermore, drawing upon the critical paradigm and considering the potential biases generated by existing power structures within local communities, particular attention was given during fieldwork and interviews to the social and power dynamics of the villages. Efforts were made to move beyond surface-level observations and gain access to deeper and less visible layers of social reality in order to develop a more accurate understanding of the research context.

For example, one of the open-ended interview questions addressed the ethnic and tribal structure of the villages and their demographic composition. Responses to this question, together with awareness of participants' ethnic backgrounds, enabled the researchers to identify potential sources of information bias. Where necessary, additional participants from other ethnic groups were consulted to enhance the comprehensiveness and balance of data collection.

Field Visits and Observational Assessments: Prior to the commencement of field interviews, throughout the interview process, and following the completion of interviews, the research team conducted a series of field visits to collect data and gain a more comprehensive understanding of the study area. These visits included observations of village environments, plains, agricultural lands and orchards, water resources, earthen dams, and other relevant local facilities and assets. Whenever necessary, these field visits were conducted with the guidance of village council members and village administrators (Dehyars), enabling the research team to receive contextual explanations on-site and thereby develop more accurate interpretations and assessments of local conditions.

Study Population and Sample: The statistical population of this study consisted of 23 villages located in Azari Rural District in the Central District of Esfarayen County. These villages include: Kalateh Sanjar, Ghahremanabad, Hesari Gazrani, Aliabad Alou, Sanjebini, Abri Tappeh, Ghasem Khan, Nasrabad, Dowlatabad, Izi, Firouzabad, Sinan, Abbasabad, Valiabad, Atimaz, Fartan-e Jadid, Kabutarkhaneh, Joushqan, Fartan-e Kohneh, Gerati, Kalateh Mirza Rahim, Ghasemabad, and Koushki. With respect to statistical and quantitative information collected at the aggregate village level (including indicators such as literacy rates, population growth rates, and similar demographic and socioeconomic measures), the study adopted a census approach covering all target villages.

However, for qualitative information and in-depth data collection, the research required interviews with informed participants and knowledgeable stakeholders. Accordingly, qualitative data were collected through interviews with the following groups of participants:

a) In the first stage, village administrators (Dehyars) and members of village councils were interviewed as key informants and primary gatekeepers with extensive knowledge of local conditions and village affairs.

b) Based on consultations with these individuals, other informed participants and local entrepreneurs where present within the villages were identified and selected for interviews.

c) During the researchers' presence in the villages, additional interviews were conducted with local residents as appropriate. These participants were generally individuals who voluntarily expressed interest and willingness to contribute to the research process.

Data Collection Procedure: The research process and data collection were conducted in the following stages:

a) In the first stage, statistical and secondary data were collected from multiple sources, including demographic statistics obtained from the Statistical Center of Iran, datasets provided by the

Management and Planning Organization, and data gathered from governmental departments and organizations at both county and provincial levels.

b) Subsequently, a quantitative questionnaire consisting of 13 data tables was developed and completed through telephone interviews with village administrators (Dehyars). The questionnaire collected village-level information across the target villages regarding educational services and facilities, water supply systems, energy infrastructure, transportation, cultural–religious–tourism facilities, administrative services, information and technology infrastructure, commercial and economic activities, agricultural infrastructure, public facilities, employment activities, and other relevant indicators. Access to this comprehensive set of information prior to field visits enabled the research team to establish a preliminary understanding of each village and provided an initial analytical framework for conducting field investigations.

c) In addition, through a series of consultation sessions, a qualitative questionnaire consisting of 22 open-ended questions was designed to be completed during field visits through open interviews. The questionnaire covered a broad range of topics, including agriculture, livestock production, workshop-based and handicraft industries, tourism, mining, capital and investment, services, development projects, socio-cultural issues, and participants' recommendations and proposed initiatives. Data Analysis Methods: Depending on the nature of the data collected across different sections of the project, appropriate analytical methods were employed.

a) In the natural and environmental studies section, after obtaining the required data from relevant governmental agencies, maps related to natural hazards (including floods, earthquakes, fault lines, and other environmental risks), vegetation cover, regional water resources, and the spatial distribution of rural settlements were prepared and analyzed using Geographic Information System (GIS) software.

b) In demographic studies and selected components of the economic analysis (including agriculture and livestock sectors), population forecasting models and descriptive statistical measures, such as means and related summary statistics, were employed for data analysis.

c) For studies based on open-ended interviews, data were analyzed using interpretive and descriptive approaches through focus group analysis conducted by the research team, with the aim of achieving the highest possible level of analytical comprehensiveness and interpretive depth.

The statistical data used in this study were obtained from official governmental organizations, including the Management and Planning Organization, the Agricultural Jihad Organization, and the Industry, Mine and Trade Organization. To improve data reliability, the research team did not rely solely on these secondary sources. During the fieldwork, official statistics were systematically compared with field observations and discussed with village administrators (Dehyars), members of village councils, local farmers, livestock producers, and other knowledgeable stakeholders. Whenever inconsistencies or ambiguities were identified, additional inquiries were made with the relevant local authorities to ensure that the information reflected the most recent conditions in the study area. This triangulation of official statistics, field observations, and stakeholder interviews enhanced the credibility of the dataset used in the analysis. Nevertheless, farm-level random sampling was not undertaken, and this should be regarded as a limitation of the study.

4. Research Findings

An assessment of the socioeconomic conditions of Azari Rural District indicates that agriculture and livestock production constitute the primary economic activities of local residents and form the main foundation of rural livelihoods. These sectors not only represent the dominant production system within the district but also contribute substantially to agricultural output at both county and provincial levels. In the agricultural sector, major crops include wheat, barley, onion, tomato, alfalfa, and sugar beet, some of which account for a considerable share of total production in Esfarayen County. In addition, within the horticultural sector, certain villages such as Hesari Gazrani benefit from favorable climatic conditions for apple production, making this activity economically significant.

Furthermore, following the migration of a considerable number of livestock breeders from the Milanlu region to this rural district over recent decades, and given the availability of relatively

suitable rangelands, livestock farming has become one of the principal economic activities in the villages of the area. This sector contributes a notable share of the county's meat and dairy production, while associated dairy products also play an important role in supporting the income and economic resilience of rural households.

In addition to agricultural and livestock-related activities, industrial and mining activities are also present within the district. These activities are primarily based on mineral resources associated with construction materials, including brick clay, rubble stone, gypsum, sand, and gravel. Accordingly, local industrial activities have largely developed around these resource-based industries and continue to demonstrate potential for further expansion.

4.1. Description, Analysis, and Interpretation of the Natural and Ecological Conditions of Azari Rural District and Target Villages

4.1.1. Topographic Conditions:

A: Elevation

Esfarayen County is located in the southern part of the Aladagh Mountain Range. Shah Jahan Mountain, the highest peak of this range with an elevation exceeding 3,000 meters above sea level and widely referred to as the "Roof of North Khorasan," is situated in the northeastern part of Esfarayen County and north of Bam Village. Other major peaks of the Aladagh range within this area include Shanu, Navari, Kheiran, Qareh Tash, Gavtigh, Bormahan, Pato, and Delghareh. The northern and northeastern parts of Azari Rural District are characterized by elevated mountainous terrain, whereas elevation gradually decreases toward the central and southern parts of the area, which predominantly exhibit plain-like landforms. The largest proportion of the district's terrain consists of areas located below 1,100 meters above sea level. Although the southern parts of the district are relatively low-lying and flat, undulating hills and rolling topography interrupt the uniformity of the plain landscape.

The study area extends across an elevation range from approximately 1,000 meters above sea level in the southern parts of the district to nearly 2,500 meters in the northeastern areas. Overall, higher-elevation zones and lands situated above 1,700 meters are concentrated in the northeastern parts of the district, whereas lower-elevation lands are predominantly distributed across the southern areas (Figure 3).

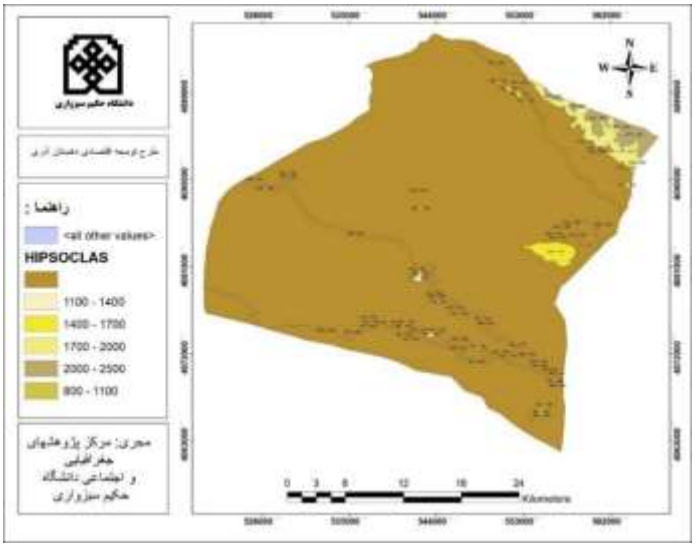


Figure 3. Elevation Classification Map of Azari Rural District

B: Slope

Slope is considered one of the key environmental factors influencing the location and development of rural and urban settlements. In addition to its important role in the initial formation of settlement cores, slope significantly affects the direction and pattern of rural expansion over time. Since slope acts as a natural constraint on settlement establishment and human activities, it is regarded as one of the major geographical determinants of population distribution and residential land development. Moreover, favorable slope

conditions not only facilitate construction and human settlement but also influence the distribution of agricultural land, which represents a critical production resource in rural areas. The presence of steep slopes in rural environments may lead to challenges such as increased physical development costs (e.g., land grading and excavation), higher transportation expenses, and reduced cultivable land area.

Previous studies suggest that urban and rural construction is generally not recommended on slopes exceeding 15%. Similarly, steep terrain creates limitations for agricultural activities and increases cultivation and production costs. Consequently, in most regions of the world, irrigated agriculture is primarily concentrated on lands with slopes below 12% (Alborz Spatial Planning and Development Consulting Engineers, 2016). According to the slope classification map prepared for Azari Rural District (Figure 4), most villages in the study area are located within low-slope zones (less than 5%), while a limited number of the target villages are situated in areas with slopes below 12%. As indicated above, the target villages are generally located in topographically favorable areas, and from the perspective of settlement establishment, rural expansion, agricultural land use, and industrial development, the conditions of Azari Rural District can be considered suitable.

The dominant slope direction across the study area extends from the north and northeast toward the south and southwest.

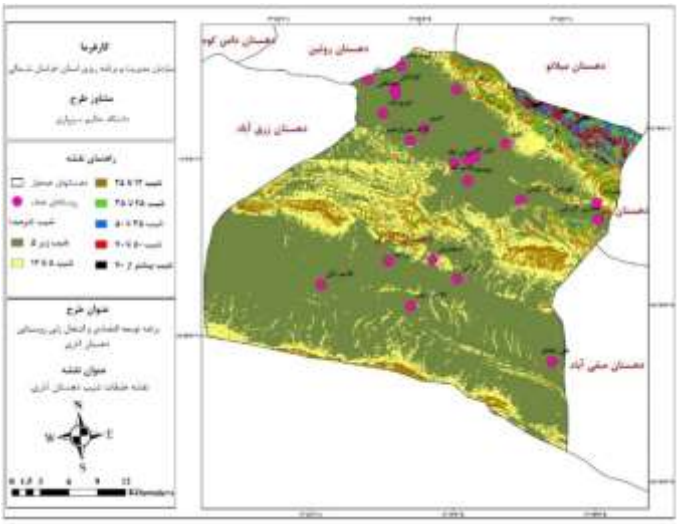


Figure 4. Slope Classification Map of the Target Villages in Azari Rural District

4.1.2. Land Use Status of Esfarayen County and Azari Rural District

Figure 5 illustrates the land use map of Esfarayen County. Based on the conducted assessments, the total area of rangelands (including dense, semi-dense, and sparse rangelands) and forest lands (comprising semi-dense forests and open forests) in Esfarayen County is estimated at approximately 337,000 hectares.

Among these land categories, sparse rangelands account for the largest share, covering 252,285 hectares, whereas dense rangelands represent the smallest portion of rangeland and forest areas, with an estimated area of approximately 3,327 hectares (Table 1). In addition, approximately 155,787 hectares of land within Esfarayen County are under agricultural cultivation. Of this total, around 79,511 hectares are allocated to irrigated farming, while 76,276 hectares are devoted to rainfed agriculture.

Table 1. Area and Percentage Distribution of Vegetation Cover in Esfarayen County

Vegetation Cover Type	Area (ha)	Percentage of Total Vegetation Cover (%)
Dense Rangelands (Good Condition)	3.327	0.99
Semi-dense Rangelands (Poor Condition)	45.492	13.51
Sparse Rangelands (Poor and Very Poor Condition)	252.285	74.92

Semi-dense Forest	3.426	1.02
Open Forest	32.207	9.56
Total Vegetation Cover	336.737	100.00

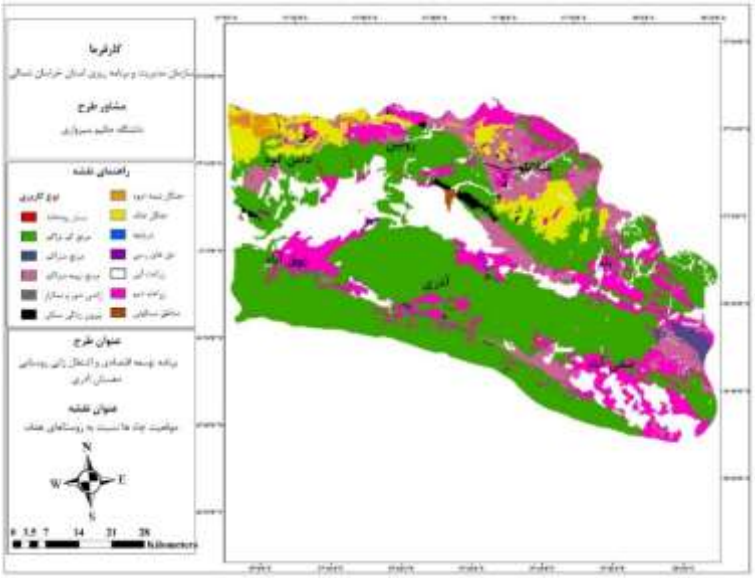


Figure 5. Land Use Map of Esfarayen County

An examination of the land use map of Azari Rural District (Figure 6) indicates that poor and very poor rangelands (sparse rangelands), covering approximately 75,819 hectares, constitute the largest share of vegetation cover in the study area. In contrast, open forests, with an area of approximately 1,073 hectares, account for the smallest proportion of vegetation cover.

According to the land use map, the largest extent of irrigated agricultural land is concentrated within villages located in the northwestern part of the rural district. As illustrated in Figure 7, the highest density of groundwater extraction wells is also concentrated in this section of the study area. Therefore, the occurrence of successive drought periods and the decline of surface water resources in the region are likely to intensify groundwater extraction to meet agricultural water demand, ultimately resulting in a decline in groundwater levels across the area.

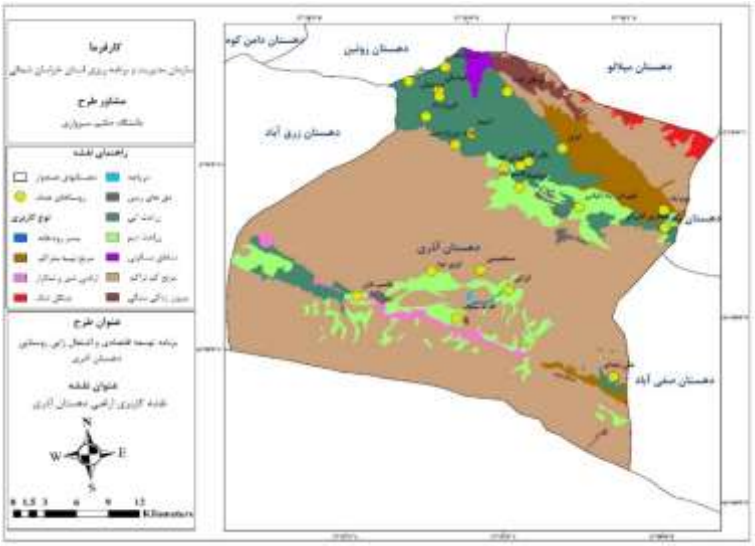


Figure 6. Spatial Distribution of Land Use Categories in Azari Rural District



Figure 7. Examples of Vegetation Cover in Azari Rural District

4.2. Description, Analysis, and Interpretation of the Agricultural Production System in the Target Villages

One of the most important considerations in designing employment generation and rural development programs is understanding the production system, market conditions, and livelihood mechanisms of rural communities. In practice, development and employment policies should be formulated based on the capabilities, comparative advantages, and endogenous potential of each region. Achieving this objective requires a comprehensive assessment of production conditions across the principal productive sectors, including agriculture and livestock production as the main pillars of rural economies, as well as industry, services, and tourism.

Accordingly, this section examines the current conditions of the target villages in terms of production structure, major products, and development potential. It should be noted that the data used in this section were compiled from a combination of official sources and field-based investigations, including governmental and provincial institutions such as the Agricultural Jihad Organization and the Industry and Mining Organization, alongside field observations and local assessments. Particular attention was given to incorporating field evidence and local observations into the interpretation of findings in order to provide a more context-sensitive and comprehensive analysis. The following sections discuss the main productive sectors that constitute the foundation of the rural production system.

4.2.1. Agricultural Production System

Figure 8 presents the per capita irrigated agricultural land across the target villages. Based on the results, Sanjebini and Abri Tappeh villages exhibit the lowest per capita irrigated farmland, whereas Valiabad records the highest value. It should be noted that this figure represents per capita land availability only, calculated by dividing the total area of irrigated agricultural land in each village by the number of households.

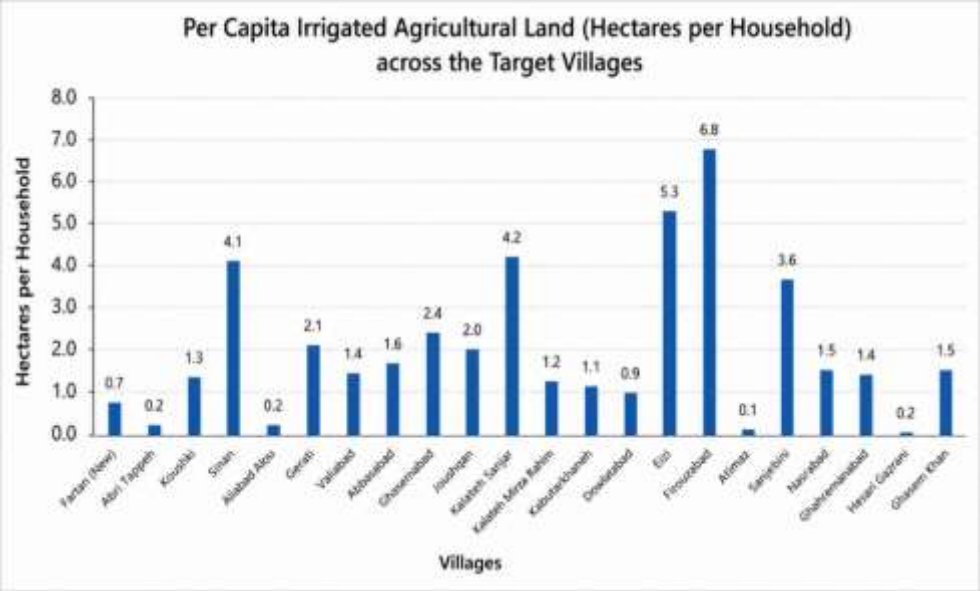


Figure 8. Per Capita Irrigated Agricultural Land across the Target Villages

Figure 9 presents the per capita orchard land area per household across the target villages. Based on the results, Fartan and Atimaz villages exhibit the lowest per capita orchard land availability, whereas Hesari Gazrani records the highest per capita value. It should be noted that this indicator reflects only per capita orchard land availability and was calculated by dividing the total orchard area of each village by the corresponding number of households.

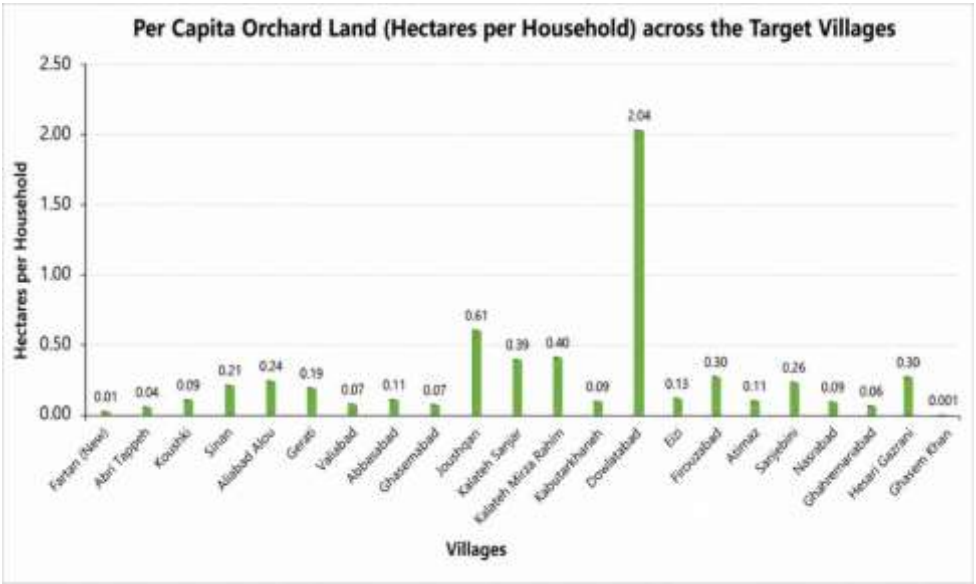


Figure 9. Per Capita Orchard Land per Household across the Target Villages

In most villages of Azari Rural District, agriculture constitutes the principal economic activity and the primary source of household income, although not all villages benefit equally from agricultural advantages and production capacity. The majority of agricultural production in the district is based on irrigated cultivation, while rainfed farming accounts for only a limited share of total agricultural activity. In practice, rainfed cultivation is limited to a small number of villages with relatively favorable environmental conditions, where only wheat and barley are cultivated under

rainfed systems. However, according to local residents, the productivity of these activities remains relatively low. This condition is largely attributable to the predominance of arid and low-precipitation climatic conditions across most parts of the district.

Among irrigated crops, wheat and barley occupy the largest proportion of cultivated land. Specifically, wheat and barley account for 32.4% and 27.2% of the total cultivated area, respectively, representing the dominant agricultural products of the district. Following these crops, watermelon and melon collectively account for approximately 13% of the cultivated area. Overall, wheat, barley, watermelon, and melon together occupy nearly 73% of the total cultivated land area in Azari Rural District. Other important agricultural products with shares exceeding 1% of the cultivated area include cumin, onion, cotton, tomato, alfalfa, sugar beet, and saffron.

4.2.2. Livestock Production System

Alongside crop cultivation, livestock production plays a significant role in the economy of Azari Rural District. Due to the migration and permanent settlement of a considerable number of Kurdish nomadic households from the Milanlu region into this district over recent decades, the area currently supports a substantial population of small livestock. However, during the warmer months of the year, many of these pastoral households continue their seasonal migration toward the northern parts of the district, the Milanlu Rural District, and the foothills of Shah Jahan Mountain, before returning to Azari Rural District for permanent residence. This seasonal mobility pattern should be taken into consideration when designing livestock-related policies and development interventions, as a significant proportion of livestock producers in the area continue to maintain transhumance practices despite being residentially settled within the district.

Livestock production is practiced, to varying degrees, across nearly all villages of the district; however, herd size and production intensity differ according to local climatic and environmental conditions. As shown in the findings, Kalateh Mirza Rahim, Fartan (New and Old), and Ghahremanabad villages each account for approximately 10% of the total small livestock capacity of the district, indicating their relatively prominent position within the local livestock production system.

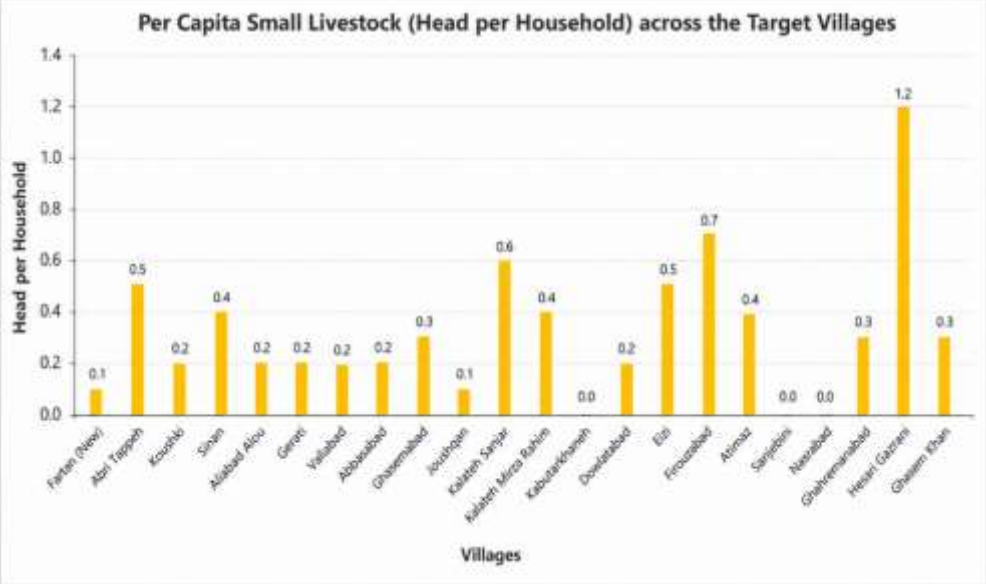


Figure 10. Per Capita Large Livestock Holdings per Household across the Target Villages

Figure 10 presents the per capita small livestock holdings per household across the target villages. Based on the results, Koushki and Sanjebini villages exhibit the lowest levels of per capita small livestock ownership, whereas Sanjebini records the highest per capita value. It should be noted that this indicator reflects the relative availability of small livestock at the household

level and provides a comparative understanding of livestock distribution among the target villages.

4.3. Identification and Feasibility Assessment of Value Chains, Production Systems, and Business Clusters in Azari Rural District

4.3.1. Value Chain of Livestock and Livestock-Related Products

One of the most important sectors in Azari Rural District, which has considerable potential to stimulate regional prosperity and economic growth through proper supply chain design and implementation, is the livestock sector and its associated value chain. In addition to generating employment opportunities, strengthening this value chain can contribute to income growth and broader regional development. The livestock supply and value chain encompasses multiple stages, extending from input provision to final product delivery.

At the initial stage, which involves livestock feed supply as a key production input, Azari Rural District possesses the capacity to establish several forage storage facilities and silos, as well as livestock feed production units. If strategically located, these facilities could not only reduce production risks and supply concerns among livestock producers but also create additional employment opportunities within the district.

At this stage, public and governmental institutions particularly the Agricultural Jihad Organization should also play an active role. This involvement is especially important during drought periods, when these institutions can support livestock producers through more efficient procurement and distribution of feed inputs via storage and processing facilities.

The next stage concerns livestock production itself. Nearly all villages within the district demonstrate the capacity to engage in both small and large livestock production, largely due to the existence of local knowledge, production experience, and community interest in livestock husbandry. At this stage, the establishment of semi-industrial livestock farming complexes, particularly for cattle breeding and production, may also represent a viable development strategy for strengthening the livestock production system and enhancing regional economic performance.

Parallel to the production stage, the district requires supporting infrastructure, including a livestock breeding improvement center and veterinary service units, to strengthen and sustain livestock production activities. Establishing such facilities can contribute not only to higher productivity and increased income but also to improving the adaptation of livestock breeds to local environmental conditions and reducing livestock mortality rates.

In addition, the involvement of experts from specialized institutions, particularly veterinary services, together with collaboration with regional universities to promote scientific livestock production practices, should be prioritized as a means of enhancing production efficiency. In this regard, capacity building and technical training for local communities should become an integral component of the programs implemented by the Agricultural Jihad Organization and the Technical and Vocational Training Organization in the region. Following the livestock production stage, processing and utilization of livestock outputs constitute the next critical component of the value chain. The establishment of dairy production, processing, and packaging workshops for traditional local products including local butter, clarified animal butter, traditional yogurt, Cream, cheese, and related products marketed under a regional brand, could create sustainable employment opportunities across the rural district. The location of such facilities should be determined based on local comparative advantages and production capacities, allowing them to evolve into recognized regional brands in the medium and long term.

The products generated through these processing units not only serve as one of the key links connecting the local value chain to markets beyond the district and county boundaries but can also contribute to tourism development through local markets and rural product experiences. Modern distribution companies operating around a district-level brand identity could play an important role in maintaining the integrity and efficiency of this value chain. In addition to dairy products, livestock meat and hides represent important components of the value chain. Considering the ongoing construction of the Esfarayen livestock slaughterhouse and livestock market in the Fartan area, this segment of the chain is expected to operate in close interaction with surrounding rural districts. Furthermore, establishing a leather tanning workshop adjacent to the slaughterhouse could increase

value added through more efficient utilization and processing of livestock hides.

At the same time, given the geographical proximity of Azari Rural District to Sabzevar County in Razavi Khorasan Province, the livestock market of Sabzevar may also function as a supporting market hub for this sector. Accordingly, market access constraints for meat products are expected to remain limited, while stronger supply-chain integration with neighboring districts and counties can be achieved. Beyond the production of meat and milk as the principal outputs of the livestock value chain, by-products such as wool should also receive strategic attention. Establishing wool collection, shearing, and processing facilities at the district level, followed by yarn production through spinning workshops, could not only improve livestock production efficiency but also expand the overall value chain.

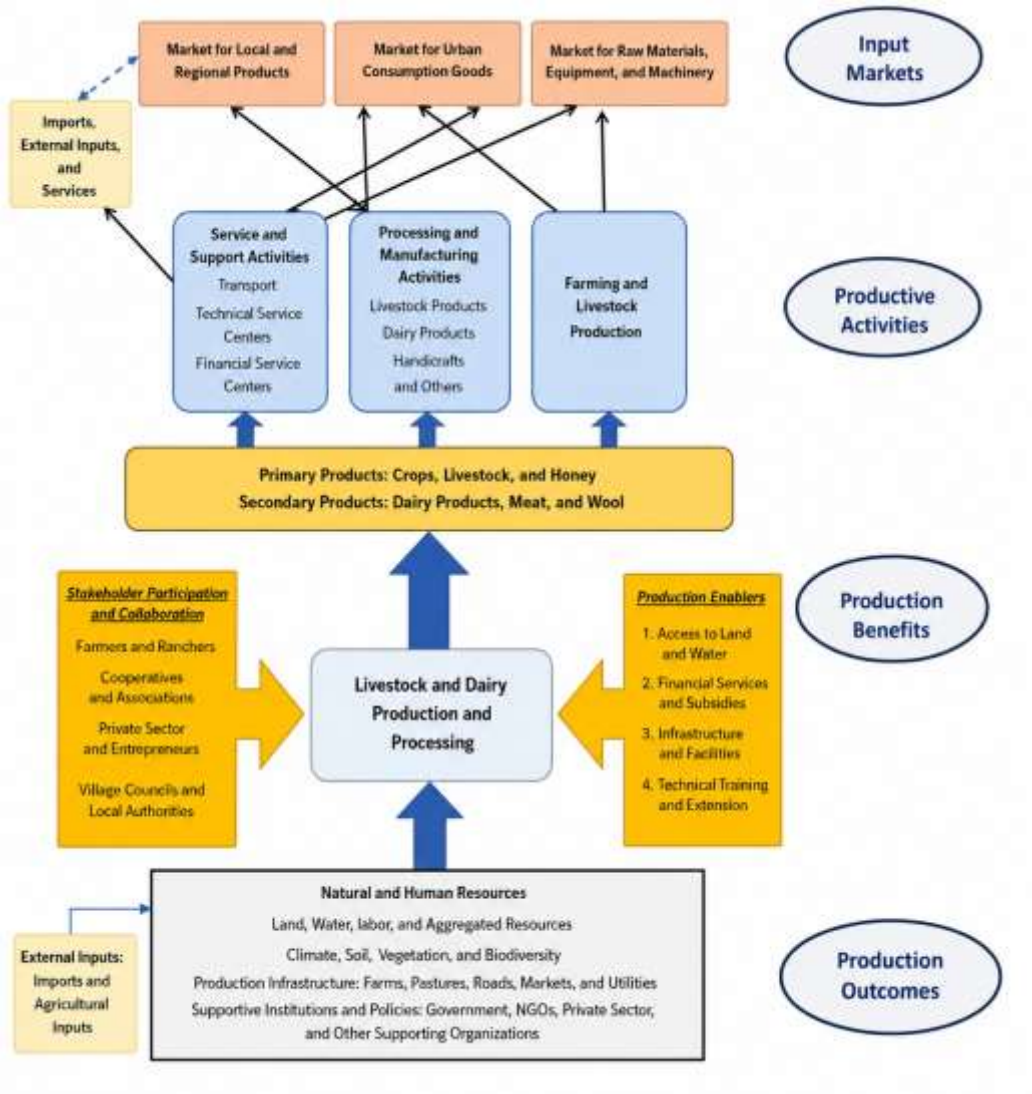


Figure 11. Livestock and Livestock-Related Products Value Chain Framework

Subsequently, small-scale dyeing workshops could generate additional value added and convert processed yarn into usable skeins for other production sectors and handicraft industries. Moreover, such processing facilities could partially resolve existing market limitations for wool products within the district. Unlike the current situation where sheep wool is largely underutilized and lacks an organized market structure these facilities would enable year-round operations, storage capacity, and distribution to neighboring counties and provinces.

This approach would also establish functional linkages between the livestock supply chain and the handicraft value chain within the district. In practice, the outputs of spinning and dyeing workshops could serve as raw materials for local carpet-weaving workshops and related handicraft activities. Figure 11 summarizes the overall process of the livestock-sector value chain.

4.3.2. Value Chain of Honey Production

Another value chain that can be developed based on the existing capacities of Azari Rural District is the honey production value chain. As demonstrated in the section on economic potentials, Azari Rural District—particularly with Fartan serving as a production center alongside other suitable villages—holds a distinguished position in honey production within Esfarayen County and even North Khorasan Province. Therefore, strengthening the honey supply chain has the potential to generate value added, create employment opportunities, and contribute significantly to the district's economic development.

At the input stage, the district already benefits from a relatively skilled and motivated labor force engaged in beekeeping activities. Nevertheless, further expansion of this sector requires targeted training programs delivered through institutions such as the Agricultural Jihad Organization and the Technical and Vocational Training Organization. Regarding other production inputs, including sugar supply and environmental conditions, no major constraints currently exist.

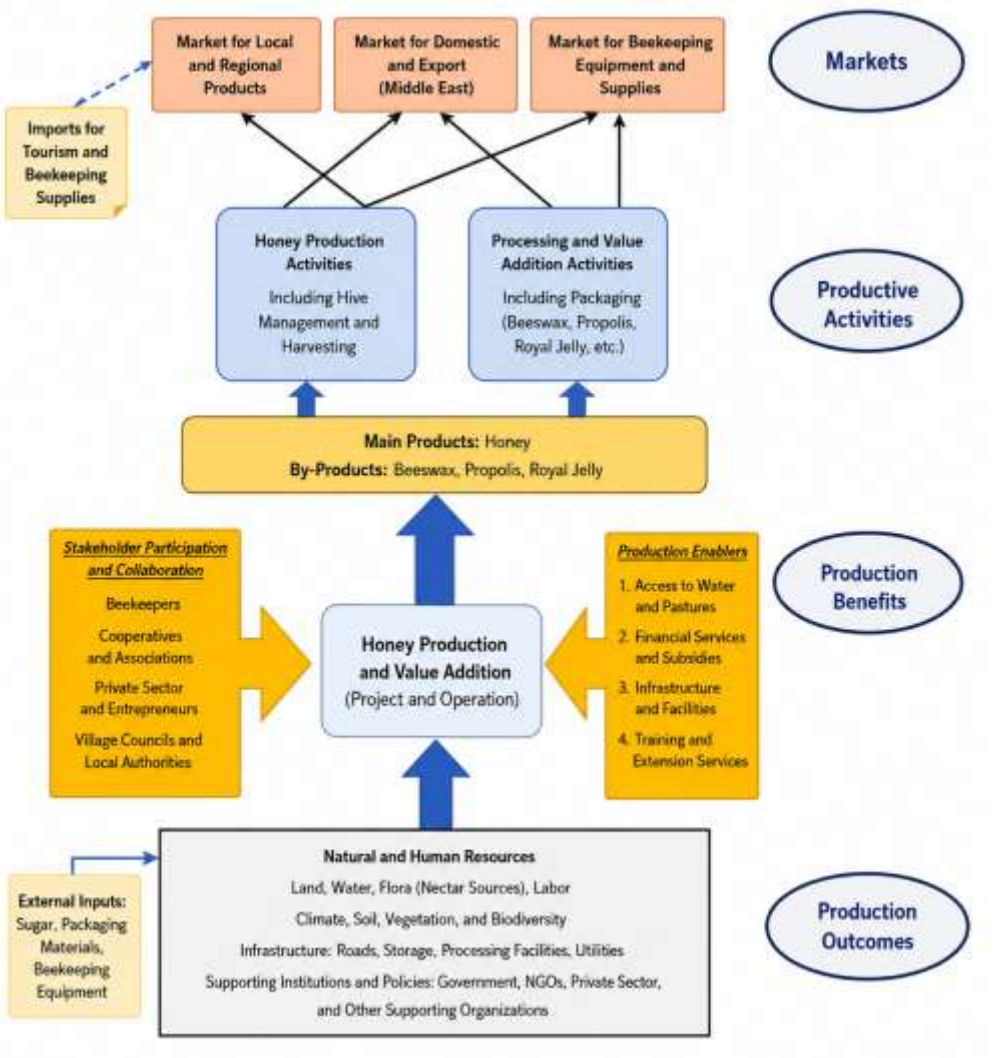


Figure 12. Honey Production Value Chain in Azari Rural District

At the production stage, facilitating licensing procedures for beekeeping operations and providing financial support mechanisms could promote the expansion of apiaries and increase honey production capacity. Training and technical capacity building for beekeepers also remain critical at this stage. In addition, local agricultural service centers can support production processes by offering technical services and introducing measures to improve productivity and production efficiency. Establishing workshops for the manufacture of beekeeping equipment may also facilitate production activities and strengthen local production networks.

Within this value chain, post-production processing constitutes another essential component of value creation. Expanding processing and packaging facilities based on regional honey branding, together with establishing workshops for the production and refining of beeswax and propolis, could substantially increase the value added of locally produced honey. At the final stage, honey products can be marketed at different spatial scales, including local county markets, provincial markets, neighboring provinces, and export destinations. It is noteworthy that export markets for the region's honey already exist, and a considerable proportion of local honey production is currently sold in Afghanistan. Through the implementation of the proposed interventions, export volumes could be expanded further, generating significant economic benefits for both the district and the province.

Moreover, organizing local honey festivals during peak harvesting seasons and establishing permanent regional honey exhibition and sales centers could contribute to promoting and institutionalizing the regional honey brand over the medium term. In addition, the role of digital platforms and online channels in marketing, sales, and branding of local honey products should not be overlooked. Figure 12 illustrates the honey value chain in Azari Rural District.

5. Discussion and Conclusion

The present study aimed to identify the economic potentials of Azari Rural District and to develop a value chain–based framework for rural employment generation by integrating spatial analysis, field investigations, and stakeholder consultations. The findings demonstrate that rural employment opportunities in the study area extend far beyond primary agricultural production and can be substantially expanded through the development of integrated value chains. Among the identified sectors, livestock production and honey production emerged as the two most promising value chains because of their comparative advantages, existing production capacity, local knowledge, and opportunities for downstream processing and value addition.

These findings directly address the first research question concerning the comparative economic advantages of the study area. The results indicate that livestock husbandry, honey production, irrigated agriculture, and related processing industries represent the principal endogenous capacities of Azari Rural District. Rather than relying solely on increasing agricultural production, the study shows that employment generation can be achieved by strengthening linkages among production, processing, marketing, and supporting institutions.

The second research question examined which value chains possess the greatest potential for sustainable rural employment generation. The analysis revealed that employment opportunities are distributed across different stages of the production system. In the livestock sector, employment can be created not only through animal husbandry itself but also through feed production, veterinary services, dairy processing, leather processing, wool collection, spinning, dyeing, packaging, transportation, and marketing. Likewise, the honey value chain provides employment opportunities through apiary development, processing and packaging facilities, beeswax and propolis production, branding, digital marketing, and regional distribution networks. These findings confirm that value chain development contributes to employment diversification and increases rural value added.

The third research question focused on the formulation of an integrated rural development strategy. The findings indicate that successful rural employment programs require simultaneous investment in production infrastructure, institutional coordination, technical training, financial support, market development, and spatial planning. Therefore, employment generation should be considered as an integrated regional development process rather than a collection of isolated projects.

The findings strongly support Porter's Value Chain Theory, which argues that competitive advantage is generated through value creation across interconnected production activities rather than within individual production units. In the present study, the proposed value chains demonstrate that substantial employment opportunities emerge from strengthening interactions among suppliers, producers, processors, distributors, and supporting organizations. Similarly, the results are consistent with the principles of Endogenous Rural Development Theory, emphasizing that sustainable rural development should build upon local resources, indigenous knowledge, and community participation. The study also supports the FAO rural value chain approach, which highlights processing, marketing, and institutional coordination as essential components of employment generation and rural economic transformation.

Unlike many previous studies that primarily evaluate agricultural production or rural employment separately, this research integrates GIS-based spatial analysis, field observations, stakeholder participation, and value chain analysis into a single planning framework. This integrated approach enables not only the identification of priority economic sectors but also the spatial allocation of processing facilities and supporting services according to local comparative advantages. Consequently, the study provides a practical framework that can assist regional planners and policymakers in designing place-based employment programs for rural areas.

Policy Implications

Based on the findings, the proposed interventions are prioritized according to implementation feasibility.

Short-term priorities (1–2 years)

• Establish livestock feed storage facilities.
• Develop veterinary and breeding improvement centers.
• Expand honey processing and packaging facilities.
• Provide technical training and extension services.

Medium-term priorities (3–5 years)

• Establish dairy processing workshops.
• Develop wool collection and processing facilities.
• Promote regional branding and digital marketing.

Long-term priorities (5–10 years)

• Develop leather processing industries.
• Expand regional logistics and distribution centers.
• Strengthen export-oriented value chains.

Study Limitations and Future Research

This study primarily focused on identifying priority value chains and suitable spatial locations for employment generation. Detailed financial feasibility analyses, including investment costs, operational costs, benefit-cost ratios, and economic return assessments, were beyond the scope of the present research. Likewise, although the proposed locations shown in Figures 13 and 14 were selected based on production concentration, local capacities, existing settlements, and field investigations, detailed GIS-based accessibility analyses considering road networks, transportation costs, travel time, and infrastructure availability were not conducted. Future studies are encouraged to integrate network analysis, location-allocation modelling, and comprehensive financial feasibility assessments to further optimize the proposed development framework.

Overall, the findings demonstrate that sustainable rural employment in Azari Rural District cannot be achieved solely by increasing agricultural production. Instead, employment generation depends on strengthening integrated value chains that connect production with processing, marketing, institutional support, and regional markets. Livestock and honey production constitute the two strategic sectors with the greatest potential to stimulate local economic development. By combining value chain analysis, spatial planning, and stakeholder participation, this study provides an operational framework for designing rural employment programs that can be adapted to other rural regions with similar socioeconomic and environmental characteristics.

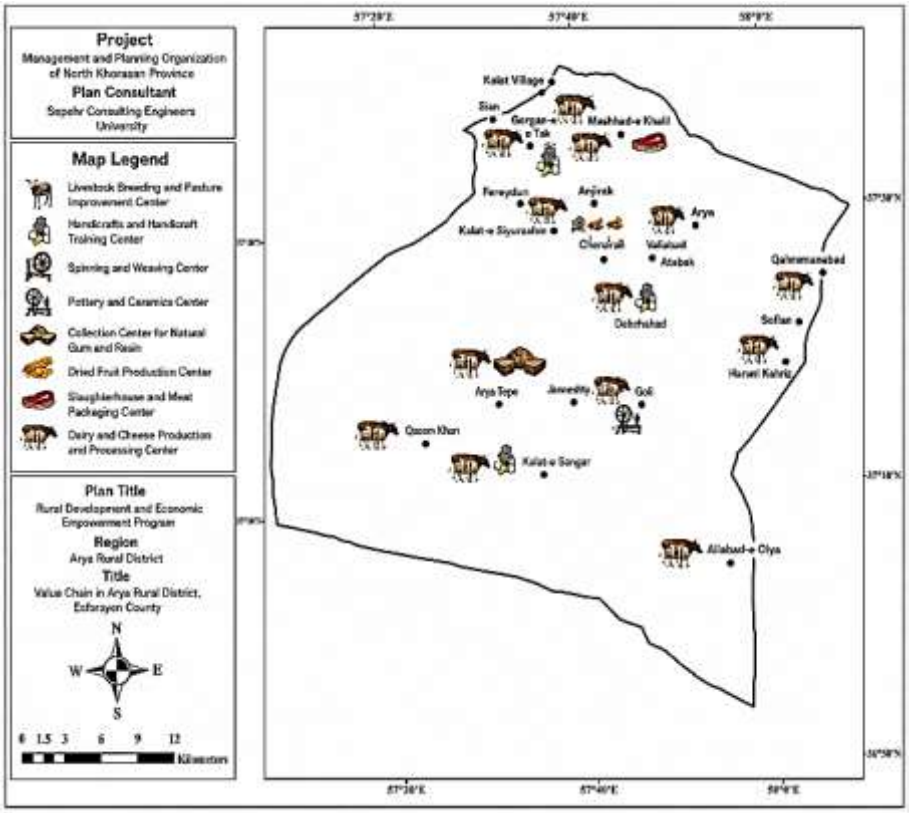


Figure 13. Location of Selected Villages for Completing the Livestock Value Chain

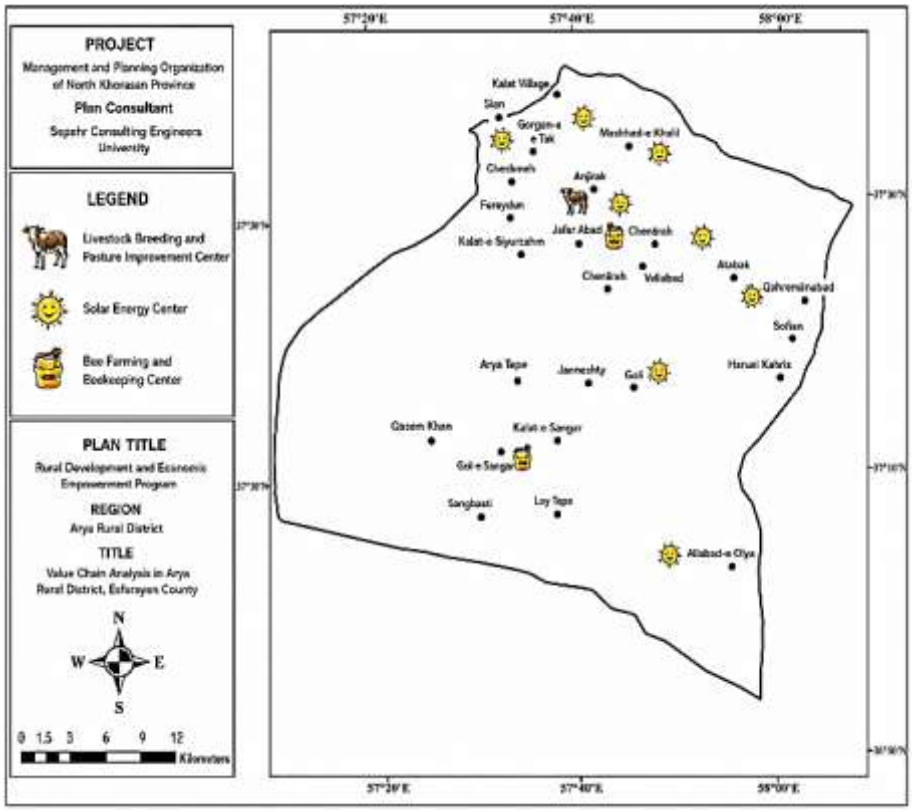


Figure 14. Location of Selected Villages for Completing the Honey Value Chain

Author Contributions
The authors contributed equally to the development and preparation of this research.
Conflict of Interest
The authors declare that there is no conflict of interest regarding the authorship or publication of this article.

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Reference

1. Aiginger, K., & Rodrik, D. (2020). Rebirth of Industrial Policy and an Agenda for the Twenty-First Century. *Journal of Industry, Competition and Trade, 20*(2), 189–207. Retrieved from https://doi.org/10.1007/s10842-019-00322-3
2. Alawode, A. (2025). The role of agricultural value chains in enhancing food security and economic development. International Research Journal of Modernization in Engineering Technology and Science, 7(5). https://doi.org/10.56726/IRJMETS75996
3. Ayyagari, M., Juarros, P., Peria, M. S. M., & Singh, S. (2021). Access to finance and job growth: Firm-level evidence across developing countries. *Review of Finance, 25*(5), 1473–1496. Retrieved from https://doi.org/10.1093/rof/rfab003
4. Bahrami, R. (2023). Identifying the key components of job creation in rural communities with emphasis on workshop and manual industries in the rural areas of Sanandaj county. *Journal of Research & Rural Planning, 12*(3), 77-90. http://dx.doi.org/10.22067/jrrp.v12i3.2307-1052.
5. Barkhordari, R., Dehghan Dehnavi, H., & Morovati Sharifabadi, A. (2022). Identifying and analyzing factors affecting the excellence and success of small and medium industries using the system dynamics approach. *International Journal of Nonlinear Analysis and Applications*. https://Doi.10.22075/ijnaa.2022.28494.3909
6. Behnia, M., Pourmohammadi, M., & Azizkhani, F. (2021). Iranian labor market policies and regulations. *Majlis Research Center*.
7. Bernanke, B. S. (2020). The new tools of monetary policy: American Economic Association presidential address. *American Economic Review, 110*(4), 943–983. Retrieved from https://doi.org/10.1257/aer.110.4.943
8. Bosworth, G., & Turner, R. (2018). Interrogating the meaning of a rural business through a rural capitals framework. Journal of Rural Studies, 60, 1–10. https://doi.org/10.1016/j.jrurstud.2018.02.002
9. Chukwunweike, J., Dolapo Salaudeen, H. (2025). Advanced Computational Methods for Optimizing Mechanical Systems in Modern Engineering Management Practices. International Journal of Research Publication and Reviews. 2025 Mar;6(3):8533-8548. Available from: https://ijrpr.com/uploads/V6ISSUE3/IJRPR40901.pdf
10. Farajnia, S., Yousefi, K., & Fadaee, M. (2020). Modeling the unemployment rate of Iran: Structural unemployment, sectoral changes and unanticipated monetary policy. *Economic Research*, Retrieved from https://joer.atu.ac.ir/article_12365_en.html
11. Granja, J., Makridis, C., Yannelis, C., & Zwick, E. (2022). Did the paycheck protection program hit the target? *Journal of Financial Economics, 119*(4), 361–416. Retrieved from https://www.sciencedirect.com/science/article/pii/S0304405X22001131
12. Hamermesh, D. S. (2021). Labor demand. In *Labor Demand*. Retrieved from https://doi.org/10.2307/j.ctv17ppcqn
13. Harpaa, E., Mocaa, S., & Rus, D. (2016). A Comparative Study of Rural Entrepreneurship Romania – Greece. *Procedia Technology*, *22*, 1100-1105. https://doi.org/10.1016/j.protcy.2016.01.155.
14. Ma, W., Zheng, H., Boansi, D., Horlu, G., & Owusu, V. (2025). Types of employment and well-being of rural residents: A multinomial endogenous switching regression application. Economic Modelling, 147, 107047. https://doi.org/10.1016/j.econmod.2025.107047
15. Malisauskaite, G., Nizalova, O., & Xanthopoulou, D. (2022). Unemployment and well-being of Europeans across the life cycle: The role of countries' macroeconomic situation. Social Indicators Research, 162, 1387–1412. https://doi.org/10.1007/s11205-022-02892-y
16. Mankiw, N. G. (2024). *Principles of Macroeconomics* (4). Instructor's Manual with Solutions Manual. Retrieved from. https://www.academia.edu/download/53871586/solutions_of_book.pdf
17. Markeson, B., & Deller, S. (2012), Growth of Rural Us Non-Farm Proprietors with a Focus on Amenities. *Review of Urban & Regional Development Studies*, 24(3), 83-105. https://doi.org/10.1111/rurd.12000.
18. Martin, L., McNeill, T., & Warren-Smith, I. (2013). Exploring business growth and eco innovation in rural small firms. *International Journal of Entrepreneurial Behavior & Research,* 19(6), 592-610. https://doi.org/10.1108/IJEBR-10-2012-0118

19. Narrod, C., Roy, D., Okello, J., Avendan, B., and Rich, K. (2009). Thorat A. Public private partnerships and collective action in high value fruit and vegetable supply chains. Food policy. 2009 Feb 1;34(1):8-15. https://doi.org/10.1016/j.foodpol.2008.10.005
20. Omri, A., Frikha, M. A., & Bouraoui, M. A. (2015). An empirical investigation of factors affecting small business success. Journal of Management Development, 34(9), 1073–1093. https://doi.org/10.1108/JMD-07-2013-0088
21. Pourmohammadi, M., & Yousefi, K. (2021). Pandemic in labor market: Evidence from Iran. *The Journal of Planning and Budgeting*. Retrieved from http://jpbud.ir/browse.php?a_code=A-10-1072-3&sid=1&slc_lang=fa&ftxt=1&pure_pdf=1.
22. Pourmohammadi, M., Taiebnia, A., & Yousefi, K. (2025). Microfinance as a Catalyst for Change: Evaluating the Success of Iran's Rural Employment Program from 2017 to 2022. *Iranian Economic Review, 29*(3), 1040-1067. https://doi.org/10.22059/ier.2025.390349.1008194
23. Tian F. A. (2017). Supply chain traceability system for food safety based on HACCP, blockchain & Internet of things. In 2017. International conference on service systems and service management 2017 Jun 16 (pp.1-6). IEEE.
24. Tripathi, R., Yadav, U. S., Tripathi, M. A., Rawat, R., & Kushwaha, J. (2022). Performance of women artisans as entrepreneurs in ODOP in Uttar Pradesh to boost economy: Strategies and away towards Global Handicraft Index for small business. *Academy of Marketing Studies Journal,* 26(1), 1-19. https://doi.org/1528-2678-26-1-104
25. Watts, N., Amann, M., Arnell, N., Ayeb-Karlsson, S., Beagley, J., Belesova, K., Boykoff, M., Byass, P., Cai, W., Campbell-Lendrum, D., Capstick, S., Chambers, J., Coleman, S., Dalin, C., Daly, M., Dasandi, N., Dasgupta, S., Davies, M., Di Napoli, C., … Costello, A. (2021). The 2020 report of the Lancet Countdown on health and climate change: Responding to converging crises. The Lancet, 397(10269), 129–170. https://doi.org/10.1016/S0140-6736(20)32290-X
26. Zou, B., & Mishra, A. K. (2024). Modernizing smallholder agriculture and achieving food security: An exploration in machinery services and labor reallocation in China. Applied Economic Perspectives and Policy, 46(4), 1662–1691. https://doi.org/10.1002/aepp.13433

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Original Article

برنامه توسعه اقتصادی و اشتغال‌زایی روستایی در استان خراسان شمالی (مطالعه موردی: دهستان آذری، شهرستان اسفراین)

حسین قدرتی*[1]، مسعود سامیان[2]

۱. دانشیار جامعه‌شناسی، دانشگاه حکیم سبزواری، سبزوار، ایران.
۲. پژوهشگر پسادکتری جامعه‌شناسی، دانشگاه حکیم سبزواری، سبزوار، ایران.

چکیده مبسوط

۱. مقدمه

توسعه اقتصادی و ایجاد اشتغال پایدار از مهم‌ترین الزامات توسعه روستایی، کاهش فقر، ارتقای معیشت و جلوگیری از مهاجرت روستاییان به شمار می‌رود. در مناطق روستایی، اتکای صرف به تولید اولیه کشاورزی به دلیل محدودیت منابع، نوسانات قیمت، خشکسالی، تغییرات اقلیمی و ضعف دسترسی به بازار، ظرفیت محدودی برای ایجاد اشتغال پایدار دارد. ازاین‌رو، توجه به فعالیت‌های مکمل، صنایع کوچک، فرآوری محصولات و به‌ویژه توسعه زنجیره‌های ارزش می‌تواند زمینه افزایش ارزش افزوده، تنوع‌بخشی به اشتغال و تقویت اقتصاد محلی را فراهم کند. زنجیره ارزش کشاورزی مجموعه‌ای از فعالیت‌ها و کنشگرانی است که از تأمین نهاده، تولید و فرآوری تا حمل‌ونقل، بازاریابی و مصرف نهایی را دربرمی‌گیرد و از طریق تقویت پیوند میان این مراحل می‌تواند به افزایش درآمد و اشتغال روستایی منجر شود.

با وجود مطالعات متعدد درباره توسعه روستایی و اشتغال، در سطح دهستانی توجه محدودی به طراحی برنامه‌های مکان‌محور و عملیاتی شده است که به‌طور همزمان از تحلیل فضایی، داده‌های کمی، مشارکت ذی‌نفعان و تحلیل زنجیره ارزش استفاده کنند. پژوهش حاضر با هدف شناسایی ظرفیت‌ها و مزیت‌های اقتصادی دهستان آذری شهرستان اسفراین و تدوین برنامه‌ای یکپارچه برای توسعه اقتصادی و اشتغال‌زایی روستایی انجام شده است. نوآوری اصلی پژوهش، ارائه چارچوب بومی زنجیره ارزش برای شناسایی بخش‌های اقتصادی اولویت‌دار، تعیین مکانی فعالیت‌های تولیدی و فرآوری و ارائه نقشه راه عملیاتی مبتنی بر ظرفیت‌های محلی و مشارکت ذی‌نفعان است.

۲. مبانی نظری تحقیق

مبنای نظری پژوهش بر پیوند میان توسعه اقتصادی روستایی، اشتغال پایدار و زنجیره ارزش استوار است. در رویکرد زنجیره ارزش، تولید به‌عنوان یک فعالیت منفرد در نظر گرفته نمی‌شود، بلکه مجموعه‌ای از حلقه‌های مرتبط شامل تأمین نهاده، تولید، جمع‌آوری، فرآوری، ذخیره‌سازی، بازاریابی و مصرف مورد توجه قرار می‌گیرد. همچنین، شبکه‌ای از بازیگران شامل تولیدکنندگان، بخش دولتی، بنگاه‌های خصوصی، کارآفرینان، نهادهای مالی و سایر ذی‌نفعان در این زنجیره مشارکت دارند. کارآمدی زنجیره نیز به نحوه هماهنگی جریان کالا، اطلاعات و سرمایه و سازوکارهای حکمرانی وابسته است. بر این اساس، پژوهش حاضر ضمن بهره‌گیری از نظریه زنجیره ارزش پورتر، با نظریه توسعه روستایی درون‌زا و رویکرد زنجیره ارزش روستایی FAO نیز همخوان است؛ زیرا بر استفاده از منابع و دانش بومی، مشارکت جامعه محلی، فرآوری محصولات، توسعه بازار و هماهنگی نهادی تأکید دارد. بنابراین، اشتغال روستایی نه صرفاً از طریق افزایش تولید، بلکه از طریق تقویت پیوند میان تولید، فرآوری، بازاریابی، خدمات پشتیبان و بازارهای منطقه‌ای دنبال می‌شود.

۳. روش تحقیق

پژوهش از نظر هدف کاربردی و از نظر روش، ترکیبی (کمی ـ کیفی) است. محدوده مطالعه، ۲۳ روستای دهستان آذری در بخش مرکزی شهرستان اسفراین است. در بخش کمی، اطلاعات جمعیتی، اقتصادی، کشاورزی، دامداری، منابع آب، زیرساخت‌ها و خدمات با استفاده از داده‌های مرکز آمار ایران، سازمان مدیریت و برنامه‌ریزی و دستگاه‌های اجرایی گردآوری و با روش سرشماری در سطح روستاها بررسی شد. همچنین، پرسشنامه‌ای شامل ۱۳ جدول اطلاعاتی درباره خدمات آموزشی، آب، انرژی، حمل‌ونقل، گردشگری، فناوری اطلاعات، فعالیت‌های اقتصادی، کشاورزی و اشتغال تکمیل شد. در بخش کیفی، از مصاحبه‌های باز و چهره‌به‌چهره، بحث‌های گروهی

*. نویسندهٔ مسئول:
دکتر حسین قدرتی
آدرس: گروه جامعه شناسی، دانشکده علوم انسانی، دانشگاه حکیم سبزواری، سبزوار، ایران.
پست الکترونیکی: Email: h.ghodrati@hsu.ac.ir

متمرکز و تکنیک درخت مشکلات استفاده شد. دهیاران، اعضای شوراهای روستا، کارآفرینان، افراد مطلع و ساکنان محلی در فرایند گردآوری اطلاعات مشارکت داشتند. علاوه بر این، بازدیدهای میدانی و مشاهده مستقیم محیط روستاها، اراضی کشاورزی، باغ‌ها، منابع آب و سایر ظرفیت‌ها انجام شد. داده‌های فضایی مربوط به مخاطرات طبیعی، پوشش گیاهی، منابع آب و پراکنش سکونتگاه‌ها نیز در محیط GIS تحلیل و نقشه‌های مرتبط تهیه شد. برای داده‌های جمعیتی و برخی مؤلفه‌های اقتصادی از آمار توصیفی و مدل‌های پیش‌بینی جمعیت و برای داده‌های کیفی از تحلیل تفسیری و توصیفی استفاده شد. اعتبار داده‌ها نیز از طریق تطبیق آمار رسمی با مشاهدات میدانی و دیدگاه ذی‌نفعان افزایش یافت.

۴. یافته‌های تحقیق

یافته‌ها نشان داد که کشاورزی و دامداری مهم‌ترین فعالیت‌های اقتصادی و پایه اصلی معیشت خانوارهای دهستان آذری هستند. در بخش کشاورزی، گندم و جو به‌ترتیب با ۳۲/۴ و ۲۷/۲ درصد بیشترین سهم از سطح زیرکشت را دارند و همراه با هندوانه و خربزه حدود ۷۳ درصد سطح زیرکشت را به خود اختصاص می‌دهند. در بخش دامداری نیز ظرفیت قابل توجهی از دام سبک در روستاهای دهستان وجود دارد. در کنار این فعالیت‌ها، ظرفیت‌های صنعتی و معدنی مرتبط با مصالح ساختمانی نیز شناسایی شد. با این حال، تحلیل زنجیره‌های ارزش نشان داد که **زنجیره دام و محصولات دامی و زنجیره تولید عسل** بیشترین ظرفیت را برای ایجاد اشتغال پایدار و افزایش ارزش افزوده دارند. در زنجیره دام، ظرفیت‌هایی مانند تولید و ذخیره خوراک دام، دامداری، خدمات دامپزشکی، اصلاح نژاد، فرآوری لبنیات، فرآوری پوست، جمع‌آوری و فرآوری پشم، ریسندگی، رنگرزی، بسته‌بندی، حمل‌ونقل و بازاریابی شناسایی شد. در زنجیره عسل نیز توسعه زنبورداری، تولید تجهیزات، فرآوری و بسته‌بندی عسل، تولید موم و بره‌موم، برندسازی، بازاریابی دیجیتال و توسعه بازارهای منطقه‌ای و صادراتی دارای ظرفیت قابل توجه تشخیص داده شد.

۵. بحث و نتیجه‌گیری

نتایج نشان می‌دهد که ایجاد اشتغال پایدار در دهستان آذری صرفاً از طریق افزایش تولید کشاورزی امکان‌پذیر نیست، بلکه مستلزم تکمیل و یکپارچه‌سازی زنجیره‌های ارزش و ایجاد پیوند میان تولید، فرآوری، بازاریابی، زیرساخت، آموزش، حمایت مالی و نهادهای پشتیبان است. دامداری و تولید عسل به دلیل برخورداری از مزیت نسبی، ظرفیت تولید، دانش بومی و امکان توسعه فعالیت‌های پایین‌دستی، دو زنجیره راهبردی منطقه محسوب می‌شوند. این یافته با نظریه زنجیره ارزش پورتر و اصول توسعه روستایی درون‌زا سازگار است و نشان می‌دهد که مزیت رقابتی و اشتغال از تعامل میان حلقه‌های مختلف زنجیره ایجاد می‌شود. بر مبنای نتایج، در کوتاه‌مدت ایجاد مراکز ذخیره خوراک دام، مراکز دامپزشکی و اصلاح نژاد، توسعه فرآوری و بسته‌بندی عسل و آموزش‌های فنی پیشنهاد می‌شود؛ در میان‌مدت، ایجاد کارگاه‌های فرآوری لبنیات، مراکز جمع‌آوری و فرآوری پشم و توسعه برندسازی و بازاریابی دیجیتال و در بلندمدت توسعه صنایع فرآوری پوست، مراکز لجستیک و تقویت زنجیره‌های صادرات‌محور ضرورت دارد. در مجموع، چارچوب پیشنهادی با ترکیب تحلیل زنجیره ارزش، برنامه‌ریزی فضایی و مشارکت ذی‌نفعان، می‌تواند مبنایی عملیاتی برای برنامه‌ریزی اشتغال مکان‌محور در دهستان آذری و مناطق روستایی دارای شرایط مشابه فراهم آورد.

کلیدواژه‌ها: توسعه اقتصادی روستایی؛ اشتغال‌زایی روستایی؛ تحلیل زنجیره ارزش؛ توسعه کشاورزی؛ پژوهش ترکیبی؛ دهستان آذری؛ شهرستان اسفراین؛ خراسان شمالی.

تشکر و قدردانی

این مقاله حاصل طرح پژوهشی با عنوان اشتغالزایی روستایی می باشد که با حمایت های مالی سازمان مدیریت و برنامه ریزی استان خراسان شمالی انجام شده است.

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Original Article

Analyzing the Phenomenon of Kolbari and Identifying the Potential for Developing Alternative Economic Activities in Rural Areas (Case Study: Sarkol and Zrivar Rural Districts, Marivan County)

Saadi Mohsmmadi*[1], Freyedon Ahmadi[2], Shavbo Karimi[3]
1. Associate Prof. in Geography and Rural Planning, Payame Noor University, Tehran, Iran.
2. Associate Prof. in Management, Payame Noor University, Tehran, Iran.
3. MSc. in Geography and Rural Planning, Payame Noor University, Tehran, Iran.

Abstract
Purpose- Kolbari (informal cross-border goods carrying) and cross-border smuggling in the rural areas of Marivan County constitute a multidimensional crisis that not only undermines the region's economic and social security but also extends its adverse impacts to the political, environmental, and food security domains, thereby generating long-term structural challenges.
Design/methodology/approach- This study employed an exploratory sequential mixed-methods design (qualitative–quantitative). In the qualitative phase, the grounded theory approach, supported by semi-structured interviews, was used to comprehensively explore the security and social dimensions and consequences of Kolbari. Participants were selected purposively from three principal groups: rural Kolbars, county development officials, and local experts, including academic specialists in regional development as well as individuals with extensive knowledge and practical experience regarding Kolbari. In the quantitative phase, a researcher-developed questionnaire was designed and validated through expert assessment of content validity. The instrument demonstrated satisfactory reliability, with a Cronbach's alpha coefficient of 0.87.
Findings- The findings reveal that Kolbari, through 65 identified adverse variables, contributes to five major security challenges: weakened political–military security, environmental–physical security, social security, economic security, and food security. Collectively, these challenges lead to persistent and long-term security vulnerabilities within the region. Furthermore, the correlation analysis indicated that two key variables—educational attainment and the proportion of young rural population—are significantly associated with the emergence and persistence of Kolbari. Specifically, educational attainment exhibited a significant negative relationship with the phenomenon, whereas the proportion of young rural population showed a significant positive relationship.
Practical Implications- Based on the research findings, an innovative three-tier strategic model was developed to reduce Kolbari and establish sustainable regional security. At the first level, the model emphasizes economic empowerment through the development of sustainable non-agricultural enterprises, particularly in handicrafts, rural tourism, and green technologies. At the second level, it advocates strengthening social capital through targeted education and enhanced participation of rural youth in local development processes. At the third level, it highlights the establishment and improvement of security infrastructure to reinforce border security and reduce the risks associated with cross-border smuggling.
Originality/Value- The principal contribution of this study lies in integrating a grounded theory-based mixed-methods approach with correlation analysis to develop a comprehensive, multidimensional, and context-specific model for Marivan County. By identifying the complex causal relationships among security, social, and economic variables, the proposed framework provides practical and implementable recommendations for development agencies, planners, and security institutions.
Keywords- Kolbari, Border Security, Development Capacities; Rural Areas, Marivan County.

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Corresponding Author:
Mohammadi, Saadi, Ph.D.
Address: Department of Geography, Faculty of Law and Social Sciences, Payame Noor University, Tehran, Iran.
Tel: +989034655990
Email: Saadi@pnu.ac.ir

1.Introduction

Border security constitutes a fundamental pillar of human security in all its dimensions. Any instability in border areas has the potential to disrupt the economic, social, cultural, political, and military systems of a country (Moradi, 2012). At the same time, security is widely recognized as the cornerstone of sustainable development, as the prosperity of economic, environmental, and social systems depends largely on the stability of security within a given geographical space (Alipour, Paydar, & Sadeghi, 2016). Accordingly, scholars and policy analysts have increasingly emphasized the inseparable relationship between security and development, arguing that their integration provides the most effective framework for formulating coherent policies and addressing security threats (Chandler, 2007). From this perspective, efforts aimed at strengthening sustainable security simultaneously contribute to the realization of sustainable development in border regions (Andalib, 2001). A closer examination of border regions, particularly rural settlements, reveals that these areas are confronted with the dual challenges of underdevelopment and geographical marginalization (Afrakhteh, 2012). Consequently, in many border villages, the primary concern is no longer economic advancement but rather livelihood survival. Under such circumstances, cross-border smuggling has emerged as one of the principal livelihood strategies adopted by border residents to overcome economic hardships and improve their quality of life. As an economic activity, smuggling has existed in border villages for decades and has continued to the present day. Owing to its relatively high profitability, it has substantially contributed to improving rural livelihoods by strengthening household incomes (Kohneh-Poushi, 2011). Indeed, rural settlements located in peripheral border regions—where inadequate infrastructure, limited public investment, and low living standards prevail—have sought to transform their geographical position into an economic asset by engaging in activities such as cross-border smuggling (Tayyebnia, Mohammadi, & Manouchehri, 2016).

The persistent shortage of decent employment opportunities in border regions, largely attributable to uneven regional development and insufficient productive investment, has driven a considerable share of the economically active population toward the informal economy, particularly *Kolbari* (informal cross-border goods carrying) (Afrakhteh, 2012; Kohneh-Poushi, 2011; Tayyebnia et al., 2016). In this context, Marivan County has, in recent years, emerged as one of the major centers for the distribution and exchange of imported goods in western Iran. The expansion of the smuggling market, much of which relies on *Kuolbari*, has generated profound cultural, social, and economic transformations throughout the county while significantly reshaping regional employment patterns and investment structures (Aslamarz, Dindarloo, & Aslamarz, 2015).The growth of this informal border economy has become even more pronounced following the intensified implementation of border closure and control policies by provincial border authorities. Coupled with the growing demand for low-priced smuggled goods and the substantial financial returns associated with this activity, these developments have not only altered the occupational structure of border communities but have also considerably reduced incentives for investment in productive and industrial sectors. As a result, Marivan County has been unable to fully exploit its strategic comparative advantage for exporting goods to the relatively untapped market of the Kurdistan Region of Iraq—an opportunity that could have served as a significant driver of sustainable development for both the county and the wider province (Aslamarz et al., 2015). A particularly noteworthy issue is the widespread prevalence of *Kolbari* among the rural population of Marivan County. Owing to the limited diversification of rural economic activities and the scarcity of alternative income sources, many villagers regard *Kolbari* as their only viable livelihood option. In these rural communities, traditional agriculture remains the principal source of household income. However, land fragmentation, inadequate capital, dependence on unfavorable climatic conditions, and insufficient investment in the agricultural sector have considerably increased livelihood vulnerability. Consequently, many rural youths, constrained by limited access to farmland and the structural limitations of the agricultural sector, have

increasingly turned to *Kolbari* as an alternative means of generating income.

Despite its important role in supporting the livelihoods of border communities, Kolbari poses substantial challenges to the sustainability of national security, particularly in its economic, social, and political dimensions. Consequently, the governance and management of this phenomenon have become highly complex and remain subject to considerable debate. On the one hand, combating cross-border smuggling and Kolbari has been recognized in Iran as a strategic national economic priority, making the formulation of effective policies for the prevention and control of smuggling an unavoidable necessity. Likewise, at the international level, numerous countries—including the United States along the Mexico border, countries of the Indian subcontinent, and several states in the Horn of Africa—have implemented various border-control and border-closure measures to combat smuggling and other forms of illegal cross-border activities (Isacson, 2012). On the other hand, given the crucial role of Kolbari in sustaining the livelihoods of many border households and maintaining the relative stability of local economies, any attempt to reduce or eliminate this activity requires carefully designed alternative livelihood strategies (Kohneh-Poushi, 2011; Tayyebnia et al., 2016). Otherwise, restricting Kolbari without simultaneously creating viable employment and income-generating opportunities is likely to reduce household incomes, increase livelihood vulnerability, and weaken the economic and social sustainability of border communities (Afrakhteh, 2012; Iranian Parliament Research Center, 2019). From this perspective, Kolbari should not be regarded merely as an isolated social problem; rather, it reflects structural deficiencies, including limited employment opportunities, inadequate economic diversification, and the underutilization of indigenous development capacities in rural border areas (Aslamarz et al., 2015; Tayyebnia et al., 2016). Accordingly, achieving a sustainable response to this phenomenon requires the identification of local development potentials, the promotion of alternative economic activities, and the adoption of development-oriented planning approaches tailored to rural border regions.

Among Iran's border regions, Marivan County has long been characterized by socioeconomic deprivation and persistent developmental challenges (Shayan & Kohneh-Poushi, 2013). Despite the significance and widespread prevalence of Kolbari in this county, previous studies have primarily focused on explaining its underlying causes, its socioeconomic consequences, the role of border markets, or its security dimensions (Mohammadi, 2023; Kohneh-Poushi, 2011; Tayyebnia et al., 2016). Other investigations have mainly examined the phenomenon from security and law-enforcement perspectives (Isacson, 2012). Although these studies have substantially enhanced our understanding of various aspects of Kolbari, they have paid relatively limited attention to identifying viable alternative economic opportunities and developing practical strategies for reducing rural households' dependence on this informal livelihood activity. Furthermore, little consideration has been given to the spatial variation among rural settlements in terms of their reliance on Kolbari and its relationship with demographic, economic, and geographical characteristics. This research gap is particularly evident in the Sarkal and Zrivar rural districts, which constitute the principal concentration areas of rural Kulbars in Marivan County. In addition to accommodating a considerable proportion of households engaged in Kolbari, these two rural districts possess substantial development potential in agriculture, horticulture, livestock production, rural tourism, handicrafts, and small-scale rural enterprises. Nevertheless, these capacities have not yet been systematically identified, prioritized, or incorporated into an integrated framework for developing alternative economic activities. Moreover, no previous study has simultaneously employed a mixed-methods approach to examine both the multidimensional impacts of Kolbari on sustainable security and the identification and spatial assessment of alternative livelihood opportunities based on the local capacities of villages affected by this phenomenon.

Accordingly, the present study seeks to address this research gap by integrating the perspectives of Kolbars, local administrators, and subject-matter experts to develop a practical framework for promoting alternative economic activities and reducing rural households' dependence on Kolbari. The central argument of this study is that the persistence of Kolbari in the rural border areas of

Marivan County primarily stems from the inadequate identification and utilization of local employment opportunities, insufficient economic planning, and the lack of institutional support for rural entrepreneurship and innovation. Identifying and strategically investing in these development capacities may therefore represent the key to mitigating the widespread expansion of Kolbari across the border villages of the county. Accordingly, this study addresses the following research questions:

1. How has the emergence and persistence of Kolbari affected the economic and social dimensions of sustainable security in the rural areas of Marivan County?
2. Are there significant spatial differences among rural settlements regarding their reliance on Kolbari? If so, which demographic, economic, and spatial characteristics best explain these differences?
3. What investment and employment potentials exist within the studied rural areas for developing small-scale enterprises capable of diversifying the local economy and reducing dependence on Kolbari?

Although numerous studies have examined cross-border smuggling in Iran, relatively few have specifically addressed Kolbari, largely because this phenomenon is geographically concentrated in the Kurdish border regions of western Iran. Consequently, the existing body of knowledge on *Kolbari* remains limited, creating a significant theoretical and empirical gap in the literature. Given the socioeconomic and security implications of this phenomenon, the present study seeks to contribute to the emerging scholarship by addressing aspects that have received limited scholarly attention. A selection of the most relevant national and international studies is reviewed below.

Hernández (2021), in an analytical study of cross-border smuggling along the Tijuana–San Diego (Mexico–United States) border based on documentary evidence and border statistics, found that informal cross-border trade is largely driven by economic disparities and differences in consumption patterns between neighboring countries. The study concluded that border enforcement and physical barriers alone are insufficient to achieve a sustainable reduction in smuggling activities and emphasized the necessity of creating alternative economic opportunities for local communities.

Hernández Campos and Torre Cantalapiedra (2022), using a descriptive–analytical approach and migration and border data, demonstrated that individuals involved in informal border economies predominantly belong to socially and economically vulnerable groups. Their findings suggest that reducing participation in such activities requires integrated development policies focusing on employment creation, poverty reduction, and the socioeconomic empowerment of border communities.

Salerno Valdez et al. (2022), through an analytical documentary study of the informal economy and smuggling in the United States–Mexico border region, reported that the persistence of informal cross-border activities generates not only economic consequences but also profound social and cultural impacts on border communities. They identified economic deprivation and unemployment as the principal factors encouraging participation in these activities.

Prieto-Curiel et al. (2023), drawing on socioeconomic datasets and analytical methods to examine recruitment into informal and illegal networks in Mexico, argued that enforcement-oriented policies alone are insufficient to curb participation in illicit activities. Instead, investments in employment, education, and local economic development provide more effective and sustainable strategies for reducing individuals' involvement in informal and high-risk economic activities.

Likewise, Augustova and Souber (2023), in their study entitled *Kurdish Smugglers on the Iran–Turkey Border*, concluded that the expansion of informal cross-border activities in Kurdish regions is driven primarily by structural poverty, unemployment, and the absence of sustainable economic opportunities rather than by criminal intent. Their findings further indicate that border-control policies implemented without adequate consideration of local livelihood conditions merely displace these activities toward more hazardous routes, thereby intensifying social vulnerabilities.

At the national level, the Iranian Parliament Research Center (2019), in its expert report entitled The Plan for Organizing Official Border Crossings (Kolbari and Teh-Lenji), argued that the

prevalence of Kolbari is inconsistent with the substantial development potential of Iran's border provinces. The report further noted that this phenomenon has frequently been exploited as political propaganda to portray deficiencies in employment generation and the protection of human dignity. It emphasized that sound economic policies, investment incentives in border regions, employment-support measures, and policies aimed at reducing the costs of residence and production could create profitable opportunities for traders, entrepreneurs, manufacturers, and investors while simultaneously fostering sustainable employment and reducing dependence on informal border activities.

Mohammadi (2023), in a study entitled Analysis of the Factors Influencing the Emergence and Persistence of Kolbari in the Rural Border Areas of Kurdistan Province, employed a descriptive–analytical design based on Grounded Theory. The study identified 76 underlying deficiencies that were classified into four principal categories: (1) weaknesses in policymaking, development planning, and border security management; (2) inadequate supportive legislation and insufficient physical infrastructure required for rural economic development; (3) social deficiencies and an unfavorable business environment for rural economic growth; and (4) limited financial capital available to local communities for entrepreneurship and employment generation. Among these, weaknesses in policymaking, development planning, and border security management, followed by the shortage of local investment capital, were identified as the most influential factors contributing to the persistence of Kolbari and the continuation of underdevelopment in the region.

Mohammadi et al. (2021), in their qualitative study entitled Sustainable Employment in Border Cities: An Analysis of the Causes and Consequences of Kolbari in Baneh, found that economic, political, legal, security, socio-cultural, geographical, and geopolitical factors collectively explain the emergence and persistence of Kolbari as an informal livelihood strategy. They argued that sustainable solutions require collaborative efforts between government institutions and border communities, emphasizing the utilization of endogenous regional capacities to promote sustainable urban development in Baneh.

Mahmoudi and Moradi (2021), using the Grounded Theory approach in their qualitative study Kolbari as an Outcome of Underdevelopment-Oriented Policies: A Qualitative Study of Kulbars in Paveh, organized their findings into 34 concepts, six major categories, and one core category, namely underdevelopment and inadequate economic growth. Their results indicate that Kolbari is a historically embedded phenomenon rooted in economic deprivation, geographical isolation, political marginalization, cultural constraints, limited livelihood opportunities, and the unintended consequences of border delineation. From the perspective of border residents, Kolbari represents the only viable livelihood strategy in response to persistent underdevelopment. The authors therefore emphasize the need for comprehensive planning at short-, medium-, and long-term horizons to address the socioeconomic needs of border communities.

Taheri (2018), in a descriptive–analytical study entitled The Impact of the Recession and Closure of Official Border Markets on the Quality of Life of Rural Residents: A Case Study of Khav and Mirabad District, Marivan County, found that the closure of temporary border markets significantly reduced the quality of life of rural households that had previously benefited from legally regulated Kolbari quotas. Furthermore, the absence of alternative income-generating opportunities resulted in a renewed increase in participation in Kolbari among rural residents.

Mottaghi et al. (2021), in their descriptive–analytical investigation of the determinants of participation in the informal economy with particular emphasis on Kolbari in Sardasht, reported no statistically significant relationship between motivations for engaging in Kolbari and variables such as gender, birthplace, migration history, household size, educational attainment, type of goods transported, monthly expenditures, pathways into the occupation, or seasonal income fluctuations. However, significant relationships were observed between motivations for engaging in Kolbari and respondents' age, previous occupation, marital status, monthly income, secondary sources of income, future occupational aspirations, job security, job satisfaction, and duration of employment as a Kulbar.

Anbari et al. (2025), applying Grounded Theory in their study The Spatial Poverty Trap and the Social

Construction of Kolbari in the Border Regions of Iranian Kurdistan, concluded that spatially embedded poverty constitutes the primary structural driver behind the emergence of Kolbari. Their findings suggest that severe economic pressures, the absence of alternative livelihood opportunities, environmental constraints, and the declining profitability of traditional cross-border trade, together with contextual factors such as the weakness of the agricultural sector, the lack of industrial employment, and the underdevelopment of tourism, compel border residents to rely primarily on their physical labor through Kolbari. The study further demonstrates that this survival strategy generates a wide range of long-term socio-cultural consequences, including the erosion of indigenous human capital, the expansion of consumerism, the deterioration of human dignity and legal rights, the proliferation of poverty-generating and marginalized spaces, and the reproduction of poverty and Kolbari across the border regions of western Iran, particularly in Kurdistan Province.

Mohammadi and Rostami (2018), in a descriptive–analytical study entitled Assessing the Effects of Establishing Border Markets on Changes in Rural Quality of Life: A Case Study of Dezli Rural District, Sarvabad County, concluded that the establishment of the border market significantly improved the quality of life of local rural residents compared with the period prior to its establishment. Improvements were observed across all measured dimensions of rural quality of life, with the economic dimension exhibiting the greatest positive change.

Likewise, Hooshangi and Mohammadi (2018), in their study An Analysis of the Role of Border Markets (Formal Kolbari) in Enhancing the Livability of Rural Areas: A Case Study of Khav and Mirabad and Dezli Rural Districts, Western Kurdistan Province, found that the establishment of officially regulated Kolbari border markets substantially enhanced the livability of the study villages. Among the four dimensions of rural livability—economic, social, physical, and environmental—the economic dimension experienced the most significant improvement following the establishment of these markets.

A synthesis of the existing literature indicates that previous studies on Kolbari can generally be classified into four major streams of research. The first stream has focused on identifying the factors contributing to the emergence and persistence of Kolbari, highlighting poverty, unemployment, inadequate economic infrastructure, underdevelopment in border regions, ineffective support policies, and limited employment opportunities as the principal drivers of participation in this activity (Mohammadi, 2023; Mahmoudi & Moradi, 2021; Anbari et al., 2025). The second stream has examined the economic, social, cultural, and security consequences of Kolbari, emphasizing its impacts on quality of life, social capital, human dignity, and the development trajectory of border regions (Mohammadi et al., 2021; Mottaghi et al., 2021; Augustova & Souber, 2023). The third stream has investigated the effectiveness of border management policies, border closures, and security-oriented interventions, consistently concluding that enforcement-based approaches alone are insufficient to achieve a sustainable reduction in Kolbari (Hernández, 2021; Hernández Campos & Torre Cantalapiedra, 2022; Prieto-Curiel et al., 2023). Finally, the fourth stream has highlighted the contribution of formal border markets and regulated cross-border trade mechanisms to improving the economic conditions and quality of life of border residents (Taheri, 2018; Mohammadi & Rostami, 2018; Hooshangi & Mohammadi, 2018).

Despite the valuable contributions of these studies, several important research gaps remain. Existing research has primarily concentrated on explaining the causes and consequences of Kolbari or evaluating policies aimed at managing this phenomenon. Comparatively little attention has been devoted to simultaneously examining the multidimensional impacts of Kolbari while identifying feasible alternative economic opportunities capable of reducing rural households' dependence on this informal livelihood strategy. Moreover, no previous study conducted in the Sarkal and Zrivar rural districts of Marivan County has adopted a mixed-methods approach to simultaneously investigate the security, social, and economic implications of Kolbari and systematically assess the local capacities for developing viable alternative economic activities. Against this background, the present study extends the existing body of knowledge by adopting an integrated analytical framework. First, it identifies

and analyzes the multidimensional impacts of Kolbari within the rural communities under investigation. Second, by examining the spatial characteristics and endogenous development capacities of these villages, it evaluates the feasibility of developing alternative economic activities aimed at reducing rural households' dependence on Kolbari while strengthening sustainable security and regional development.

2.Research Theoretical Literature

Rural settlements located in border regions often experience persistent geographical marginalization, limited infrastructure, inadequate public and private investment, and consequently lower standards of living. Under such conditions, their proximity to international borders has frequently been utilized as an economic resource through engagement in informal cross-border activities, including the smuggling of goods (Tayyebnia, Mohammadi, & Manouchehri, 2016). At the same time, the predominance of a vulnerable mono-sectoral rural economy, coupled with the lack of employment diversification based on local comparative advantages, insufficient investment, and inadequate human capital development, has resulted in fragile and highly dependent local economies. As a consequence, many members of the rural labor force have resorted to *Kolbari*—the physically demanding practice of carrying goods across borders—as a means of securing their livelihoods. In many border villages, the workforce has been left without adequate vocational skills or sustainable employment opportunities and has consequently become dependent on Kolbari as one of the few available income-generating activities. In this sense, both public perceptions and, to some extent, governmental development policies have implicitly associated the economies of border villages with cross-border smuggling and Kolbari. Such an association has, in turn, diverted attention from the structural transformation and diversification of rural economies. Viewed from this perspective, Kolbari, as one manifestation of informal cross-border smuggling, represents a consequence of uneven regional development and unequal socioeconomic relations. These structural inequalities, reflected in pronounced regional and socioeconomic disparities, have contributed to the emergence and persistence of cross-border smuggling, whereby economically disadvantaged border residents (Kulbars) and wealthier actors within informal trade networks pursue their respective economic interests (Abdolmohammadi, 2010).

One of the fundamental concepts in regional economic planning is comparative advantage, which serves as an important criterion for identifying both the potential and actual production capacities of a region and its ability to produce goods and services at lower opportunity costs. According to the theory of comparative advantage, the total output of individuals, firms, or nations is maximized when each economic actor specializes in producing goods or services for which it possesses the lowest opportunity cost (Piran & Oskouei, 2015). However, the concept of competitive advantage extends beyond comparative advantage by emphasizing the capability of organizations, regions, or local economies to achieve superior performance under competitive conditions (Pirasteh & Eslaminejad, 2010).Competitive advantage refers to a factor—or a combination of factors—that enables an organization, region, or economic system to outperform its competitors in a manner that is difficult to imitate. As illustrated in Figure 1, uniqueness and distinctiveness constitute the core characteristics of competitive advantage. Contemporary strategic management therefore places considerable emphasis on developing mechanisms capable of generating sustainable competitive advantage (Cegliński, 2016). Durability, resilience, and value creation are widely recognized as its defining attributes, while product quality, technological capability, innovation, brand image, and access to information represent some of its principal determinants (Wen-Cheng & Chien-Hung, 2011). Within the context of rural development, competitive advantage encompasses the set of local resources, capabilities, and endogenous potentials that enable rural producers and service providers to achieve superior performance relative to competing regions and thereby enhance local economic development (Pourtaheri et al., 2017).

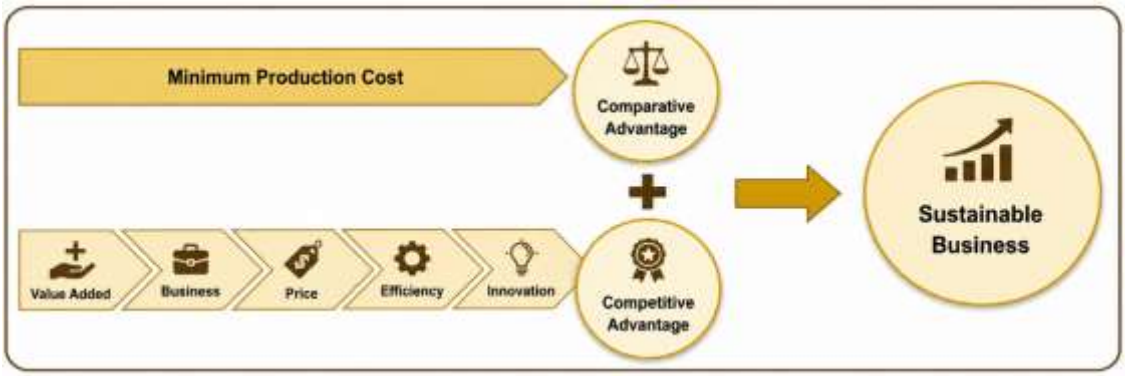


Figure 1. Relationship between comparative advantage and competitive advantage in the development of sustainable businesses and the criteria used for their assessment.

The emphasis on assessing the comparative and competitive advantages of rural border areas stems from the premise that addressing Kolbari—a phenomenon fundamentally rooted in persistent rural unemployment—can only be achieved through economic development based on the endogenous capacities and investment potentials of these regions. Temporary welfare-oriented interventions and short-term support programs may provide limited relief for border communities; however, they cannot adequately address the structural livelihood needs of rural households or eliminate their dependence on Kolbari. In contrast, identifying the comparative advantages and development potentials of border villages and providing institutional support for their effective utilization can foster the establishment of sustainable rural enterprises that constitute viable and long-term alternatives to Kolbari. Such an approach reflects the principles of endogenous, self-reliant, and place-based rural development, which have become central paradigms in contemporary rural development planning.

From this perspective, once it is recognized that the principal driving force behind the emergence and persistence of Kolbari is the lack of sustainable employment opportunities, the logical policy response is to identify local development capacities and transform them into productive economic opportunities. The creation of small-scale enterprises and diversified rural livelihoods based on indigenous resources and local capabilities provides a structural solution to Kolbari, rather than merely alleviating its symptoms. Consequently, the primary development need of border villages extends beyond improvements in physical infrastructure or welfare provision. Instead, sustainable livelihood security depends fundamentally on strengthening local economies through employment generation based on endogenous capacities and comparative regional advantages. Given that the present study adopts a participatory approach to identifying local development potentials and formulating strategies for alternative economic development, participatory development planning is regarded as an essential mechanism for strengthening local capacities and enhancing rural development processes. In this regard, the United Nations Environment Programme (UNEP) defines capacity development as a set of interventions designed to strengthen the knowledge, skills, and experience of rural communities, thereby enabling them to promote positive social transformation and community empowerment (UNEP, 2011). Similarly, Young (2006) argues that capacity development enhances both physical and human capacities, including infrastructure, knowledge, technical skills, and institutional capabilities. Strengthening these capacities encourages broader community participation in rural development initiatives (Lavergne & Saxby, 2001), while simultaneously enhancing self-confidence, informed decision-making, and social cohesion and reducing social isolation and passivity among rural residents. As a result, rural communities become active stakeholders capable of leading and sustaining their own socioeconomic development processes (Wendy, 2007) (Figure 2).

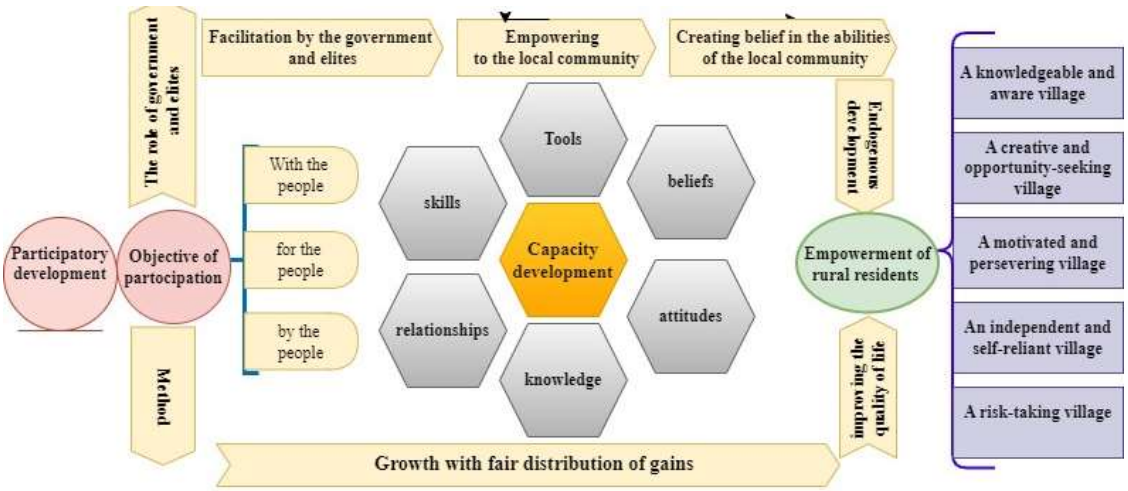


Figure 2. Process and outcomes of the participatory development approach

Accordingly, the management and mitigation of Kolbari in the rural areas of Marivan County should be pursued through comprehensive planning strategies aimed at reducing dependence on this informal livelihood by identifying local development capacities and promoting the diversification of rural economies. Within this perspective, the present study is founded upon the complementary development paradigms of economic diversification, participatory development, sustainable security, and sustainable livelihoods. These approaches stand in contrast to the conventional **core**–periphery model of development, which emphasizes urban-centered economic growth and concentrates investment and development opportunities in metropolitan areas. Instead, they advocate a place-based and endogenous development strategy that mobilizes local resources, strengthens community participation, and fosters sustainable livelihood opportunities. These theoretical perspectives collectively constitute the conceptual foundation of the present research and are integrated into the study's conceptual framework (Figure 3).

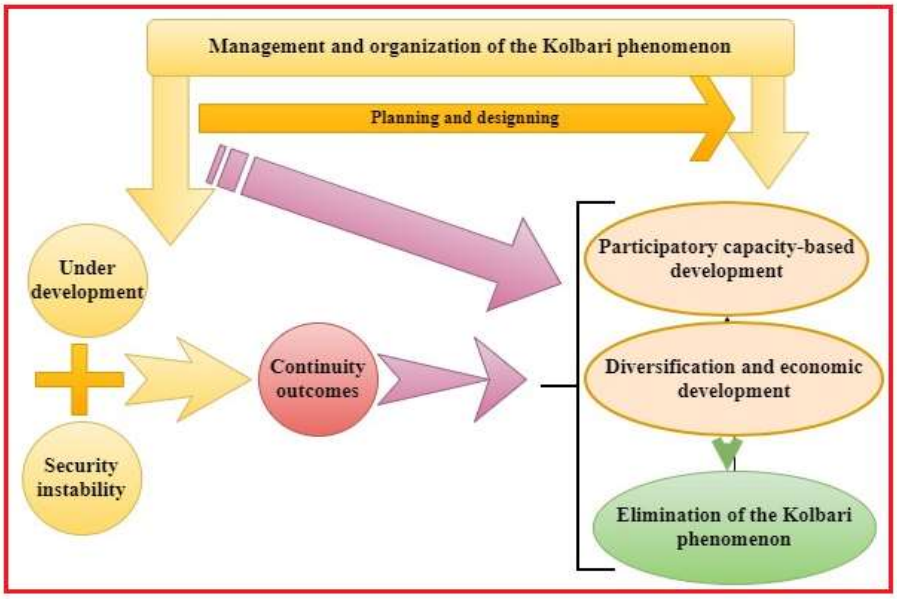


Figure 3. Conceptual framework of the study

3. Research Methodology

3.1. Geographical Scope of the Research

Marivan County is located in the western part of Kurdistan Province, adjacent to the border with Iraq. Covering an area of approximately 2,326.4 km², the county is centered on the city of Marivan and comprises four cities: Marivan, Kanidinār, Chenareh, and Bardeh Rash. Administratively, the county consists of three districts, six rural districts (dehestans), 149 inhabited villages, and 25 uninhabited villages (Statistical Gazetteer of Marivan County, 2016) (Figure 4).

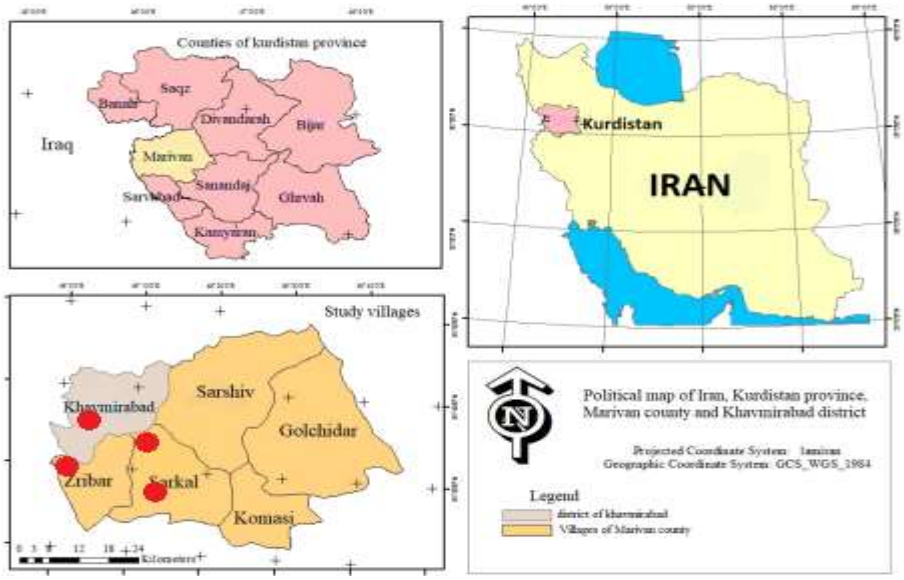


Figure 4. **Location of the Central District of Marivan County.**
Source: (Mohammadi & et al, ,2021: 84).

3.2. Methodology

This study is applied in terms of its objective and descriptive–analytical in terms of its research design. Data were collected using a combination of documentary (library-based) and field survey methods. The overall research design followed an exploratory sequential mixed-methods approach (qualitative → quantitative), whereby qualitative findings informed the subsequent quantitative phase. In the qualitative phase, the multidimensional consequences of Kolbari for the security and sustainable development of rural communities in the study area were explored using the Grounded Theory methodology and semi-structured interviews. Grounded Theory is a qualitative research strategy designed to generate theory inductively from empirical data. Rather than testing pre-existing theoretical assumptions, this approach enables researchers to systematically collect, code, and analyze field data in order to identify concepts, categories, and the relationships among them. The selection of Grounded Theory for the present study was motivated by the absence of a comprehensive theoretical framework explaining the multidimensional nature and consequences of Kolbari, as well as the need to identify alternative rural development opportunities based on the experiences and perspectives of local stakeholders. Qualitative data analysis followed the three-stage coding procedure commonly employed in Grounded Theory. During open coding, initial concepts and themes emerging from the interview transcripts were identified and coded. Subsequently, axial coding was employed to organize similar concepts into broader categories and subcategories while establishing relationships among them. Finally, selective coding was used to identify the core category, integrate the relationships among the identified categories, and develop the study's conceptual framework explaining both the underlying drivers of Kolbari and the strategies for promoting alternative economic activities in the study area. In addition to the interview process, focus group discussions and researcher-designed questionnaires were employed to formulate an economic development program aimed at reducing dependence on Kolbari through the identification

of locally appropriate livelihood alternatives. To establish the validity of the questionnaire, both face validity and content validity were assessed. An initial version of the questionnaire was reviewed by a panel of university faculty members specializing in geography, rural planning, rural development, and experts familiar with Kolbari. Based on their comments, revisions were made regarding the relevance of questionnaire items to the research objectives, the clarity of wording, the comprehensiveness of the questions, and the modification or removal of ambiguous items. Furthermore, to ensure that the questionnaire was understandable for respondents, a pilot survey involving 12 participants was conducted, after which the final revisions were incorporated. The reliability of the questionnaire was evaluated using Cronbach's alpha coefficient. Following the pilot survey, the collected data were analyzed using SPSS, yielding a Cronbach's alpha value of 0.78. Since this value exceeds the commonly accepted threshold of 0.70, the questionnaire demonstrated satisfactory internal consistency and reliability for subsequent statistical analyses.

The study population consisted of rural Kolbari workers, county development officials, and local experts, including academic specialists in the field of development as well as individuals with practical knowledge, innovative ideas, and research experience related to Kolbari. In addition, village heads (Dehyars) and members of village councils in the Central District of Marivan County, which constitutes the principal area where rural Kolbari is concentrated, were included in the process of developing the proposed economic development and employment program. Given the limited knowledge regarding the dimensions and characteristics of the Kolbari phenomenon in the study area and the necessity of obtaining comprehensive and in-depth information, purposive sampling was adopted. The selection of participants in the qualitative phase of the study was carried out as follows. Regarding Kolbari workers and villages affected by the Kolbari phenomenon in the Central District, information obtained from the County Governor's Office and the Central District Office indicated that, among the 43 villages located in the district, the highest concentration of Kolbari activities occurred in Sarkol and Zrivar rural districts. Accordingly, these two rural districts were selected for the study. Subsequently, based on the recommendations of the Central District Office, four villages with the largest number of rural Kolbari workers were purposively selected as the sample villages. These included Darzian and Balak in Sarkol Rural District, and Kalakeh Jan and Sianav in Zrivar Rural District. During the field visits, and with the cooperation of the village heads, approximately five Kolbari workers from each village were interviewed. For the group of development officials representing organizations responsible for rural employment generation and development, nine participants were purposively selected from the Governor's Office, the Central District Office, the Rural Cooperative Organization, and the Agricultural Jihad Organization based on criteria including administrative responsibility, familiarity with the study area, and professional experience (Table 1). Similarly, twelve local experts and academic specialists were purposively selected according to criteria such as educational qualifications, academic specialization related to rural development, and familiarity with the socioeconomic conditions of the study area (Table 1). For the Delphi panel, participants were selected based on their knowledge of the research topic, indigenous familiarity with the region, academic qualifications and field of specialization, and administrative responsibilities related to rural employment generation and economic development. Accordingly, ten experts, together with the village heads of the selected villages, were included in the Delphi panel, resulting in a total of 15 participants (Table 1).

Table 1. Characteristics of the Participants in the Development Officials, Local Experts, and Delphi Groups

Government Officials			**Local Experts**		**Delphi Panel**	
Organization (Affiliation)	Field of Study and Academic Degree	(N)	Field of Study and Academic Degree	(N)	Field of Study and Academic Degree	(N)
Governor's Office	M.A. in Rural Geography and Planning /	3	Assistant Professor, Ph.D. in Rural Geography and Planning	3	Associate Professor, Ph.D. in Rural Geography and	3

Government Officials			Local Experts		Delphi Panel	
	Management				Planning	
Central District Office	M.A. in Rural Geography and Planning / Sociology	2	Ph.D. in Development Sociology	3	Ph.D. in Development Sociology	3
Rural Cooperative Organization	M.A. in Social Welfare Planning	1	M.A./Ph.D. in Business Administration	2	Ph.D. in Entrepreneurship	1
Agricultural Jihad Organization	M.A. in Horticulture and Animal Sciences	2	Ph.D. in Entrepreneurship	1	M.A. in Rural Geography and Planning	1
Industry, Mine and Trade Organization	M.A. in Business Administration	1	Ph.D. in Agriculture	1	M.A. in Sociology	1
Cultural Heritage and Tourism Organization	M.A. in Tourism Management	1	Ph.D. in Political Geography	1	M.A. in Social Welfare Planning	1
Border Guard Command	B.A. in Border Guard Studies	1	B.A. in Border Guard Studies	1	—	—
—	—	—	B.A. in Business Administration	1	—	—
—	—	—	Associate Degree in Technical Sciences	1	—	—
—	—	—	M.A. in Remote Sensing	1	—	—
—	—	—	B.A. in Educational Sciences	1	—	—

In the quantitative phase of the study, 30 participants, a sample size considered acceptable for descriptive research, were purposively selected to validate the findings obtained from the qualitative phase. The participants were selected based on criteria including familiarity with the research topic, indigenous knowledge of the study area, academic qualifications and field of specialization, and administrative responsibilities related to rural employment generation and economic development. The selected participants included 10 experts, together with the village heads of the study villages.

The selection of a sample size of 30 participants in the quantitative phase was based on the exploratory nature of the study, the limited number of experts with relevant knowledge of the research topic, and the use of purposive sampling. Since the primary objective of this phase was to verify and evaluate the findings derived from the qualitative stage, and the respondents consisted of academic experts, executive managers, and local specialists, this sample size was considered appropriate for expert-based analyses. Furthermore, given that the statistical analyses relied on non-parametric techniques, particularly Spearman's rank correlation coefficient, which is suitable for relatively small sample sizes, a sample of 30 respondents was deemed sufficient.

Subsequently, in line with the main objective of the study—namely, reducing dependence on Kolbari in the villages with the highest concentration of rural Kolbari workers in the Central District of Marivan County—a participatory planning process was undertaken. Following joint meetings with village heads, members of village councils, and local experts, together with extensive field observations, the capacities for diversifying the rural economy were identified and incorporated into the development planning process as alternative economic activities to Kolbari. Given the importance of identifying comparative advantages as the principal drivers of rural economic development and the catalysts for economic diversification, an assessment of the comparative advantages of the study villages was undertaken. In this regard, identifying the comparative advantages of each village constituted the first essential step. The concept of comparative advantage may be defined in various ways. If a

rural area can produce a particular good at a lower opportunity cost than other areas, that area is considered to possess a comparative advantage in producing that good. The central premise of this theory is the concept of opportunity cost, which refers to the value of the next best alternative forgone in producing a particular good. Accordingly, rural producers who incur lower opportunity costs in producing a specific commodity or service—that is, those who sacrifice fewer alternative goods or services—are considered to possess a comparative advantage in that activity.

To identify and prioritize alternative economic activities capable of replacing Kolbari, the Delphi technique was employed. Accordingly, a Delphi panel comprising 15 experts, including university faculty members, specialists in rural development, entrepreneurship, development sociology, and executive officials responsible for rural employment and development, was established. The Delphi process was conducted in three rounds. During the first round, an initial list of potential economic capacities and development opportunities for the study villages was compiled based on documentary sources, field interviews, and expert opinions. In the second round, a questionnaire based on a five-point Likert scale (1 = very low to 5 = very high) was distributed among the panel members to evaluate the importance and feasibility of each proposed activity. In the third round, the results of the previous round were returned to the panel members, who were invited to reconsider and, where necessary, revise their responses. Consensus was considered to have been achieved when more than 75% agreement among the experts was reached and the mean scores stabilized during the third Delphi round.

Furthermore, it was necessary to examine the influence of variables such as distance from the county center, the proportion of young population in the village, the diversity of local economic capacities, distance from the international border, educational attainment, marital status, and age on the persistence of the Kolbari phenomenon and its prevalence within the study villages. Accordingly, the opinions of 30 respondents, including development officials, village heads, district administrators, academic experts, and local specialists, were collected using a five-point Likert scale. The variables examined in this stage were selected based on the spatial, demographic, and socio-economic characteristics of the villages. Although household income and expenditure are widely recognized as important determinants of participation in Kolbari, reliable household-level data were not available due to the informal nature of much of the economic activity associated with Kolbari. Consequently, direct measurement of these variables was not feasible. Instead, proxy indicators, including educational attainment, the proportion of young population, and the diversity of local economic opportunities, were employed.

4. Research Findings

The principal impacts and consequences of the persistence of Kolbari on the security and development conditions of the study area were identified through the analysis of the semi-structured interviews using the Grounded Theory approach (Table 2). As shown in Table 2, the continuation of the Kolbari phenomenon has the potential to undermine security across multiple dimensions while simultaneously reinforcing the cycle of underdevelopment within the region. These adverse impacts extend from the individual and household levels to the local, regional, and even national scales.

Table 2. Effects of the Persistence of *Kolbari* on Sustainable Security in the Study Area

Core Category		Categories	Concepts
Security Instability	National Security	Political–Military Security:	Increasing social distance between local communities and security forces; intensification of security-oriented policies and border closures; expansion of a culture of law evasion; declining sense of belonging and loyalty toward the political system; recruitment of young people into illegal groups operating in border areas; increased media attention to the socioeconomic challenges of border regions; growing threats against border guards and border posts; rising costs of border protection; formation of organized criminal networks (e.g., smuggling and arms trafficking); increasing ethnic tensions arising from perceived regional inequalities; damage to security infrastructure; and the growth of religious radicalism.

Core Category		Categories	Concepts
	Human Security (Local–Regional)	Environmental–Physical Security:	Destruction of agricultural land and orchards; deterioration of transportation infrastructure and residential buildings; degradation of the visual quality of rural landscapes; and expansion of abandoned and unsafe spaces within villages.
		Social Security:	Declining attachment to rural communities; increasing fear and insecurity among households regarding the safety of their property (e.g., tractors, irrigation pumps, combine harvesters, and private vehicles); declining educational attainment; widening income disparities between rural and urban areas; migration; erosion of social capital; increased conflicts and disputes; expansion of informal settlements and crime-prone areas in neighboring cities; declining public trust in local media due to inadequate news coverage; increasing poverty and the culture of poverty; and reduced cooperation between local residents and public authorities in implementing security and development programs.
		Economic Security:	Increasing involvement in commodity smuggling; declining public and private investment; greater interest in intermediary and informal urban occupations; transfer of rural capital to neighboring cities; closure of border markets; rising unemployment; lack of occupational diversification; increasing public expenditures for infrastructure and security; declining household income and savings; reduced household purchasing power; dissolution of rural production cooperatives and local savings funds; reduced access to employment, housing, and production loans; and declining livestock numbers and diversity.
		Food Security:	Reduced capacity of households to meet their food needs (including meat and dairy products) and declining production of food crops for household consumption.
	Long-term Security Consequences	Long-term Security Vulnerabilities	Depopulation of sparsely populated villages located near the international border; depletion of land and water resources accompanied by declining national production; changes in the demographic structure of neighboring urban areas; social unrest and conflicts; expansion of organized smuggling; increasing poverty; declining institutional legitimacy in border regions; loss of previous investments devoted to regional security and development; further border restrictions; and increasing human and financial losses affecting border security forces and infrastructure.

As the results of the Spearman's rank correlation analysis indicate (Table 3), at the 0.05 significance level, statistically significant relationships were identified only for the variables of educational attainment and the proportion of the young population. In other words, these were the only variables that exhibited a significant association with the persistence and expansion of Kolbari in the study villages. The relationship between the proportion of the young population and Kolbari was positive, indicating that villages with larger young populations tend to experience higher levels of participation in Kolbari. Conversely, the relationship between educational attainment and Kolbari was negative, suggesting that higher educational levels are associated with lower levels of engagement in Kolbari. By contrast, the absence of statistically significant relationships for variables such as economic diversification, distance from the international border, marital status, and age constitutes an important finding with substantial policy implications. These results suggest that the Kolbari phenomenon has become deeply embedded across the rural communities of the study area, irrespective of these characteristics. In particular, the lack of association between economic diversification and the prevalence of Kolbari indicates that insufficient diversification of the rural economy has resulted in the dominance of a single-source livelihood structure, thereby diminishing the effectiveness of alternative economic activities that could otherwise serve as viable substitutes for Kolbari in the study villages.

Table 3. Relationship between individual and village characteristics and the persistence of cross-border portering in the study area

Statistical indicator	Test	N	Coefficient	Significance level	Result
Young population of villages	Spearman	30	0.641	0.000	Reject H_0
Educational level	Spearman	30	-0.295	0.000	Reject H_0
Economic diversification of villages	Spearman	30	–	0.115	Accept H_0
Age	Spearman	30	–	0.514	Accept H_0
Marital status	Spearman	30	–	0.098	Accept H_0
Distance from the border	Spearman	30	–	0.117	Accept H_0
Distance from the county center	Spearman	30	–	0.386	Accept H_0

In this section, the capacities and comparative advantages of the four sample villages are identified and analyzed with the aim of proposing sustainable economic alternatives to cross-border portering. It should be noted that the prioritization of economic development drivers was carried out based on the scores assigned by experts and participants during the focus group discussions. To this end, the identified economic activities were evaluated using a five-point Likert scale (1 = very low importance to 5 = very high importance). Subsequently, the mean score for each activity was calculated, and the final ranking of the proposed economic activities was determined accordingly.

4.1. KalakehJan Village

The prioritization of the economic development drivers in Kalakeh Jan village (Figure 5) revealed that, from the perspective of the participants in the focus group discussions, rainfed farming, livestock husbandry, horticulture, and skilled/service-based occupations respectively constitute the most important existing sources of income and economic activities in the village, although these activities currently operate with relatively low productivity. In this regard, with the implementation of the village economic development plan and considering the rapid expansion of orchards—particularly rainfed vineyards—throughout Marivan County, together with the considerable potential of livestock husbandry, these two sectors are expected to become the principal economic activities of the village. Meanwhile, rainfed farming will decline to the lowest development priority within the proposed economic development framework, since it is characterized by very low productivity and a considerable proportion of rainfed agricultural lands are expected to be converted into vineyards. Furthermore, poultry farming, which is currently an underutilized economic activity practiced by only one villager, is projected to become an important complementary economic sector alongside skilled and service-oriented occupations in the future. Consequently, it can contribute to diversifying the village economy, creating new employment opportunities, and ultimately reducing villagers' dependence on kolbari.

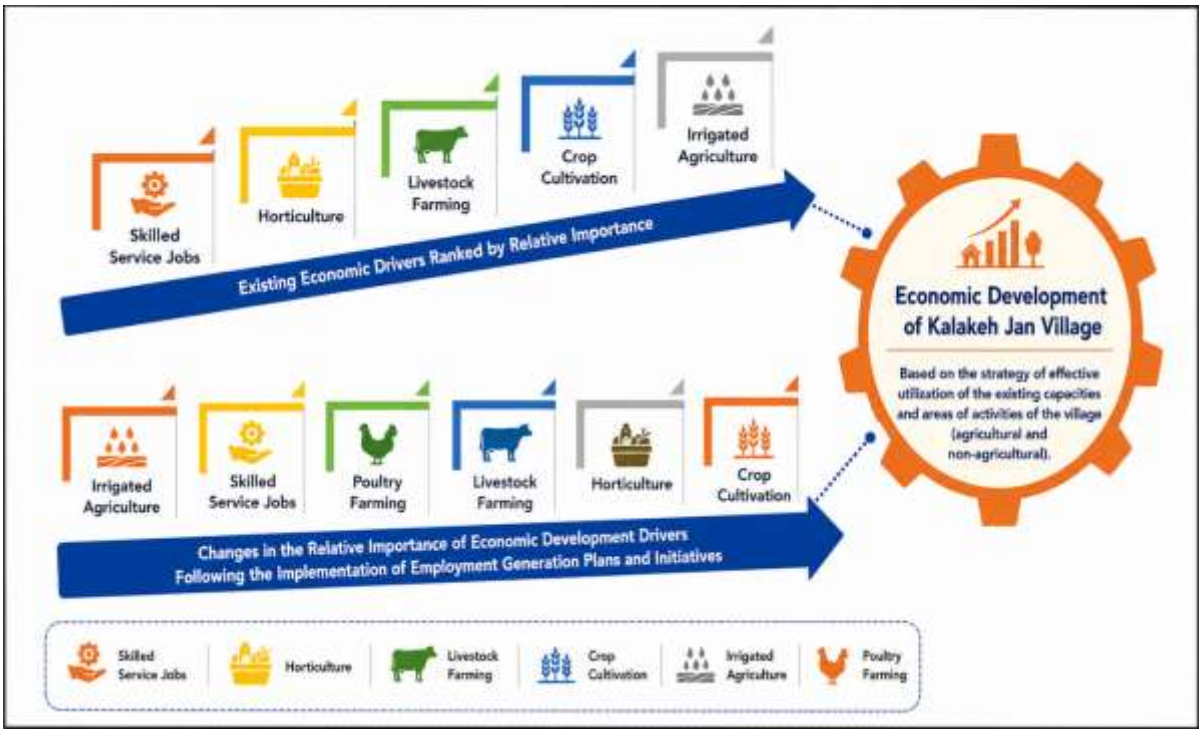


Figure 5. Economic development drivers of KalakehJan Village under the current conditions and after the implementation of employment development programs

With regard to the existing pattern of economic activities in Kalakeh Jan village, and based on criteria such as the quantity and quality of production, the capacity of local natural resources to support the development of each activity, the willingness, skills, and experience of local residents, as well as the current comparative advantages of the village economy, the village's comparative economic advantages were identified through the consensus achieved during participatory meetings and individual interviews with local residents and regional experts (Figure 6). As illustrated, under the current conditions no economic sector can be regarded as possessing a clear comparative advantage in Kalakeh Jan village. Economic activities are primarily concentrated in livestock husbandry and skilled/service-based occupations; however, these sectors currently operate with limited effectiveness and productivity. Nevertheless, the proposed village economic development plan indicates that livestock husbandry, skilled and service-based occupations, together with poultry farming, have the potential to evolve into the village's principal comparative advantages, thereby providing a stronger foundation for sustainable livelihoods, economic diversification, and reducing dependence on kolbari.

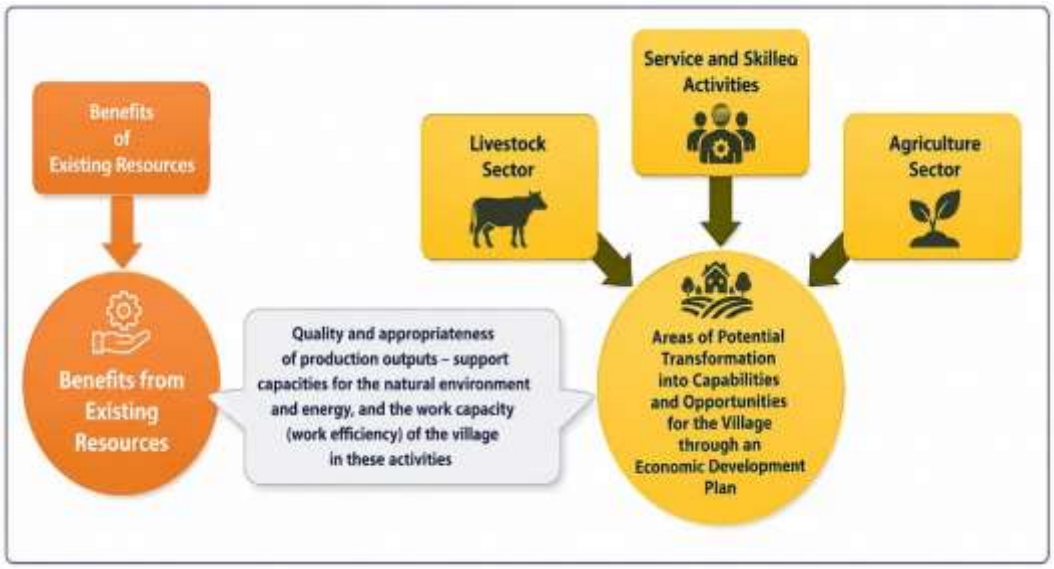


Figure 6. Identification of the comparative advantages of economic activities in Kalakeh Jan Village under the current conditions and after the implementation of the village economic development plan.

4.2. Darziyan Village

The preliminary assessment revealed that the business environment of Darziyan village suffers from very low productivity, with many of its economic potentials remaining underutilized due to inadequate management, insufficient investment, and ineffective resource utilization. The lack of sustainable employment opportunities has driven a considerable proportion of the village's workforce toward informal occupations, particularly *kolbari* and cross-border smuggling, thereby fostering a gradual shift away from a culture of production, entrepreneurship, and innovation within the village. At the same time, the active involvement of rural women in livestock production, agro-processing, and agricultural value-added activities, together with the availability of livelihood-oriented residential spaces, provides favorable conditions for the expansion of home-based enterprises, strengthening women's economic participation, and promoting a livelihood-oriented housing model. However, social constraints on women's participation, limited awareness among villagers regarding income-generating activities that can be established within residential units, and inadequate financial resources have prevented the full utilization of these capacities for the development of home-based and livelihood-oriented businesses.

The prioritization of the economic development drivers in Darziyan village (Figure 7) indicated that, under the current economic conditions, livestock husbandry, crop cultivation, and horticulture constitute the principal economic activities of the village. However, according to the participants, implementation of the proposed employment development plan would, in addition to strengthening these three sectors, introduce beekeeping, women-centered home-based businesses, and mulberry cultivation combined with sericulture as new pillars of employment generation and local economic development.

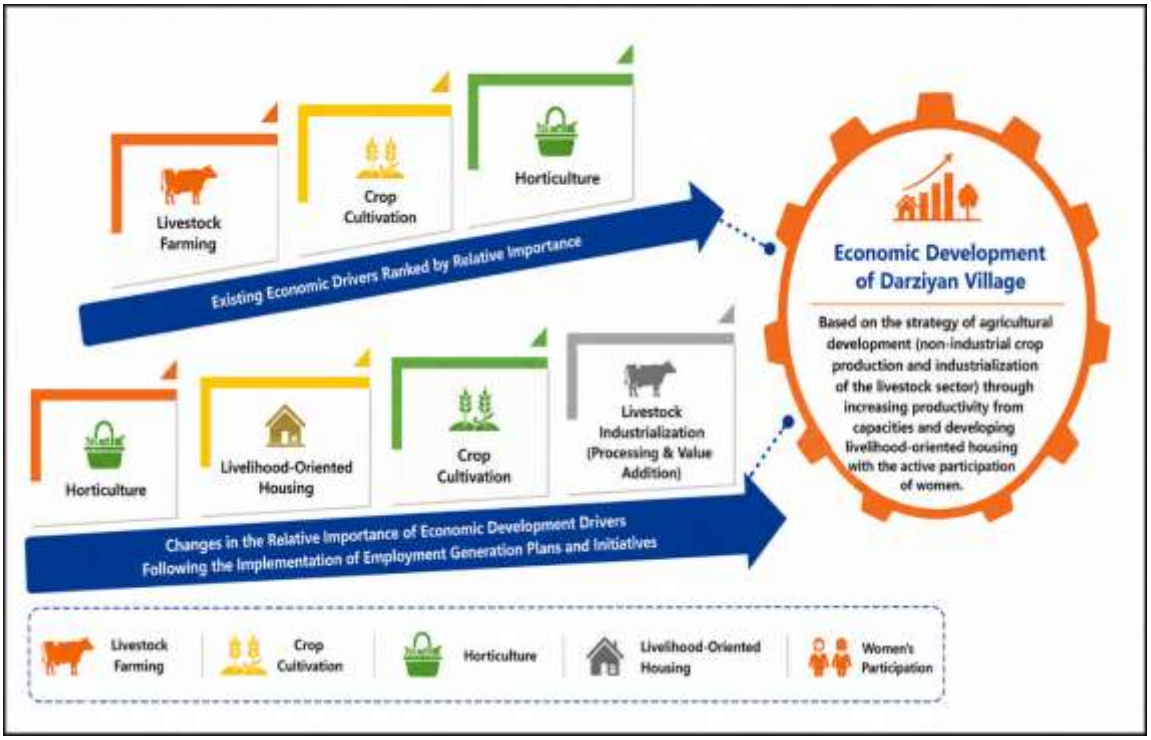


Figure 7. Importance of the economic development drivers in Darziyan Village under the current conditions and following the implementation of employment development programs

Considering the importance of comparative advantage assessment as the foundation of rural economic development and as a catalyst for agricultural diversification in Darziyan village, the village's comparative advantages were subsequently evaluated. Accordingly, identifying comparative advantages constituted the first step of the analysis. Based on the existing pattern of economic activities in Darziyan village, and considering criteria such as the quantity and quality of production, the capacity of natural resources to support each activity, the willingness, skills, and experience of local residents, as well as the current comparative advantages of the village economy, the village's comparative economic advantages were identified through the consensus reached during participatory meetings and individual interviews with local residents and regional experts (Figure 8). The findings indicate that, under the current conditions, livestock husbandry and tobacco cultivation represent the village's principal comparative advantages. Under the proposed economic development plan, however, rainfed viticulture, greenhouse cultivation, and the production of medicinal plants are expected to emerge as the main comparative advantage sectors. Furthermore, if the proposed Garan Dam water transfer project to the village's agricultural lands is implemented, forage crop cultivation is also expected to become an additional comparative advantage and an important component of the village's future economic structure.

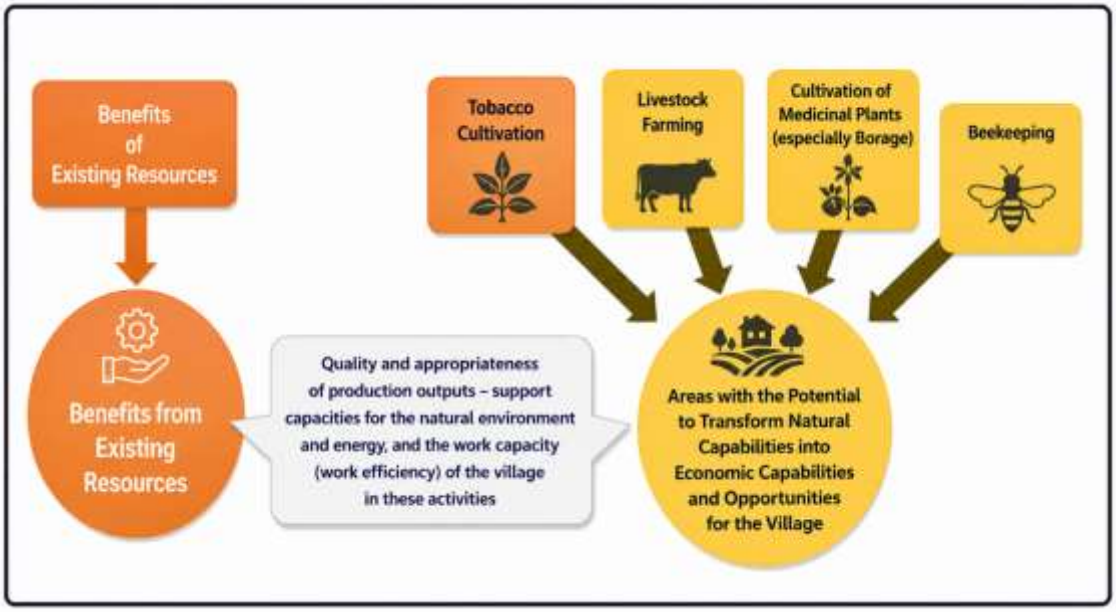


Figure 8. Identification of the comparative advantages of economic activities in Darziyan Village under the current conditions and after the implementation of the village economic development plan.

4.3. Balak Village

The prioritization of the economic development drivers in Balak village indicated that, from the perspective of the participants, implementation of the proposed employment initiatives and the village economic development plan would not only strengthen the position of horticulture as the village's primary economic activity, but would also elevate livestock husbandry to the second most important economic sector. In addition, home-based enterprises and *Kalash* weaving, which are closely associated with the independent economic participation of rural women, together with aquaculture and religious tourism, are expected to emerge as new sources of employment and income generation. The development potential of aquaculture is primarily attributed to the availability of adequate water resources, provided that the village's springs and water resources are properly managed, while the potential for religious tourism stems from the presence of the culturally and religiously significant shrine of Imam Mohammad Mulla Baqer Balak, which constitutes an important local attraction (Figure 9).

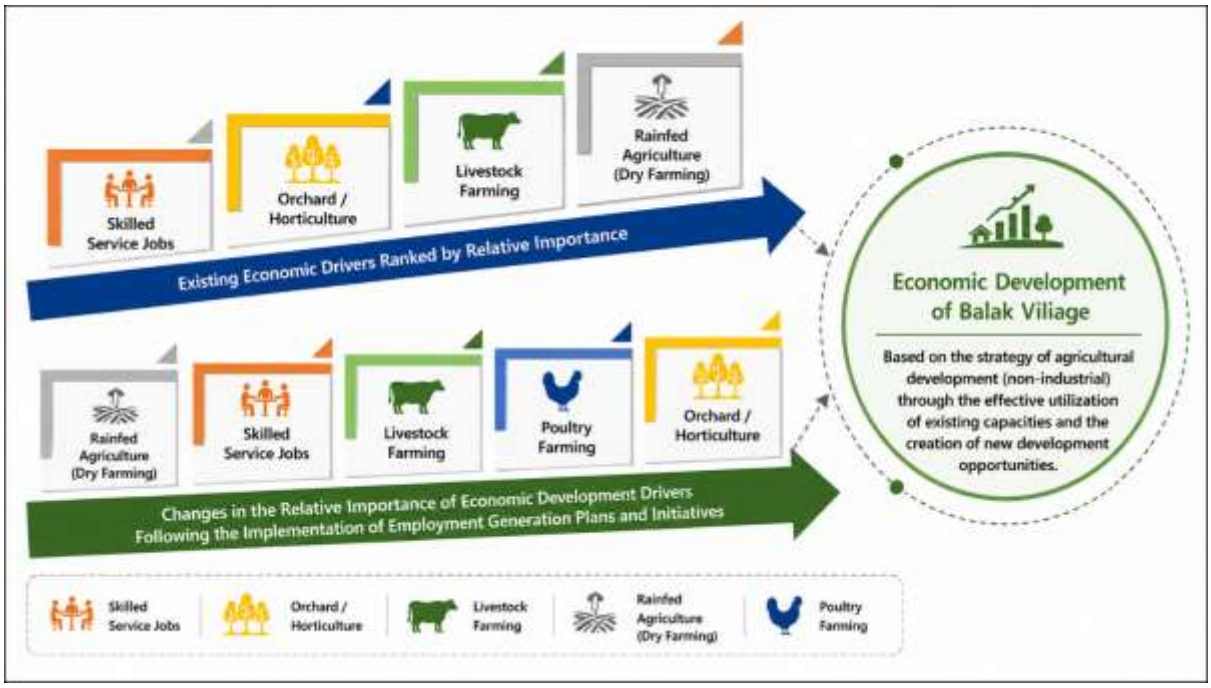


Figure 9. Importance of the economic development drivers in Balak Village under the current conditions and following the implementation of employment development programs

Based on the existing pattern of economic activities in Balak village, and considering criteria such as the quantity and quality of production, the capacity of local natural resources to support the development of each activity, the willingness, skills, and experience of local residents, as well as the existing comparative advantages of the village economy, the comparative economic advantages of the village were identified through the consensus achieved during participatory meetings and individual interviews with local residents and regional experts. Accordingly, the comparative advantages of Balak village were determined both under the current conditions and under the proposed village economic development plan, which emphasizes the effective utilization of local resources and development potentials (Figure 10).

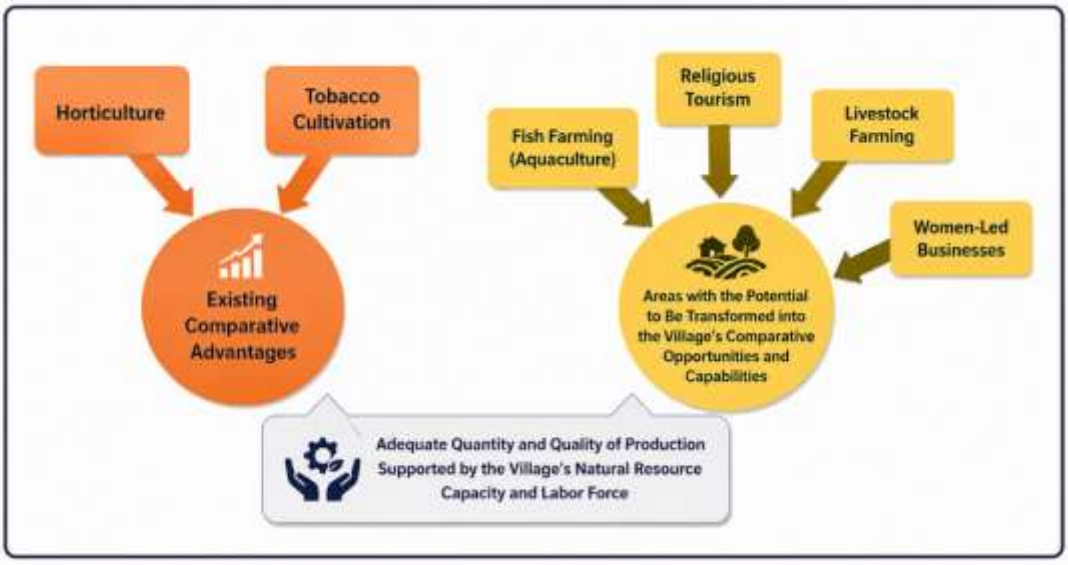


Figure 10. Identification of the comparative advantages of economic activities in Balak Village under the current conditions and after the implementation of the village economic development plan

4.4. Sianav Village

The prioritization of the economic development drivers in Sianav village, based on the views expressed by participants during the focus group discussions, indicated that the village's existing economic sectors will be maintained and further strengthened through the implementation of the proposed economic development plan. In essence, the primary objective is to enhance the productivity and efficiency of these existing activities. At the same time, economic diversification is expected to be achieved through the establishment of small-scale enterprises linked to livestock husbandry, the expansion of women-led income-generating activities, and the development of service-oriented businesses that capitalize on the village's strategic location and its function as a local service center. Consequently, these economic sectors are anticipated to play a more substantial role in promoting employment generation and fostering the overall economic development of the village (Figure 11).

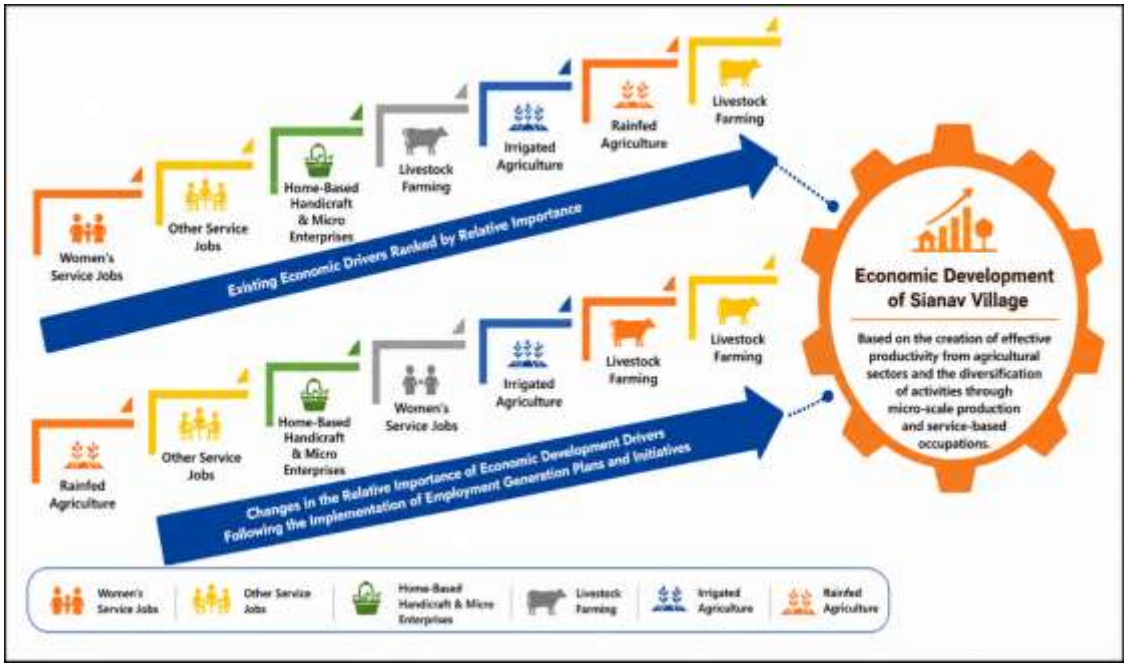


Figure 11. Importance of the economic development drivers in Siyanav Village under the current conditions and following the implementation of employment development programs

Considering the current pattern of economic activities in Sianav Village and based on criteria such as the quantity and quality of production, the capacity of natural resources to support the expansion of economic activities, the support, willingness, and skills of local residents to engage in these activities, as well as the existing comparative advantages identified through consensus achieved during participatory meetings and individual interviews with villagers and regional experts, the comparative advantages of the village economy were identified. As illustrated in Figure 12, under present conditions**,** livestock farming constitutes the village's primary comparative advantage. However, with the implementation of the village economic development plan and its associated employment-generation projects, beekeeping, rain-fed grape cultivation, and women-based entrepreneurial and home business activities can also be transformed into major comparative advantages, thereby strengthening the village's economic base, diversifying livelihood opportunities, and reducing dependence on cross-border carrying (Kolbari).

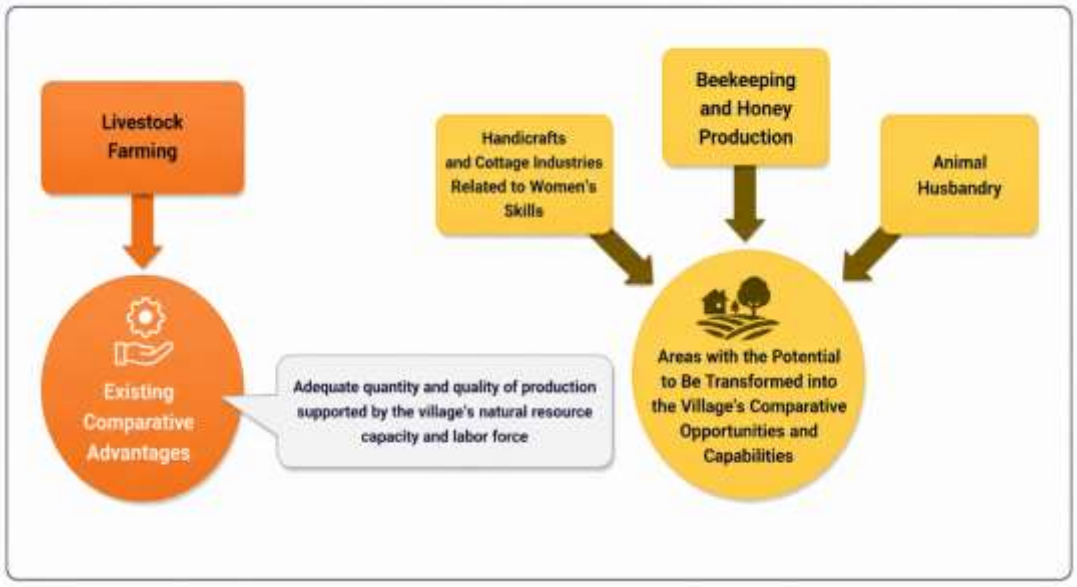


Figure 12. Identification of the comparative advantages of economic activities in Siyanav Village under the current conditions and after the implementation of the village economic development plan

5. Discussion and Conclusion

The present study aimed to analyze the socio-economic impacts of *Kolbari* (cross-border carrying) and to identify regional capacities for reducing dependence on this activity in the rural border areas of Marivan County. The findings, presented in relation to the three main research questions, not only clarify the multidimensional nature of Kolbari but also reveal potential pathways for promoting alternative livelihood opportunities and reducing rural households' reliance on this informal economic activity.

With regard to the first research question, the findings indicate that *Kolbari* is not merely an informal income-generating activity adopted by border households to secure their livelihoods; rather, it has far-reaching implications for the sustainable security of the region. The qualitative analysis revealed that the persistence of this phenomenon has generated challenges across multiple dimensions of security, including political–military security, economic security, social security, food security, and environmental–physical security, ultimately contributing to long-term developmental and security instability in the study area. These findings are consistent with those reported by Mohammadi et al. (2021), Augustova and Sober (2023), Salerno Valdez et al. (2022), and Anbari et al. (2025), who argue that *Kolbari* and other forms of informal cross-border economic activity have consequences that extend well beyond the economic sphere, affecting social cohesion, cultural values, and regional security. The findings are also in line with the studies of Hernández (2021), Hernández Campos and Torre Cantalapiedra (2022), and Prieto-Curiel et al. (2023), which demonstrate that border-control and enforcement-oriented policies, when implemented without addressing the livelihood needs and development challenges of local communities, are unlikely to achieve a sustainable reduction in informal cross-border activities. However, the present study advances the existing literature by systematically conceptualizing the security implications of *Kolbari* within a comprehensive framework encompassing five dimensions of sustainable security. The results suggest that the continuation of this phenomenon not only undermines the quality of life of rural residents but also imposes substantial economic, administrative, and security costs on the country's border management system. From this perspective, the findings reinforce the argument that security in border regions is inherently multidimensional and that its sustainable realization requires the simultaneous integration of economic development, social well-being, and livelihood improvement into border governance strategies.

In response to the second research question, the results of the Spearman correlation analysis revealed that, among the variables examined, only educational attainment and the proportion of the

young population in the villages were significantly associated with the persistence of *Kolbari*. The positive relationship between the young population and the prevalence of *Kolbari* indicates that, in the absence of sustainable employment opportunities, young people are more likely than other social groups to engage in this activity. This finding is consistent with the studies of Mohammadi (2023), Mahmoudi and Moradi (2021), and Anbari et al. (2025), which identified unemployment, an underdeveloped business environment, and limited economic opportunities as the principal factors driving border residents toward *Kolbari*. Furthermore, the significant negative relationship between educational attainment and the continuation of *Kolbari* suggests that improving human capital through education can play a crucial role in reducing individuals' dependence on informal and high-risk economic activities. This result is in agreement with the findings of Hernández Campos and Torre Cantalapiedra (2022) and Prieto-Curiel et al. (2023), who emphasized the importance of education, capacity building, and employment creation in reducing participation in the informal economy. In contrast, this finding differs from that of Motaghi, Amraei, and Ghorbani (2021), who reported no significant relationship between educational level and the tendency to engage in *Kolbari*. This discrepancy may be attributed to differences in the socio-economic characteristics of the study areas as well as the greater dependence of rural households in Marivan County on *Kolbari* as a livelihood strategy. Moreover, the absence of significant relationships between *Kolbari* and variables such as distance from the border, distance from the county center, age, marital status, and the degree of economic diversification indicates that, within the study area, *Kolbari* has evolved beyond a localized phenomenon and has become deeply embedded in the economic and social structure of rural communities. The lack of a significant relationship with economic diversification further suggests that existing economic activities have not yet developed sufficient capacity to serve as viable alternatives to *Kolbari*, and that the regional economy continues to suffer from limited diversification and structural vulnerability.

Regarding the third research question, the findings derived from participatory economic development planning and field investigations in the selected villages demonstrated that each village possesses distinctive economic capacities and comparative advantages that can support the development of alternative livelihood opportunities. Livestock production, rain-fed grape cultivation, beekeeping, poultry farming, medicinal plant cultivation, home-based enterprises, agro-processing industries, religious tourism, and women-led economic activities were identified as the most promising development opportunities. These findings are consistent with those reported by the Iranian Parliament Research Center (2019), Mohammadi et al. (2021), Hernández (2021), and Prieto-Curiel et al. (2023), all of whom emphasized that expanding local employment opportunities, investing in productive economic activities, and strengthening regional economies constitute the most effective strategies for reducing border communities' dependence on informal economic activities. The findings are also in line with the studies of Taheri (2018), Mohammadi and Rostami (2018), and Hooshangi and Mohammadi (2018), which highlighted the positive role of formal economic activities and border markets in improving the quality of life and alleviating the economic pressures experienced by border households. Nevertheless, the principal contribution of the present study lies in moving beyond merely identifying the causes and consequences of *Kolbari* by systematically identifying and assessing the feasibility of locally appropriate economic development opportunities within the study villages. Accordingly, the findings suggest that the sustainable reduction of *Kolbari* cannot be achieved solely through border enforcement and security measures; rather, it requires endogenous economic development, diversification of rural economic activities, and the creation of employment opportunities that are compatible with the comparative advantages of each village.

Overall, the findings of this study indicate that *Kolbari* should be understood not simply as an economic choice but as a livelihood strategy adopted in response to limited employment opportunities and the persistent underdevelopment of border regions. Consequently, policies aimed at reducing this phenomenon should be founded upon the interdependent relationship between security and development while prioritizing improvements in the quality of life of rural communities. In this

regard, revising security-centered border management approaches, expanding formal border markets, supporting productive investments, promoting agro-processing industries, strengthening vocational education and skills training, encouraging rural entrepreneurship, developing tourism, and supporting women's economic participation are among the key strategies that can reduce rural households' dependence on *Kolbari* and contribute to the realization of sustainable security and balanced regional development in border areas

It should be noted that, like any empirical investigation, the present study was subject to several limitations. The most significant limitation was the security-sensitive nature of *Kolbari*, which made access to information and individuals involved in this activity particularly challenging. In some cases, respondents were understandably cautious in providing information, which may have affected the depth of the collected data. Another limitation was the lack of comprehensive and reliable official statistics concerning the various dimensions of *Kolbari*, as well as the fact that the empirical investigation was confined to selected villages in Marivan County, thereby limiting the generalizability of the findings to other border regions. Furthermore, although household income and expenditure are recognized as important determinants of engagement in *Kolbari*, these variables could not be examined due to the absence of accurate and reliable data and the difficulty of obtaining detailed household economic information.

Based on the findings of this study, the most effective strategy for reducing rural households' dependence on *Kolbari* is to promote economic development and diversify income-generating activities in rural border areas. In this regard, it is essential that the management of border regions shifts from a predominantly security-oriented and threat-based perspective toward a development-oriented approach grounded in the principles of sustainable security. In addition, revising existing border closure policies, adopting modern border-monitoring technologies, and strengthening coordination among security, administrative, and development agencies would enhance the effectiveness of regional development programs. Moreover, strengthening formal border markets, promoting agro-processing industries, supporting rural cooperatives and local investment funds, providing entrepreneurship and vocational training, developing rural tourism, branding local products, and facilitating financial support for productive investments are among the most important strategies for generating sustainable employment opportunities in the region. Expanding social insurance coverage, improving service and transportation infrastructure, and increasing media attention to both the challenges and development potential of border regions can also contribute significantly to improving the quality of life of rural residents and enhancing sustainable regional security.

Finally, the authors wish to express their sincere gratitude to all *Kolbars* who participated in this study, as well as to the experts, practitioners, and other participants who generously shared their valuable experiences, insights, and information, making this research possible. The authors also gratefully acknowledge the cooperation and support of the relevant governmental organizations, institutions, and agencies that facilitated the data collection process and the implementation of this study. Finally, the authors extend their sincere appreciation to the anonymous reviewers for their constructive comments and valuable suggestions, which substantially contributed to improving the quality of the manuscript.

Author Contributions

The authors contributed equally to the development and preparation of this research.

Conflict of Interest

The authors declare that there is no conflict of interest regarding the authorship or publication of this article.

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References

1. Abdolmohammadi, A. (2010). A study of social factors affecting smuggling in Iran. *Journal of Law Enforcement Security*, 3(2), 179-205. [In Persian] https://search.isc.ac/dl/search/defaultta.aspx?DTC=8&DC=477140

2. Anbari, M., Ahmadifar, R., Abdezade, S (2025). Trap of Poverty and Out comes of construction of Cullbari in border areas of Iranian Kurdistan, *Sociology of Culture and Art*, 7(2), 41 – 57. https://doi.org/10.22034/scart.2024.139849.1377
3. Augustova, K., & Suber, D. L. (2023). The Kurdish kaçakçı on the Iran–Turkey border: corruption and survival as EU sponsored counter-smuggling effects. Trends in Organized Crime, 26(1), 48–63. https://link.springer.com/article/10.1007/s12117-023-09484-3
4. Afrakhteh, H. (2012). Border, social capital, development, and security of border regions. *National Conference on Border Cities and Security: Challenges and Approaches*, University of Sistan and Baluchestan.Zahedan,Iran. https://civilica.com/l/4358/
5. Alipour, S. K.,, Paydar, A., & Sadeghi, Kh. (2016). Providing a spatial model for improving the livelihood of villagers with an emphasis on sustainable security (Implementation area of CSP in Jazmourian, southern Kerman). *Journal of Geography and Development*, 14(44), 45-64. [In Persian]. https://doi.org/10.22111/gdij.2016.2718
6. Andalib, A.R., (2001). *Basic theory and principles of spatial planning in the border regions of the Islamic Republic of Iran*. Tehran: Command and Staff College of the Islamic Revolutionary Guard Corps. [In Persian]. https://elmnet.ir/doc/31346126-71142
7. Aslamarz, A., Dindarloo, S., & Aslamarz, O. (2015). Investigating the social factors affecting the tendency of border residents in Baneh toward smuggling. *Journal of Social Order*, 7(2), 33-45. [In Persian]. https://elmnet.ir/doc/1474859-13561
8. Cegliński, P. (2016). The concept of competitive advantages: Logic, sources, and durability. *Journal of Positive Management*, 7(3), 57–70. https://apcz.umk.pl/JPM/article/view/JPM.2016.016
9. Chandler, D. (2007). The security–development nexus and the rise of 'anti-foreign policy.' *Journal of International Relations and Development*, 10(4), 362-386. https://link.springer.com/article/10.1057/palgrave.jird.1800135
10. Hernandez, A. (2021). *Smuggling, Illegality and Circulation in the US–Mexico Border: The Case of Tijuana–San Diego.* Estudios Fronterizos, 22, e077. DOI: 10.21670/ref.2114077. https://www.scielo.org.mx/scielo.php?pid=S0187696120210001001 14&script=sci_abstract&tlng
11. Hernández Campos, C., & Torre Cantalapiedra, E. (2022).How can Mexican migrants reduce the risk of being abandoned by smugglers while clandestinely crossing the US Mexico border? Migration Studies, 10(4), 746–765. https://doi.org/10.1057/palgrave.jird.1800135
12. Isacson, A. (2012). *Beyond the border buildup: Security and migrants along the U.S.-Mexico border.* Retrieved from: https://www.wola.org/analysis/beyond-the-border-buildup-security-and-migrants-along-the-us-mexico-border/
13. Kohnehpoushi, S.H. (2010). *Investigating the relationship between smuggling and the economic sustainability of villagers (Case study: Khavomirabad district, Marivan County)*. Master's Thesis, Faculty of Literature and Humanities, University of Zanjan. [In Persian]
14. Mahmoodi , M.A,. Moradi, A., (2021), Kolbari, the outcome of policies oriented to underdevelopment (A qualitative study of Kolbars in Pave city), *Sociology of Culture and Art Quarterly*, 3(8), 1-21 https://scart.uok.ac.ir/article_61941.html?lang=en
15. Mohammadi, S., & Houshengi, H. (2018). An analysis of the role of border markets in the livability of rural areas (Case study: Khavomirabad and Dezli districts in western Kurdistan Province). *Journal of Geography and Urban-Regional Planning*, 8(28), 69-90. [In Persian] https://doi.org/10.22111/gaij.2018.4146
16. Mohammadi, S. & Rostami, Kh. (2018). The evaluation of the effects of borderline markets establishment on the changes of villagers' life quality level (Case study: Dezli Dehestan of Sarvabad County). *Journal of Research & Rural Planning*, 7(2), 115-134. http://dx.doi.org/10.22067/jrrp.v5i4.68452
17. Mohammadi, S. (2023). Analysis of Factors Affecting the Occurrence and Continuity of Porterage (Kolbari) Phenomenon in Border Rural Areas of Kurdistan Province. *Human Geography Research Quarterly*, 55 (2), 135-154. [In Persian]. http://doi.org/10.22059/JHGR.2022.326304.1008332
18. Mohammadi, S., Rostami, Kh. & Karimian, T. (2021). Analyzing the effects of rural economy diversification on the livelihood assets of rural households (Case study: Khavmirabad District of Marivan County). *Journal of Research & Rural Planning*, 10(2), 79-97. http://dx.doi.org/10.22067/jrrp.v10i2.72816
19. Mohammadi, H., Mosavi Jad, S.M., Salehi, Yosra, Salmasi, Samane., (2021),Sustainable employment in border cities; Analysis of causes and consequences of kulbary in Baneh City,*Sustainable development of geographical Environment*, 3(5), 5, 18-35. https://doi.org/10.52547/sdge.3.5.18
20. Moradi, N. (2012). Border cities and their security and law enforcement issues. *First National Conference on Border Cities and Security*: Challenges and Approaches, Zahedan.Iran. [In Persian] https://civilica.com/l/4358/

21. Mottaghi, A., Amraie, M., Ghorbani Sepehr, A., (2021) An Analysis of the Causes of the Tendency Towards Informal Economy in Border Cities with Emphasis on Coolbury Employment (Case study: Sardasht City), *Journal of Research and Urban Planning*, 12(47),286-271. https://doi.org/10.30495/jupm.2022.4105
22. Piran, H., & Eskoui, N., (2015). Investigating the comparative and competitive advantages of major agricultural products in Alborz Province. *Economic Journal,* 15(3-4), 41-62. [In Persian]. https://www.virascience.com/article/230731/
23. Pirasteh, H., & Eslami Nasab, E. (2010). Evaluation of the comparative and competitive advantages of the detergent powder industry in Iran. *Economic Research and Policies*, 18(53), 77-107. [In Persian]. https://qjerp.ir/article-1-245-fa.html
24. Prieto-Curiel, R., Campedelli, G. M., & Hope, A. (2023).*Reducing cartel recruitment is the only way to lower violence in Mexico. https://doi.org/10.48550/arXiv.2307.06302*
25. Pourtaheri, M., (2017). *Economic development and job creation plan for Qazvin Province*. Qazvin Provincial Management and Planning Organization. [In Persian]. https://www.erqz-mporg.ir/
26. Research Center of the Islamic Consultative Assembly. (2019). *Plan for organizing border crossings in the country (Kolbari and Talanji)*. 2(10), 1-24. [In Persian] .https://report.mrc.ir/article_7748.html
27. Salerno Valdez, E., Obeng-Kusi, M., Brady, B., et al. (2022).Perceived Normalization of Drug Trafficking and Adolescent Substance Use on the US–Mexico Border. Journal of Drug Issues, 52(3). https://doi.org/10.1177/00220426211046593
28. Lavergne, R., Saxby, J. (2001). Capacity development: Vision and implications. Canadian *International Development Agency* https://www.academia.edu/49628680/Capacity_development_Vision_and_implications
29. Shayan, H., Kohnepushi, S.H. (2013). Analysis of the causes of rural-urban migration (Case study: Khav and Myrabad District, Marivan County), *Journal of Research & Rural Planning,* 2(1), 115-141. https://doi.org/10.22067/jrrp.v2i3.18132
30. Strategic Plan for Rural Development of Iran. (2014). Deputy of Rural Development, Presidential Office. [In Persian]. https://dolat.ir/cat/530
31. Taheri, S. (2018). An analysis of the effects of the closure and recession of economic gates (Kolbari markets) on the quality of life in border rural areas (Case study: Khavomirabad district, Marivan County). Master's Thesis in Geography and Rural Planning, supervised by Dr. Saadi Mohammadi, Payame Noor University. [In Persian]
32. Tayebnia, S.H., Mohammadi, S., & Manouchehri, S., (2015). An analysis of the impact of border closure on the sustainable security of surrounding rural areas (Case study: Border villages of Marivan County). *Journal of Spatial Planning and Development*, 20(1), 95-110. [In Persian]. https://www.ensani.ir/file/download/article/20160719125510-9564-136.pdf
33. UNEP. (2011). *Community capacity building: Voluntary and community sector.* Margaret Ritchie, Department for Social Development.
34. Wen-Cheng, W., & Chien-Hung, L. (2011). Types of competitive advantage and analysis. *International Journal of Business and Management*, 6(5), 101-108. https://www.ccsenet.org/journal/index.php/ijbm/article/view/10432
35. Wendy, L. (2007). *Building community capacity*: Resources for community learning & development. Practice compiled by the Scottish Community Development Centre for Learning Connections, The Scottish Government, Edinburgh. https://dera.ioe.ac.uk/id/eprint/1402/7/0054848_Redacted.pdf
36. Young, J. (2006). *Capacity development for policy advocacy*: Current thinking and approaches among agencies supporting civil society organizations. https://www.files.ethz.ch/isn/22812/wp260.pdf

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Original Article

تحلیل پدیده کولبری و شناسایی ظرفیت های توسعه اقتصادی جایگزین در نواحی روستایی (مطالعه موردی: دهستانهای سرکل و زریوار- شهرستان مریوان)

سعدی محمدی*[1]، فریدون احمدی[2]، شوبو کریمی[3]

۱. دانشیار جغرافیا و برنامه‌ریزی روستایی، دانشگاه پیام نور، تهران، ایران
۲. دانشیار مدیریت، دانشگاه پیام نور، تهران، ایران
۳. کارشناسی ارشد جغرافیا و برنامه‌ریزی روستایی، دانشگاه پیام نور ، تهران، ایران

چکیده مبسوط

۱. مقدمه

امنیت پایدار در نواحی مرزی از مهم‌ترین پیش‌نیازهای تحقق توسعه پایدار محسوب می‌شود، زیرا هرگونه اختلال در امنیت این مناطق می‌تواند آثار گسترده‌ای بر ابعاد اقتصادی، اجتماعی، سیاسی و حتی زیست‌محیطی کشور برجای گذارد. نواحی روستایی مرزی به دلیل دوری از مراکز تصمیم‌گیری، ضعف زیرساخت‌ها، محدودیت فرصت‌های شغلی و سرمایه‌گذاری، همواره با چالش‌های توسعه‌ای مواجه بوده‌اند. این شرایط موجب شده است بخشی از جمعیت فعال این مناطق، به‌ویژه جوانان، برای تأمین معیشت خود به فعالیت‌های اقتصاد غیررسمی از جمله کولبری روی آورند. کولبری در سال‌های اخیر به یکی از مهم‌ترین شیوه‌های کسب درآمد در بخش قابل توجهی از روستاهای مرزی غرب کشور، به‌ویژه شهرستان مریوان، تبدیل شده است. اگرچه این فعالیت در کوتاه‌مدت بخشی از نیازهای معیشتی خانوارهای مرزنشین را تأمین می‌کند، اما در بلندمدت پیامدهای نامطلوبی بر امنیت مرزی، توسعه اقتصادی، انسجام اجتماعی و سرمایه‌گذاری در منطقه برجای می‌گذارد. شهرستان مریوان به دلیل همجواری با اقلیم کردستان عراق، یکی از مهم‌ترین کانون‌های فعالیت کولبری در غرب ایران محسوب می‌شود. رونق مبادلات غیررسمی کالا، ضمن تغییر ساختار اشتغال و درآمد روستاییان، موجب کاهش انگیزه سرمایه‌گذاری در بخش‌های مولد، تضعیف فعالیت‌های تولیدی، گسترش اقتصاد واسطه‌ای و افزایش وابستگی معیشتی خانوارها به فعالیت‌های غیررسمی شده است. در چنین شرایطی، مدیریت این پدیده صرفاً از طریق اقدامات انتظامی و انسداد مرزها نه‌تنها به کاهش پایدار آن منجر نمی‌شود، بلکه در صورت نبود فرصت‌های شغلی جایگزین، می‌تواند آسیب‌های اقتصادی و اجتماعی گسترده‌تری برای جوامع محلی ایجاد کند. بر این اساس، پژوهش حاضر با هدف تحلیل پیامدهای امنیتی و توسعه‌ای کولبری، شناسایی عوامل مؤثر بر تداوم آن و تدوین چارچوبی کاربردی برای توسعه فعالیت‌های اقتصادی جایگزین در روستاهای دهستان‌های سرکل و زریوار انجام شده است.

۲. روش تحقیق

این پژوهش از نظر هدف، کاربردی و از لحاظ ماهیت، توصیفی ـ تحلیلی است و با استفاده از رویکرد آمیخته متوالی اکتشافی (کیفی– کمی) انجام شده است. در مرحله نخست، به‌منظور شناخت عمیق ابعاد، علل و پیامدهای کولبری، از روش نظریه داده‌بنیاد و مصاحبه‌های نیمه‌ساختاریافته استفاده شد. مشارکت‌کنندگان به روش نمونه‌گیری هدفمند از میان کولبران روستایی، مدیران و مسئولان توسعه شهرستان، خبرگان علمی و محلی و نیز دهیاران و اعضای شوراهای اسلامی روستاهای مورد مطالعه انتخاب شدند. تحلیل داده‌های کیفی بر اساس مراحل کدگذاری باز، محوری و انتخابی انجام گرفت و در نتیجه، مقوله‌های اصلی، مفاهیم محوری و روابط میان آن‌ها استخراج شد. در بخش کمی، برای ارزیابی و تأیید یافته‌های کیفی، پرسشنامه‌ای محقق‌ساخته تدوین شد. روایی ابزار از طریق نظر متخصصان حوزه توسعه روستایی و جغرافیا و پایایی آن با استفاده از ضریب آلفای کرونباخ مورد سنجش قرار گرفت که مقدار آن برابر با ۸۷/۰ بود و پایایی مطلوب ابزار را نشان داد. داده‌های گردآوری‌شده با استفاده از آزمون همبستگی اسپیرمن تحلیل شدند تا رابطه میان ویژگی‌های جمعیتی، اجتماعی و فضایی روستاها با تداوم پدیده کولبری بررسی شود.

۲. یافته‌های تحقیق

نتایج مرحله کیفی نشان داد که کولبری صرفاً یک فعالیت معیشتی نیست، بلکه به پدیده‌ای چندبعدی تبدیل شده است که پیامدهای

*. نویسندهٔ مسئول:
دکتر سعدی محمدی
آدرس: گروه جغرافیا و برنامه ریزی روستایی، دانشکده حقوق و علوم اجتماعی، دانشگاه پیام نور، تهران، ایران.
پست الکترونیکی: Email: Saadi@pnu.ac.ir

گسترده‌ای بر امنیت پایدار منطقه دارد. بر اساس تحلیل داده‌ها، تعداد ۶۵ مفهوم منفی استخراج شد که در قالب پنج مقوله اصلی شامل ضعف در امنیت سیاسی ـ نظامی، امنیت اقتصادی، امنیت اجتماعی، امنیت محیطی ـ کالبدی و امنیت غذایی طبقه‌بندی شدند. این پیامدها در نهایت موجب شکل‌گیری آسیب‌های بلندمدت امنیتی از جمله افزایش هزینه‌های حفاظت از مرز، کاهش سرمایه اجتماعی، گسترش قانون‌گریزی، افزایش مهاجرت، کاهش سرمایه‌گذاری مولد، تخریب زیرساخت‌ها، افزایش فقر، کاهش امنیت غذایی، کاهش تولیدات محلی و تشدید نابرابری‌های منطقه‌ای می‌شوند.

نتایج تحلیل کمی نشان داد که از میان متغیرهای مورد بررسی، تنها سطح تحصیلات و نسبت جمعیت جوان روستاها دارای رابطه معنادار با تداوم کولبری هستند. به‌گونه‌ای که افزایش سطح تحصیلات با کاهش گرایش به کولبری همراه بوده، در حالی که افزایش سهم جمعیت جوان موجب افزایش احتمال گرایش به این فعالیت شده است. در مقابل، متغیرهایی مانند فاصله از مرز، فاصله از مرکز شهرستان، سن، تأهل و تنوع اقتصادی موجود روستاها رابطه معناداری با تداوم کولبری نشان ندادند. این یافته بیانگر آن است که کولبری در محدوده مورد مطالعه از یک فعالیت محدود فراتر رفته و به بخشی از ساختار اقتصادی و اجتماعی منطقه تبدیل شده است.

در بخش برنامه‌ریزی توسعه اقتصادی، نتایج نشان داد که هر یک از روستاهای مورد مطالعه دارای ظرفیت‌های متفاوتی برای توسعه فعالیت‌های اقتصادی جایگزین هستند. در روستای کلکه‌جان، توسعه دامداری، باغداری انگور دیم، پرورش طیور و مشاغل خدماتی دارای بیشترین اولویت بود. در روستای درزیان، توسعه دامداری، زنبورداری، باغداری، گیاهان دارویی، مشاغل خانگی و صنایع تبدیلی به عنوان مهم‌ترین ظرفیت‌ها شناسایی شد. در روستای بالک، باغداری، دامداری، پرورش ماهی، گردشگری مذهبی و صنایع‌دستی زنان روستایی در اولویت قرار گرفتند. همچنین در روستای سیاناو، توسعه دامداری، زنبورداری، باغداری انگور دیم، کسب‌وکارهای مبتنی بر مشارکت زنان و فعالیت‌های خدماتی مهم‌ترین گزینه‌های اشتغال جایگزین تشخیص داده شدند. این نتایج نشان می‌دهد که توسعه اقتصادی مناطق روستایی مرزی نیازمند برنامه‌هایی متناسب با مزیت‌های نسبی و قابلیت‌های محلی هر روستا است و نمی‌توان برای تمامی روستاها نسخه‌ای واحد ارائه کرد.

۵. بحث و نتیجه‌گیری

یافته‌های پژوهش نشان می‌دهد که کولبری بیش از آنکه یک انتخاب اقتصادی باشد، راهبردی معیشتی در واکنش به ضعف ساختارهای توسعه‌ای، کمبود فرصت‌های اشتغال و نبود تنوع اقتصادی در نواحی روستایی مرزی است. بنابراین، تداوم این پدیده را نمی‌توان صرفاً با سیاست‌های امنیتی و انتظامی کنترل کرد، بلکه کاهش پایدار آن مستلزم پیوند هم‌زمان سیاست‌های امنیتی و توسعه‌ای است. بر این اساس، رویکرد مدیریت مرزها باید از نگرش صرفاً تهدیدمحور به رویکرد امنیت پایدار و توسعه‌محور تغییر یابد.

از مهم‌ترین دستاوردهای پژوهش حاضر، ارائه مدلی سه‌سطحی برای کاهش وابستگی معیشتی به کولبری است. در سطح نخست، توسعه اقتصادی بر پایه ظرفیت‌های بومی هر روستا، از طریق حمایت از دامداری، باغداری، زنبورداری، صنایع‌دستی، گردشگری روستایی، صنایع تبدیلی، مشاغل خانگی و کسب‌وکارهای نوآورانه مورد تأکید قرار گرفته است. در سطح دوم، تقویت سرمایه انسانی و اجتماعی از طریق آموزش‌های مهارتی، توسعه کارآفرینی، افزایش مشارکت جوانان و توانمندسازی اقتصادی زنان روستایی پیشنهاد می‌شود. در سطح سوم نیز توسعه زیرساخت‌های خدماتی، تقویت بازارچه‌های رسمی مرزی، حمایت از تعاونی‌های محلی، تسهیل سرمایه‌گذاری بخش خصوصی، بهبود هماهنگی میان نهادهای توسعه‌ای و امنیتی و بهره‌گیری از فناوری‌های نوین مدیریت مرزها به‌عنوان راهبردهای مکمل مطرح شده‌اند.

کلیدواژه‌ها: کولبری، امنیت مرزی، ظرفیت های توسعه‌ای، نواحی روستایی شهرستان مریوان.

تشکر و قدردانی

نویسندگان مراتب سپاس و قدردانی خود را از تمامی کولبران پاسخ دهنده، خبرگان، کارشناسان و افراد شرکت‌کننده در این پژوهش ابراز می‌دارند. همچنین از همکاری و حمایت نهادها، سازمان‌ها و مؤسسات مرتبط، صمیمانه تشکر و قدردانی می‌شود. و در نهایت از داوران ارجمند و سردبیر محترم نشریه که با یادآوری نکات ارزشمند به بهبود کیفیت مقاله، کمک نمودند، سپاسگزاریم.

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Original Article

Ranking the Drivers of Agricultural Machinery Maintenance Costs and Their Impacts on Rural Economic Sustainability in Western Iran

Khalil Jaidari[1], Sadegh Feizollahi[*2], Alireza Irajpour[3]
1- Ph.D. Candidate in Industrial Management, Qa, C., Islamic Azad University, Qazvin, Iran.
2- Assistant Prof. in Industrial Management, Il, C., Islamic Azad University, Ilam, Iran.
3- Assistant Prof. in Industrial Management, Qa, C., Islamic Azad University, Qazvin, Iran.

Abstract
Purpose- This study aims to identify and rank the key drivers affecting agricultural machinery maintenance and repair costs and to examine their implications for strengthening the economic sustainability of rural areas in western Iran.
Design/methodology/approach- This study employs a mixed-methods research design integrating qualitative and quantitative approaches. In the qualitative phase, a systematic literature review and semi-structured interviews with 24 agricultural mechanization experts were conducted to identify and validate the main factors influencing maintenance and repair costs. In the quantitative phase, real maintenance records of 80 agricultural machines operating in the provinces of Kermanshah, Ilam, and Kurdistan were collected over a three-year period, resulting in 240 machine-year observations. The Extreme Gradient Boosting (XGBoost) algorithm was then applied to model the relationship between explanatory variables and maintenance costs and to rank the relative importance of factors based on the Gain criterion.
Findings- The findings demonstrate that maintenance and repair costs are influenced by the simultaneous interaction of technical, managerial, operational, human, and environmental factors. The XGBoost model achieved satisfactory predictive performance on the testing dataset, with an R^2 value of 0.86, RMSE of 39.4 million IRR, and MAE of 28.7 million IRR. The feature importance analysis revealed that machine age (18.9%), lack of preventive maintenance implementation (17.2%), and unfavorable operating conditions (15.1%) were the three most influential determinants of maintenance and repair costs, jointly accounting for more than half of the model's total importance. These findings indicate that machinery aging, insufficient maintenance planning, and improper operating practices represent the primary sources of increased maintenance expenditures. Furthermore, the results demonstrate that effective preventive maintenance programs, improved maintenance management systems, optimized spare parts management, and enhanced operator practices can reduce life-cycle machinery costs and contribute to rural economic sustainability.
Research limitations/implications- This study is limited by the geographical scope of the investigated provinces and the availability of historical maintenance records from agricultural machinery. Future research may expand the analysis to other regions and incorporate larger longitudinal datasets, economic variables, and advanced predictive approaches to further improve the understanding of machinery maintenance cost dynamics.
Originality/value- This study contributes to the agricultural mechanization and rural sustainability literature by integrating expert-based knowledge, real machine-year maintenance records, and machine-learning techniques within a unified analytical framework. Unlike previous studies that mainly relied on conventional statistical methods or examined individual factors separately, this research applies the XGBoost algorithm to quantify the relative importance of maintenance cost drivers and links machinery maintenance management with rural economic sustainability.
Keywords: Agricultural machinery, Maintenance and repair costs, XGBoost algorithm, Economic sustainability, Rural development, Agricultural mechanization.

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Corresponding Author:
Feizollahi, Sadegh, Ph.D.
Address: Department of Industrial Management, Qa, C., Islamic Azad University, Qazvin, Iran.
Tel: +989182624788
Email: Sadegh.feizollahi@iau.ac.ir

1. Introduction

Sustainable rural development has become a major global priority because of its critical role in ensuring food security, reducing rural poverty, and improving the quality of life in agricultural communities (Falchetta et al., 2024: 418). Since agriculture remains the principal economic activity in many rural regions, its productivity and efficiency directly influence rural economic sustainability (Yang et al., 2025: 396). Accordingly, improving agricultural productivity while reducing production costs has become an essential requirement for sustainable rural development (Rana et al., 2025: 3). Agricultural mechanization has contributed substantially to this objective by increasing operational efficiency, improving resource utilization, reducing labor requirements, and enhancing farm productivity (Salvati et al., 2025: 118). As a result, agricultural machinery represents one of the most valuable productive assets in modern farming systems and plays a crucial role in improving farmers' income and sustaining rural economies (He et al., 2025: 203).

Despite these benefits, maintenance and repair (M&R) of agricultural machinery remain major challenges for farmers and agricultural managers (Leslie, 2023: 9). Machinery reliability and operational efficiency depend heavily on effective maintenance practices, whereas inadequate maintenance increases equipment failures, production costs, and operational interruptions while reducing agricultural productivity (Shen et al., 2025: 222). In contrast, preventive and predictive maintenance programs improve machinery reliability, extend service life, minimize downtime, and reduce long-term maintenance expenditures (Soleimani et al., 2025: 441).

The importance of efficient maintenance management is particularly evident in Iran, where a considerable proportion of the agricultural machinery fleet is aging and operates under demanding field conditions (Karimikia & Mohammadi, 2025: 80). Rising machinery and spare-parts prices, limited access to specialized maintenance services, and increasing production costs have substantially increased maintenance expenditures for agricultural producers (Yousefi Taleghani et al., 2022: 167). Financial constraints frequently force farmers to postpone preventive maintenance and major repairs, leading to more frequent equipment failures, shorter machinery service life, and higher long-term repair costs (Pakzat & Rezvani, 2025: 266). Consequently, increasing maintenance expenditures reduce farm profitability, limit reinvestment opportunities, and weaken the economic sustainability of rural households (Seifollahi, 2026: 119).

Maintenance and repair costs constitute a substantial share of machinery operating expenses, including expenditures on spare parts, labor, servicing, repairs, machinery downtime, and indirect production losses (Wu et al., 2023: 512). Therefore, identifying the factors responsible for increasing maintenance costs has become an important scientific and managerial priority for improving machinery performance, enhancing agricultural productivity, and strengthening the long-term economic sustainability of rural communities (Rizzo et al., 2025: 348)

Despite the recognized importance of maintenance and repair (M&R) costs, decision-makers still face a fundamental challenge: determining which factors contribute most to increasing these costs and therefore deserve the highest managerial priority. In practice, agricultural machinery maintenance is influenced by numerous technical, managerial, operational, human, and environmental variables that interact simultaneously. However, because these factors rarely operate independently, identifying their relative contributions remains difficult. As a result, maintenance planning and investment decisions are often based on experience rather than objective evidence, leading to inefficient allocation of financial resources and higher machinery life-cycle costs. This problem is particularly important in western Iran, where aging machinery, limited financial resources, and increasing maintenance expenditures directly threaten the economic sustainability of rural production systems. Therefore, developing an evidence-based approach capable of identifying and ranking the principal drivers of maintenance and repair costs represents the central research problem addressed in this study.

Previous studies have shown that agricultural machinery maintenance and repair (M&R) costs are affected by a combination of technical, managerial, operational, and human factors.

Machinery age, operating conditions, equipment utilization, preventive maintenance implementation, spare-parts availability, operator skills, maintenance planning, and the adoption of modern maintenance technologies have consistently been identified as important determinants of maintenance performance (Karami & Khalilian, 2026; Takeshima, 2025; Fromjan, 2025; Martinez-Monro et al., 2024). More recent studies have further emphasized the contribution of maintenance management to agricultural productivity and economic performance. For example, Kedir Busse et al. (2026) demonstrated that machinery aging substantially increases repair costs and reduces operational efficiency, while Soltanali and Khojastehpour (2023) highlighted the importance of preventive maintenance, maintenance planning, and organizational support in improving maintenance performance. Likewise, Shen et al. (2025), Soleimani et al. (2025), Wang et al. (2024), and Hertwich et al. (2025) emphasized the growing role of intelligent technologies, data-driven maintenance, and advanced mechanization in improving equipment efficiency and supporting sustainable agricultural development.

Despite these valuable contributions, several important limitations remain. Most previous studies have examined technical, managerial, or operational factors separately, providing only a fragmented understanding of the mechanisms driving maintenance costs. In addition, conventional statistical techniques have been the dominant analytical approach, limiting the ability to capture complex nonlinear interactions among multiple influencing factors. Consequently, although the existing literature has identified numerous determinants of maintenance costs, it has provided limited evidence regarding their relative importance and their combined contribution to maintenance cost variation. Despite these valuable contributions, several important research gaps remain. First, previous studies have primarily relied on conventional statistical techniques or descriptive analyses, and no study has employed the Extreme Gradient Boosting (XGBoost) algorithm to rank the relative importance of the factors affecting agricultural machinery maintenance and repair costs. Second, although maintenance costs have been widely investigated from technical and engineering perspectives, their implications for the economic sustainability of rural areas have received little direct attention, and no previous research has explicitly linked maintenance cost drivers with rural economic sustainability within an integrated analytical framework. Third, most existing studies have relied on cross-sectional surveys, expert opinions, or experimental observations, whereas evidence based on real machine-year maintenance records remains largely absent. Consequently, there is still a lack of empirical studies that combine actual longitudinal machinery data with advanced machine-learning techniques to identify and prioritize the determinants of maintenance and repair costs. The present study addresses these gaps by integrating qualitative and quantitative evidence, employing real machine-year observations from agricultural machinery operating in western Iran, and applying the XGBoost algorithm to rank the key drivers of maintenance and repair costs while examining their implications for rural economic sustainability.

Recent advances in artificial intelligence and machine learning have created new opportunities for modelling complex agricultural systems. Among the available techniques, the Extreme Gradient Boosting (XGBoost) algorithm has become one of the most powerful predictive tools because of its high accuracy, ability to model nonlinear relationships, robustness in handling complex datasets, and capability to quantify the relative importance of explanatory variables (Khajeh et al., 2025: 39). These characteristics make XGBoost particularly suitable for identifying and prioritizing the principal drivers of agricultural machinery maintenance and repair costs while providing more reliable evidence for maintenance planning and managerial decision-making.

Against this background, the present study aims to identify and rank the factors affecting agricultural machinery maintenance and repair (M&R) costs using the Extreme Gradient Boosting (XGBoost) algorithm and to examine how these factors influence the economic sustainability of rural areas in western Iran. The study is based on real machine-year observations collected from agricultural machinery operating in the provinces of Kermanshah, Ilam, and Kurdistan, providing empirical evidence from actual maintenance records rather than experimental or perception-based data. By integrating qualitative findings,

conventional statistical analyses, and machine-learning techniques within a unified analytical framework, this research offers a more comprehensive understanding of the determinants of maintenance and repair costs than has previously been available.

Accordingly, the study addresses the following research question: Which technical, managerial, operational, human, and environmental factors exert the greatest influence on agricultural machinery maintenance and repair costs, and what is the relative importance of each factor in explaining cost variation? Answering this question not only identifies the principal cost drivers but also provides a scientific basis for prioritizing maintenance interventions and allocating resources more effectively. Such evidence is expected to support the design of preventive maintenance strategies, optimize machinery replacement decisions, improve spare-parts management, strengthen the implementation of Computerized Maintenance Management Systems (CMMS), and ultimately reduce machinery life-cycle costs. Beyond its methodological contribution, this study has important practical implications. Reducing maintenance and repair costs can improve machinery availability, increase farm profitability, enhance farmers' capacity for reinvestment, and strengthen the resilience of agricultural production systems. These improvements contribute directly to the economic sustainability of rural communities by increasing production efficiency and supporting the long-term competitiveness of the agricultural sector. Therefore, the findings of this study provide valuable evidence for agricultural managers, extension organizations, and policymakers seeking to improve maintenance management practices and promote sustainable rural development in western Iran

2.Research Theoretical Literature

2.1. Asset Life Cycle Theory

Asset Life Cycle Theory is one of the fundamental frameworks in asset management and maintenance engineering. It is based on the premise that every industrial asset progresses through a series of identifiable stages throughout its lifetime, including design, procurement, installation, operation, maintenance, upgrading, and ultimately retirement or replacement (Freiberger et al., 2025: 201). The theory emphasizes that decisions made at each stage of the asset life cycle influence not only the technical performance of the equipment but also its total life-cycle cost (Weiss et al., 2024: 679). From this perspective, focusing solely on the initial acquisition cost often results in suboptimal decision-making because the majority of an asset's actual costs are incurred during its operation and maintenance phases (Wang et al., 2023: 446).

One of the leading scholars in this field is Andrew K. S. Jardine, whose life-cycle maintenance theory argues that maintenance strategies should be tailored to the specific stage of an asset's life cycle. According to Jardine, maintenance efforts during the early stages of an asset's life should emphasize condition monitoring and the prevention of premature failures, whereas decisions concerning refurbishment or replacement become increasingly important as the asset approaches the end of its useful life. His theory highlights the critical role of operational performance data in reducing life-cycle costs and extending the effective service life of physical assets (Jardine, 2023: 50-52).

Another prominent contributor is B. S. Dhillon, who expanded the concept of Life Cycle Engineering by emphasizing the integration of technical, economic, and managerial decisions throughout the entire life span of engineering assets (Dhillon, 2022: 69-70). Dhillon argues that maintenance and repair costs are determined by the combined effects of initial design, operating conditions, and maintenance management policies. He further maintains that scientifically informed interventions during the early stages of the asset life cycle can substantially reduce future maintenance expenditures. From his perspective, life-cycle asset management serves as a strategic approach to improving system reliability while minimizing long-term organizational costs (ibid: 87-88).

Overall, Asset Life Cycle Theory provides a comprehensive analytical framework for systematically examining the relationships among equipment characteristics, maintenance decisions, and repair costs over the entire service life of industrial assets.

2.2. Reliability and Maintainability Theory

Reliability and Maintainability Theory constitutes one of the principal theoretical foundations of systems engineering and maintenance management. The theory focuses on analyzing equipment failure behavior and its consequences for system performance and organizational costs.

Reliability refers to the probability that a component or system will perform its intended function under specified operating conditions for a defined period of time, whereas maintainability denotes the ease, speed, and effectiveness with which maintenance activities can restore the system to an operational state (Pilanawithana et al., 2024: 23-24). The theory assumes that increases in failure rates, equipment downtime, and maintenance complexity directly contribute to higher maintenance and repair costs (Marugan, 2023: 177).

One of the most influential scholars in this field is John Moubray, who introduced the Reliability-Centered Maintenance (RCM) framework and fundamentally transformed maintenance management practices. Moubray argued that not all equipment requires the same level of maintenance and that maintenance strategies should be designed according to the consequences of failure, operational risk, and the functional importance of equipment. Reliability-Centered Maintenance emphasizes identifying failure modes, analyzing the consequences of failures, and selecting the most appropriate maintenance policies with the objective of minimizing critical failures while effectively controlling maintenance costs (Moubray, 2023: 21-24).

Another notable contributor is Marvin Rausand, whose work on system reliability analysis and risk engineering has significantly advanced the field. By developing probabilistic reliability models, Rausand demonstrated how failure rates, mean time between failures, and repair times can be quantitatively modeled. He argues that reliability analysis is not only essential for improving system safety but also serves as an effective tool for predicting and controlling maintenance and repair costs (Rausand, 2023: 55-58). Within this theoretical framework, variables such as equipment age, operating conditions, the quality of preventive maintenance, workforce competency, and the implementation of computerized maintenance management systems (CMMS) are recognized as key determinants of maintenance and repair costs (Zaccarine et al., 2024: 381).

In summary, Reliability and Maintainability Theory provides a robust scientific foundation for understanding the relationship between equipment failures and maintenance expenditures.

In the present study, Asset Life Cycle Theory serves as the primary framework for analyzing the effects of the structural and temporal characteristics of agricultural machinery particularly equipment age and operational life stage on maintenance and repair costs. Reliability and Maintainability Theory, in turn, provides the conceptual basis for explaining how failure rates, operating conditions, preventive maintenance quality, and the effectiveness of maintenance support systems influence maintenance expenditures. The integration of these complementary theoretical perspectives enables a more comprehensive understanding of the interactions between the technical and operational characteristics of agricultural machinery and their economic consequences for rural producers. Finally, this theoretical framework is complemented by a machine learning approach based on the Extreme Gradient Boosting (XGBoost) algorithm, enabling a data-driven identification and prioritization of the factors influencing the economic sustainability of rural areas.

2.3. Empirical Literature Review

Kedir Busse et al. (2026), in a study entitled Evaluation and Optimization of Agricultural Machinery Management System Costs in the Arjo Didessa Sugar Factory, reported that among the inactive machines, 49% required minor repairs, while 14% were beyond repair and should be permanently removed from service. The predicted work rate exceeded the actual work rate by 35.33%. Among the agricultural operations examined, land clearing exhibited the smallest deviation from the actual work rate (5.73%), whereas row planting showed the largest deviation (67.21%). Although initial repair costs were relatively low, maintenance expenditures increased substantially as machinery aged. The optimization model implemented during the 2021–2022 cropping season reduced overall operating costs by 10.60%, highlighting the importance of accurately estimating actual machinery work rates and conducting performance analyses to improve operational efficiency. Karimikia and Mohammadi (2025), in their study entitled Identification and Ranking of Agricultural Machinery Productivity Indicators in the Horticultural and Crop Production Sectors of Chaharmahal and Bakhtiari Province, found that the most influential factor affecting

agricultural machinery productivity was machinery design and its compatibility with cultivated land conditions. This was followed by optimal management and planning as the second most influential indicator. Among the six identified sub-criteria, operational performance (approximately 38%), suitability to local needs and conditions (15%), and machinery efficiency (14%) ranked first, second, and third, respectively. Within the second group of indicators, machinery efficiency (14%), proper machinery utilization (11.5%), and financial resource provision (7.8%) were identified as the most significant determinants. Karami & Khalilian (2025), in their study examining the impact of investment in agricultural machinery on the value added of Iran's agricultural sector, concluded that investment in agricultural machinery and equipment has a significant positive effect on agricultural production. Their findings indicate that increasing investment in mechanization directly contributes to higher agricultural output. Soltanali and Khojastehpour (2023), in a study on identifying and prioritizing the factors influencing effective maintenance management in agro-industrial enterprises, found that organizational management, human factors, and structural factors were the three most important dimensions of maintenance management. Furthermore, based on the Best–Worst Method (BWM), the sub-criteria top management support, allocation of maintenance budgets and optimized inventory management, and adoption of appropriate maintenance strategies received the highest overall weights of 0.108, 0.075, and 0.067, respectively. Shen et al. (2025), in their study entitled Cost–Benefit Analysis of Remanufacturing Used Agricultural Machinery Components in China and Its Implications for Agricultural Economic Prosperity, concluded that remanufacturing agricultural machinery components can substantially reduce production costs while improving productivity and farm profitability. Given the dependence of many rural regions in China on mechanized agriculture, expanding the remanufacturing industry can strengthen rural economies and create new employment opportunities in equipment maintenance and refurbishment. Consequently, remanufacturing represents not only an economically and environmentally sustainable strategy but also an effective instrument for promoting sustainable agricultural development and reducing regional economic disparities. Soleimani et al. (2025), in a systematic review entitled Artificial Intelligence in Agricultural Machinery and Robotics: A Systematic Review and Future Perspectives, concluded that artificial intelligence (AI) and machine learning significantly enhance the performance of agricultural machinery and intelligent robotic systems, particularly in the areas of detection, navigation, decision-making, and structural optimization. These technological improvements increase agricultural productivity, reduce production costs, enhance farmers' incomes, and strengthen rural agricultural value chains. The authors further argued that the continued adoption of intelligent mechanization technologies is expected to promote rural economic development by creating new employment opportunities in the maintenance, management, and operation of advanced agricultural systems while reducing dependence on traditional labor. Hertwich et al. (2025), in their critical assessment of the climate and resource-related costs and benefits of agricultural machinery and equipment in Southeastern European countries, concluded that agricultural mechanization should increasingly focus on improving machinery utilization efficiency, reducing resource consumption, and promoting low-carbon technologies in order to enhance rural economic performance while ensuring the sustainability of agricultural production systems. Wang et al. (2024), in their investigation of the impact of modern agricultural machinery on agricultural economic development in eastern China, found that modern mechanization significantly improves machinery performance in uneven and sloping agricultural lands. Through higher operational efficiency, reduced labor dependence, and greater precision in agricultural operations, modern machinery contributes to improved production systems, particularly in rural and mountainous regions.

Overall, the reviewed studies provide valuable evidence regarding agricultural mechanization, machinery productivity, maintenance management, artificial intelligence applications, and the economic benefits of improved machinery utilization. However, several important limitations can be identified. First, most previous studies have examined only one dimension of the problem, such

as machinery productivity, maintenance management, investment in mechanization, or intelligent technologies, without providing an integrated assessment of the factors affecting agricultural machinery maintenance and repair costs. Second, although several studies have prioritized maintenance-related factors using multi-criteria decision-making methods or conventional statistical techniques, these approaches are generally limited in capturing complex nonlinear relationships and interactions among multiple technical, managerial, operational, and environmental variables. Third, recent research on artificial intelligence has mainly focused on autonomous machinery, robotics, and precision agriculture rather than on identifying and ranking the determinants of maintenance and repair costs. Furthermore, although some studies have discussed the contribution of mechanization to rural economic development, they have not explicitly examined how maintenance cost drivers influence rural economic sustainability. These limitations indicate the need for a comprehensive analytical framework capable of integrating qualitative knowledge with real operational data while employing advanced machine-learning techniques to identify and prioritize the principal drivers of agricultural machinery maintenance and repair costs. The present study addresses these limitations by combining qualitative expert knowledge with real machine-year observations from agricultural machinery operating in western Iran and applying the XGBoost algorithm to rank the relative importance of the factors influencing maintenance and repair costs and to explain their implications for rural economic sustainability.

3. Research Methodology

3.1 Geographical Scope of the Research

The study area includes three western provinces of Iran, namely Kermanshah, Ilam, and Kurdistan, which were selected due to the considerable contribution of agriculture to rural livelihoods and the extensive use of agricultural machinery in crop and livestock production systems. These provinces represent important agricultural regions characterized by diverse climatic conditions, varying topographic features, and a wide range of machinery utilization patterns. The geographical location of the study area is presented in Figure X. The map was prepared using Geographic Information System (GIS) techniques to accurately illustrate the spatial distribution of the investigated provinces within western Iran (Figure 1).

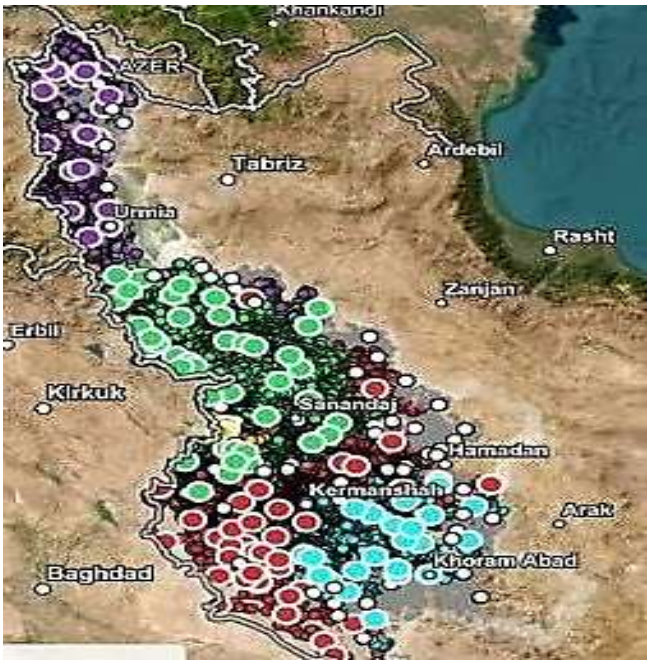


Figure 1. Location map of the study area (Kermanshah, Ilam, and Kurdistan provinces in western Iran)

3.2. Methodology

The present study is applied in terms of its objective and descriptive–survey in terms of its

research design. It adopts a mixed-methods (qualitative–quantitative) approach to identify the factors affecting agricultural machinery maintenance and repair costs, determine their relative importance, and examine their implications for the economic sustainability of rural areas in western Iran. The geographical scope of the study includes rural areas located in the three western provinces of Kermanshah, Ilam, and Kurdistan, which represent important agricultural regions with a considerable dependence on agricultural machinery for crop production activities. The selection of these provinces was based on their significant agricultural potential, extensive use of mechanized farming systems, and the challenges associated with machinery aging, maintenance management, and increasing repair costs. By focusing on these regions, the study aims to provide an empirical assessment of the factors influencing agricultural machinery maintenance and repair costs under real operating conditions in western Iran.

3.3. Qualitative Phase

The qualitative phase began with a systematic literature review to identify the initial set of factors influencing agricultural machinery maintenance and repair costs. Relevant scientific sources including peer-reviewed journal articles, scholarly books, and technical reports related to maintenance management, equipment reliability, and agricultural mechanization were comprehensively reviewed. The outcome of this stage was the development of a preliminary conceptual framework of the determinants of maintenance and repair costs.

To contextualize and refine these factors, semi-structured interviews were subsequently conducted with 24 experts in agricultural mechanization. Participants were selected through purposive sampling based on their professional experience in agricultural machinery operation and maintenance, expertise in agricultural mechanization, and relevant occupational background. Interviews continued until theoretical saturation was achieved. The collected qualitative data were analyzed using thematic analysis, allowing the identification of the principal themes and the relationships among them.

Following thematic analysis, the extracted qualitative concepts were transformed into measurable quantitative variables through a structured coding procedure. Each identified theme was operationalized as a measurable indicator suitable for inclusion in the quantitative model. Coding followed a combined inductive and literature-driven approach: initial codes were generated from the interview data and subsequently refined by comparison with the findings of the systematic literature review.

Each identified factor was then assigned an appropriate numerical measurement scale. Most variables were measured using five-point Likert scales (ranging from *very low* to *very high*), while others were represented by objective operational indicators extracted from machinery records, including annual operating hours, number of equipment failures, and maintenance delay duration. To improve coding accuracy, the qualitative-to-quantitative transformation process was reviewed iteratively, and inconsistencies were resolved before constructing the final dataset. The resulting coded dataset served as the input for the XGBoost machine learning model.

To enhance the trustworthiness of the qualitative findings, several quality assurance procedures were implemented. First, the interview coding process was conducted in multiple iterative rounds to ensure coding consistency and reliability. Second, member checking was employed by providing summaries of the extracted themes to selected interview participants, whose feedback was incorporated into the final thematic structure. Furthermore, to minimize researcher bias and improve coding reliability, a subset of the qualitative data was independently coded by two researchers, and the level of inter-coder agreement was assessed. The results indicated an acceptable degree of agreement, confirming the consistency of the coding process. Finally, all stages of qualitative analysis—including code generation, theme development, and integration with interview documentation—were fully documented to enhance the confirmability and auditability of the research process.

3.4. Quantitative Phase

The quantitative phase focused on agricultural machinery operating in farms located in western Iran. Maintenance and repair cost data were collected from maintenance records, financial documents of agricultural enterprises, and machinery operation logs. These records contained actual information regarding maintenance

expenditures, equipment failures, repair activities, and preventive maintenance operations. After data cleaning and integration, the dataset was used for statistical analysis and predictive modeling.

Using purposive sampling, 80 agricultural machines with complete maintenance records covering a three-year period were selected. The unit of analysis was defined as the machine-year. Accordingly, annual observations were recorded for each machine over three consecutive years, yielding a total of 240 observations for statistical analysis.

Descriptive statistics were initially employed to summarize the characteristics of the study variables. Pearson's correlation coefficient was then calculated to examine preliminary linear relationships among the quantitative variables. Finally, the Extreme Gradient Boosting (XGBoost) algorithm was implemented in the Python programming environment to identify and rank the determinants of maintenance and repair costs. Variable importance was evaluated using the Gain importance metric, which was subsequently used to establish the final ranking of explanatory variables.

To clarify the analytical framework, Table 1 presents the study variables together with their operational definitions and measurement scales. The variables comprise technical, managerial, and operational factors affecting agricultural machinery maintenance and repair costs. These variables were identified during the qualitative phase and the systematic literature review before being converted into quantitative indicators suitable for statistical modeling.

Table 1. Independent and dependent variables and their measurement methods

Variable Type	Variable	Description	Measurement Indicator	Scale
Dependent	Maintenance and repair costs	Total annual maintenance and repair expenditure per machine-year	Total maintenance expenditures recorded in financial and operational documents	Continuous (Monetary)
Technical	Machinery age	Operational age of machinery since purchase	Years elapsed since purchase	Ratio
Technical	Operating conditions	Intensity and type of machinery operation	Composite index based on soil type, terrain slope, and operating hours (normalized to a 1–5 scale)	Ordinal (Likert/Index)
Technical	Annual operating hours	Annual machinery utilization	Recorded operating hours	Ratio
Technical	Preventive maintenance implementation	Compliance with scheduled preventive maintenance	0 = Not implemented; 1 = Fully implemented (or implementation percentage)	Binary
Managerial	Spare parts procurement time	Average time required to obtain replacement parts	Mean number of days required to procure spare parts following equipment failure	Ratio
Managerial	CMMS utilization	Extent of computerized maintenance management system usage	Composite score (1–5)	Ordinal
Operational	Operator skill	Competency level of machinery operator	Experience score (years of experience or expert rating, 1–5)	Ordinal
Operational	Environmental working conditions	Physical environmental conditions affecting machinery operation	Composite normalized index including humidity, dust, and temperature	Ordinal/Index

It should be noted that the dataset employed in this study has a **panel-data structure** at the machine-year level. Maintenance performance and repair costs were recorded annually for each machine over a three-year period. This panel structure enables simultaneous analysis of temporal variations and cross-sectional differences among machines, thereby improving the robustness and explanatory power of the empirical analysis.

3.5. XGBoost Model Development and Implementation

To identify and prioritize the factors affecting agricultural machinery maintenance and repair costs, the Extreme Gradient Boosting (XGBoost)

algorithm was employed as an ensemble learning technique based on decision trees. Prior to model training, the dataset was examined for missing values, inconsistencies, and recording errors, all of which were corrected during the preprocessing stage. Categorical variables were encoded into numerical representations to ensure compatibility with the machine learning algorithm. These preprocessing procedures were undertaken to improve predictive accuracy and minimize potential sources of bias.

The final dataset, consisting of 240 machine-year observations, was randomly divided into training (80%) and testing (20%) subsets. Model hyperparameters were selected to achieve an appropriate balance between predictive performance and overfitting prevention. The relative importance of each predictor was subsequently computed using the Gain metric, which measures the contribution of each variable to reducing the model's prediction error during tree construction.

To evaluate the predictive performance of the XGBoost model, three widely used regression performance metrics were employed: the coefficient of determination (R^2), Mean Absolute Error (MAE), and Root Mean Square Error (RMSE). The coefficient of determination (R^2) measures the proportion of variance in the dependent variable explained by the model, with values closer to one indicating superior explanatory performance. RMSE quantifies prediction error on the original measurement scale while assigning greater weight to large errors. In contrast, MAE represents the average magnitude of prediction errors and is generally more robust to outliers. The combined use of these three evaluation metrics provides a comprehensive assessment of model accuracy, stability, and sensitivity to prediction errors, thereby enhancing confidence in the model's predictive capability.

Table 2. Hyperparameter settings of the XGBoost model

Parameter	Value	Rationale
Objective	Regression	Continuous prediction of maintenance and repair costs
n_estimators	300	Balance between predictive accuracy and model stability
max_depth	4	Prevent excessive model complexity
learning_rate	0.05	Gradual learning to reduce overfitting
subsample	0.80	Improve model generalization
colsample_bytree	0.80	Reduce correlation among trees
min_child_weight	2	Prevent unnecessary tree branching
random_state	42	Ensure reproducibility
Feature importance metric	Gain	Rank influential variables

As shown in Table 2, the model hyperparameters were selected to maximize predictive performance while minimizing the risk of overfitting. Because the dependent variable maintenance and repair costs is continuous, the regression objective function was adopted. Furthermore, the Gain metric was selected as the criterion for feature importance because it quantifies the contribution of each predictor to reducing prediction error during the construction of decision trees, making it particularly suitable for interpreting the relative importance of explanatory variables in applied research.

4. Research Findings

4.1. Initial Identification of Factors Affecting Maintenance and Repair Costs

The identification of the factors influencing agricultural machinery maintenance and repair costs was conducted systematically through two complementary phases. The primary objective of this stage was to establish a reliable conceptual framework that would serve as the foundation for the subsequent qualitative analysis and quantitative modeling.

In the first phase, a systematic literature review was conducted, through which 47 preliminary factors were identified across four major domains: technical, managerial, human, and environmental/operational. These factors were extracted from internationally recognized studies in the fields of reliability engineering, maintenance management, agricultural mechanization systems, and life-cycle cost analysis (Table 3).

Table 3. Classification of the Initial Factors Identified from the Literature

Domain	Number of Initial Factors	Representative Factors
Technical–Equipment	16	Equipment age, machinery deterioration, component failures, technical complexity
Managerial	12	Lack of a computerized maintenance management system (CMMS), inadequate preventive maintenance (PM) planning, inefficient spare parts management
Human	9	Operator errors, shortage of skilled personnel, inadequate training
Environmental–Operational	10	Soil conditions, climatic conditions, workload intensity, dust exposure

The outcome of this phase was the development of a preliminary conceptual framework comprising 47 variables, indicating that maintenance and repair costs are influenced by a multidimensional set of factors, including the physical condition of machinery, the quality of maintenance management, farm operating conditions, and environmental and operational characteristics.

The second phase focused on refining and contextualizing the identified factors to reflect the conditions of western Iran. Following the literature review, the preliminary framework entered the qualitative stage of the research. As described in the methodology section, 24 agricultural mechanization experts were selected through purposive sampling and participated in semi-structured interviews. Thematic analysis was subsequently employed to eliminate overlapping concepts, merge conceptually similar factors, and remove variables that could not be measured reliably. As a result, the number of factors was reduced from 47 initial variables to 21 refined factors.

Considering the limitations of the quantitative dataset (240 machine-year observations), only variables that satisfied three criteria were retained for the quantitative analysis: (1) measurability, (2) availability of reliable empirical data, and (3) compatibility with the XGBoost machine learning algorithm. Consequently, 13 final variables were selected to serve as the basis for all subsequent statistical analyses and machine learning modeling (Table 4).

Table 4. Summary of the Variable Reduction Process

Stage	Number of Variables	Description
Systematic literature review	47	Initial identification of factors from the global literature
Qualitative expert analysis	21	Contextualization and refinement through thematic analysis
Variable selection for modeling	13	Measurable variables supported by empirical data
XGBoost implementation	13	Final variables analyzed using 240 machine-year observations

The findings of this stage demonstrate that the identification of the determinants of agricultural machinery maintenance and repair costs followed a rigorous, multi-stage, and data-driven process. The final outcome was a set of refined and measurable variables that were not only grounded in established theoretical and empirical literature but also closely reflected the actual operating conditions of agricultural machinery in western Iran. These variables constituted the analytical foundation for the subsequent statistical analyses and machine learning modeling

4.2. Results of the Qualitative Analysis (Expert Interviews)

Following the extraction of the initial factors through the systematic literature review, the second phase of the study was conducted with the aim of localizing, refining, and completing the factors affecting the maintenance and repair costs of agricultural machinery. In this phase, semi-structured interviews were conducted with 24 experts in the field of agricultural mechanization, including university faculty members, mechanization managers, maintenance and repair specialists, and experienced agricultural machinery operators. A purposive sampling method was employed, and the inclusion criteria for selecting the experts included at least 15 years of professional experience, practical expertise in the

operation and maintenance of agricultural machinery, and familiarity with agricultural mechanization issues. The interview process continued until theoretical saturation was achieved; specifically, no new codes emerged after the twenty-second interview, while the final two interviews were conducted solely to confirm and validate the identified themes (Table 5).

Table 5. Demographic Characteristics of the Experts

Indicator	Category	Frequency	Percentage
Gender	Male	19	79.2
	Female	5	20.8
Education	Master's degree	4	16.7
	Ph.D.	20	83.3
Work Experience	15–20 years	10	41.7
	21–25 years	9	37.5
	More than 26 years	5	20.8
Field of Expertise	Agricultural Mechanization	8	33.3
	Maintenance and Repair Management	6	25.0
	Mechanical Engineering / Equipment	5	20.8
	Agricultural Machinery Operation	3	12.5
	Data Analytics and Decision Support Systems	2	8.4

The interview data were analyzed using thematic analysis through three sequential stages: open coding, axial coding, and selective coding. During this process, the complete interview transcripts were first transcribed and reviewed several times. Initial codes were then extracted and grouped according to conceptual similarities into subcategories, which were subsequently integrated into broader overarching themes.

Table 6. Stages of Thematic Analysis and Their Outputs

Analysis Stage	Description	Output
Open Coding	Extraction of initial concepts from interview transcripts	128 initial codes
Axial Coding	Merging similar codes and forming subcategories	18 subcategories
Selective Coding	Integrating subcategories and identifying overarching themes	4 main themes

As shown in Table 6, a total of 128 initial codes were identified from the interview transcripts. After eliminating duplicate items and merging conceptually overlapping codes, 18 subcategories were extracted and ultimately organized into four main themes. These themes formed the conceptual framework of the factors influencing the maintenance and repair costs of agricultural machinery and served as the basis for deriving the quantitative variables used in the subsequent stage of the study.

Frequency of the Extracted Themes- To illustrate the recurrence and relative importance of each theme identified in the interviews, the frequency of codes assigned to each main theme was calculated.

Table 7. Frequency of Themes Extracted from Expert Interviews

Main Theme	Number of Subcategories	Number of Assigned Codes	Percentage of Total Codes (%)
Managerial	5	39	30.5
Technical–Equipment	5	36	28.1
Human	4	27	21.1
Economic–Environmental	4	26	20.3
Total	18	128	100.0

The results presented in Table 7 indicate that the largest proportion of the extracted data was associated with managerial factors (30.5%) and technical–equipment factors (28.1%). This finding suggests that the experts primarily attributed the increase in maintenance and repair costs to deficiencies in machinery life-

cycle management and the technical condition of the machinery fleet (Table 8 & 9).

Table 8. Final Structure of the Thematic Analysis

Main Theme	Subcategory	Examples of Initial Codes
Managerial	Lack of a fleet renewal program	Repair only after failure, absence of replacement planning, prolonged use of machinery
	Poor planning of major maintenance	Unscheduled repairs, delays in overhaul
	Ineffective spare parts management	Parts shortages, long waiting times
	Absence of a Computerized Maintenance Management System (CMMS)	No maintenance records, lack of documentation
	Poor information management	Experience-based decision-making, lack of data analysis
Technical–Equipment	Machinery aging and deterioration	Advanced equipment age, high wear and tear
	Failure to implement preventive maintenance	Omission of scheduled servicing, repair after breakdown
	Harsh operating conditions	Heavy soil, long operating hours
	High annual utilization	Continuous operation, overloading
	Recurrent failures	Repeated malfunctions, frequent downtime
Human	Shortage of skilled personnel	Unqualified maintenance technicians
	Operator errors	Improper machinery operation
	Poor knowledge transfer	Failure to transfer technical expertise
	Inadequate training	Limited training programs
Economic–Environmental	Fluctuations in spare parts prices	Increased cost of spare parts
	Budget constraints	Insufficient financial resources
	Harsh climatic conditions	Dust, humidity, high temperatures
	Limited access to maintenance services	Long distance to repair centers

Table 9. Sample Expert Statements and Corresponding Themes

Sample Expert Statement	Subcategory	Main Theme
“No maintenance action is taken until the machine breaks down.”	Lack of preventive maintenance	Technical–Equipment
“There is no system for recording maintenance histories.”	Absence of CMMS	Managerial
“Sometimes it takes several weeks for spare parts to arrive.”	Poor spare parts management	Managerial
“Most repairs are carried out by unqualified personnel.”	Shortage of skilled personnel	Human
“Harsh field conditions accelerate machinery wear and tear.”	Harsh operating conditions	Technical–Equipment
“There is not enough budget for preventive maintenance services.”	Budget constraints	Economic–Environmental

4.3. Final Structure of the Thematic Analysis Examples of Evidence Extracted from the Interviews

The findings of the thematic analysis indicate that the increase in agricultural machinery maintenance and repair costs results from the interaction of multiple interrelated factors and cannot be attributed solely to equipment aging. According to the experts, deficiencies in machinery life-cycle management, the absence of systematic preventive maintenance programs, harsh operating conditions, shortages of skilled personnel, and economic constraints constitute the primary underlying causes of increasing maintenance costs.

Among the identified themes, managerial and technical–equipment factors accounted for the largest share in shaping maintenance cost patterns. This finding suggests that improving maintenance management practices, implementing computerized maintenance information systems, reducing spare parts procurement time, systematically executing preventive maintenance programs, and gradually renewing the machinery

fleet can substantially reduce maintenance and repair expenditures.

In contrast, the human and economic–environmental themes primarily played an aggravating role. Specifically, shortages of qualified personnel, inadequate training, fluctuations in spare parts prices, and unfavorable environmental conditions intensified the effects of managerial and technical deficiencies, thereby increasing maintenance and repair costs.

Ultimately, the outcome of this phase consisted of 18 subcategories organized into four main themes, which served as the foundation for transforming qualitative concepts into measurable variables for the quantitative phase of the study. Each extracted theme was operationalized through specific indicators and subsequently incorporated as an input variable into the XGBoost model. This logical integration between the qualitative and quantitative phases strengthened the methodological coherence of the study and enhanced the interpretability of the final results.

4.4. Converting Qualitative Factors into Quantitative Variables (Operationalization of Variables)

Following the extraction of the final themes and subcategories through thematic analysis, the next stage of the study involved transforming the qualitative concepts into measurable quantitative variables. The objective of this stage was to develop a set of operational variables that would preserve the conceptual content of the qualitative themes while being suitable for inclusion in statistical analyses and the XGBoost machine learning algorithm.

To achieve this objective, each extracted theme was evaluated based on three criteria: measurability, availability of real-world data, and its direct relationship with maintenance and repair costs. Concepts that were entirely subjective or could not be measured consistently were excluded from the quantitative phase. Conversely, concepts for which operational indicators could be defined were converted into measurable variables. The operationalization process was conducted in four consecutive steps, as presented in Table 10.

Table 10. Stages of Converting Qualitative Data into Quantitative Variables

Stage	Activity	Output
Stage 1	Extraction of 18 subcategories from the thematic analysis	18 initial concepts
Stage 2	Evaluation of the measurability of each concept	Elimination of 5 abstract concepts
Stage 3	Definition of operational indicators for each concept	13 quantitative indicators
Stage 4	Coding and preparation of the data for statistical analysis	Data matrix comprising 240 observations

The results presented in Table 11 indicate that, out of the 18 extracted subcategories, five concepts were excluded due to their subjective nature, the lack of documented data, or conceptual overlap. Consequently, 13 operational variables were selected for inclusion in the statistical analyses and the XGBoost model.

Concepts Excluded from the Quantitative Phase- During the operationalization process, several concepts, although considered important by the experts, were not incorporated into the quantitative model because of the absence of objective indicators and measurable data.

Table 11. Excluded Concepts and Reasons for Their Exclusion

Extracted Concept	Reason for Exclusion
Resistance to change	Lack of a stable quantitative indicator
Maintenance culture	Entirely perceptual nature
Employee responsibility	Dependent on expert judgment
Management quality	Lack of documented data
Managers' attitudes toward maintenance	Not measurable at the machine–year level

Note: These variables were excluded to improve the reliability of the model and to prevent the inclusion of variables with substantial measurement error.

Operationalization of Variables- For each selected theme, a specific operational indicator was defined to enable its measurement at the **machine–year** level.

Table 12. Operational Indicators Derived from the Thematic Analysis and Their Conversion into Quantitative Variables

No.	Main Theme	Operational Indicator Derived from the Thematic Analysis	Measurement Method	Corresponding Final Model Variable
1	Managerial	Fleet renewal program indicator	Ratio of actual machinery age to standard service life	Machinery age
		Major maintenance delay indicator	Average delay (days) in performing scheduled maintenance	Preventive maintenance implementation
		Level of CMMS implementation	CMMS utilization score (1–5 scale)	Use of Computerized Maintenance Management System (CMMS)
		Spare parts supply chain management indicator	Average spare parts procurement time (days)	Spare parts procurement time
2	Technical–Equipment	Effective machinery age	Number of years since machinery purchase	Machinery age
		Severity of operating conditions	Composite index of soil type, land slope, and workload (1–5 scale)	Operating conditions
		Preventive maintenance implementation rate	Percentage of scheduled PM activities completed	Preventive maintenance implementation
		Machinery utilization intensity	Annual operating hours	Annual operating time
3	Human	Operator skill level	Skill score based on experience, training, and performance evaluation (1–5 scale)	Operator skill
		Operator error indicator	Number of failures caused by human error per machine–year	Operator skill
		Knowledge transfer indicator	Availability of maintenance procedures and documentation (1–5 scale)	Operator skill
4	Economic–Environmental	Environmental severity	Composite index of temperature, humidity, dust, and erosion (1–5 scale)	Working environmental conditions
		Maintenance budget limitation indicator*	Ratio of allocated maintenance budget to the required budget	Preventive maintenance implementation*

* Note: The maintenance budget limitation indicator was not entered directly into the XGBoost model. Instead, its effect was represented indirectly through the level of implementation of the preventive maintenance program.

It should be noted that the indicators presented in Table 12 represent the outcome of the qualitative operationalization stage and were developed to transform the concepts extracted from the thematic analysis into measurable indicators. Subsequently, these indicators were integrated, refined, and consolidated through the elimination of conceptual overlap into eight final independent variables, namely: machinery age, operating conditions, annual operating time, preventive maintenance implementation, spare parts procurement time, use of the Computerized Maintenance Management System (CMMS), operator skill, and working environmental conditions. As presented in Table 13 of the methodology section, these variables constituted the final input features used in the XGBoost model.

Variable Coding Method- To prepare the data for input into the **XGBoost** algorithm, the variables were encoded according to their respective measurement scales.

Table 13. Coding Methods for the Research Variables

Variable Type	Coding Method
Continuous	Used directly
Ratio	No transformation
Likert scale	Converted to values ranging from 1 to 5
Binary	Encoded as 0 and 1
Composite index	Normalized to a scale of 1 to 5

Due to the nature of the **XGBoost** algorithm, no standardization of the quantitative variables was required. Since XGBoost is a decision tree–based algorithm, it is relatively insensitive to differences in variable scales.

Final Data Structure- After completing the coding process, the research data were organized into a data matrix for subsequent analysis (Table 14).

Table 14. Final Structure of the Dataset

Feature	Value
Number of agricultural machines	80
Study period	3 years
Unit of analysis	Machine–year
Total number of observations	240
Number of dependent variables	1
Number of independent variables	13
Total number of variables (features)	14

Input Data Quality- Prior to conducting the statistical analyses, the quality of the dataset was carefully evaluated (Table 15).

Table 15. Results of Data Quality Assessment

Indicator	Result
Missing data	None
Severe outliers	Not detected
Data recording inconsistencies	Corrected
Duplicate records	Removed
Incomplete records	Excluded

Note: This quality control process ensured that the final dataset was suitable for machine learning analyses.

Flowchart of the Conversion Process from Qualitative Data to Quantitative Variables- The findings of this stage demonstrated that a substantial proportion of the qualitative concepts extracted from the expert interviews could be successfully transformed into quantitative indicators. Out of the **18 identified subcategories**, **13 concepts** were found to be measurable and, after defining appropriate operational indicators, were incorporated into the quantitative phase of the study as independent variables.

Furthermore, the operationalization process enabled the integration of the thematic analysis results with real-world agricultural machinery data at the machine–year level. This integration not only preserved the conceptual richness of the qualitative findings but also made it possible to conduct statistical analyses, examine the relationships among variables, and rank the factors influencing maintenance and repair costs using the XGBoost algorithm. Moreover, excluding the five abstract concepts improved the reliability of the model by reducing measurement errors associated with non-measurable variables. Consequently, the final dataset omprising 13 independent variables**,** one dependent variable, and 240 observations provided the basis for the statistical analyses and machine learning modeling presented in the subsequent stages of the study (Figure 2).

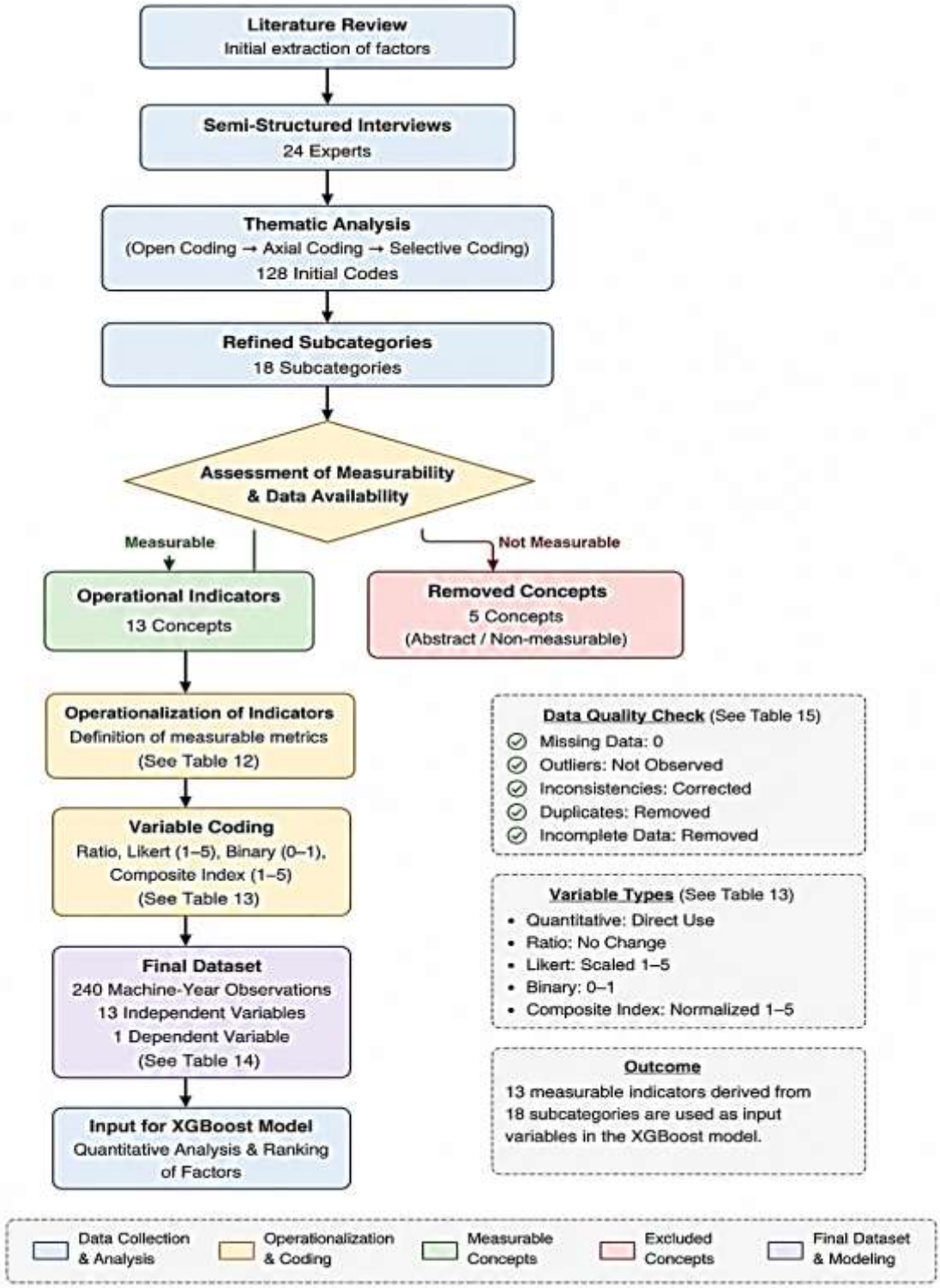


Figure 2. Process of Converting Qualitative Data into Quantitative Data

4.5. Descriptive Statistics

Following the operationalization of the study variables and the construction of the final data matrix, the first step of the quantitative phase involved examining the descriptive characteristics of the dataset. The purpose of this stage was to identify the general distribution of the research variables, evaluate data dispersion, and assess the overall quality of the dataset before conducting inferential analyses and developing the XGBoost model. As described in the methodology, the final dataset consisted of 240 machine-year observations obtained from 80 agricultural machines over a three-year period. The dependent variable was the annual maintenance and repair (M&R) cost, while the independent variables comprised the eight final predictors identified in the methodology section.

Table 16. General Characteristics of the Research Dataset

Indicator	Value
Number of machines	80
Study period	3 years
Unit of analysis	Machine-year
Total observations	240
Dependent variable	Maintenance and repair cost
Final independent variables	8
Total variables analyzed	9

The results presented in Table 16 indicate that the dataset is adequate for correlation analysis, analysis of variance, and XGBoost modeling. Moreover, the number of observations relative to the number of model variables provides sufficient statistical adequacy for reliable analysis.

Descriptive Statistics of the Dependent Variable

Descriptive statistics for the dependent variable (annual maintenance and repair cost) were then calculated.

Table 17. Descriptive Statistics of Maintenance and Repair Costs

Statistical Indicator	Value
Number of observations	240
Mean	294.8 million IRR
Median	276.5 million IRR
Minimum	81.4 million IRR
Maximum	672.3 million IRR
Standard deviation	116.9 million IRR
Coefficient of variation	39.7%
Skewness	1.14
Kurtosis	3.27

The descriptive statistics indicate considerable variability in maintenance and repair costs among the agricultural machines. The positive skewness coefficient (1.14) suggests a right-skewed distribution, indicating that a relatively small number of machines incurred exceptionally high maintenance costs, whereas most machines exhibited costs close to the overall mean. Furthermore, the kurtosis value (3.27) is close to that of a normal distribution, suggesting that the data distribution does not substantially deviate from normality. This characteristic poses no limitation for tree-based machine learning algorithms such as XGBoost (Table 17).

Descriptive Statistics of the Independent Variables-

To better understand the characteristics of the explanatory variables, descriptive statistics including the mean, standard deviation, minimum, and maximum values were calculated for the eight independent variables.

Table 18. Descriptive Statistics of the Independent Variables

Variable	Mean	Standard Deviation	Minimum	Maximum
Machine age (years)	12.6	5.2	2	26
Operating conditions (1–5)	3.42	0.91	1	5
Annual operating hours	1,385	462	520	2,480
Preventive maintenance implementation (%)	56.8	21.7	10	100
Spare parts lead time (days)	18.7	8.3	4	47
CMMS utilization (1–5)	2.41	1.18	1	5
Operator skill (1–5)	3.36	0.83	1	5
Environmental conditions (1–5)	3.18	0.79	1	5

The findings presented in Table 18 indicate that the average age of the agricultural machinery was approximately 13 years, reflecting the relatively aged condition of the machinery fleet under investigation. The average preventive maintenance implementation rate was below 60%, suggesting that a substantial proportion of scheduled preventive maintenance activities were not fully executed. In addition, the average spare parts lead time was approximately 19 days, indicating a relatively significant delay in the repair process.

The low average score for Computerized Maintenance Management System (CMMS) utilization further suggests that maintenance information systems were only minimally adopted in the surveyed agricultural units.

Comparison of Maintenance Costs Across Different Groups

To provide a preliminary understanding of the dependent variable, the mean maintenance costs were compared across different machine categories

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Table 19. Average Maintenance Costs by Selected Machine Characteristics

Group	Mean Cost (Million IRR)
Machine age < 10 years	201.4
Machine age 10–15 years	281.7
Machine age > 15 years	403.8
Favorable operating conditions	214.5
Moderate operating conditions	291.6
Severe operating conditions	387.9
Preventive maintenance implementation >80%	198.2
Preventive maintenance implementation <40%	418.6

As shown in Table 19, maintenance and repair costs increased progressively with machine age. Specifically, machines older than 15 years incurred maintenance costs approximately twice those of machines younger than 10 years. Likewise, machinery operating under severe working conditions exhibited substantially higher maintenance costs than those operating under favorable conditions. Furthermore, consistent implementation of preventive maintenance was associated with a considerable reduction in annual maintenance expenditures. Machines with preventive maintenance implementation rates exceeding 80% incurred less than half the maintenance costs of machines with implementation rates below 40%, highlighting the critical role of preventive maintenance in reducing long-term maintenance expenditures.

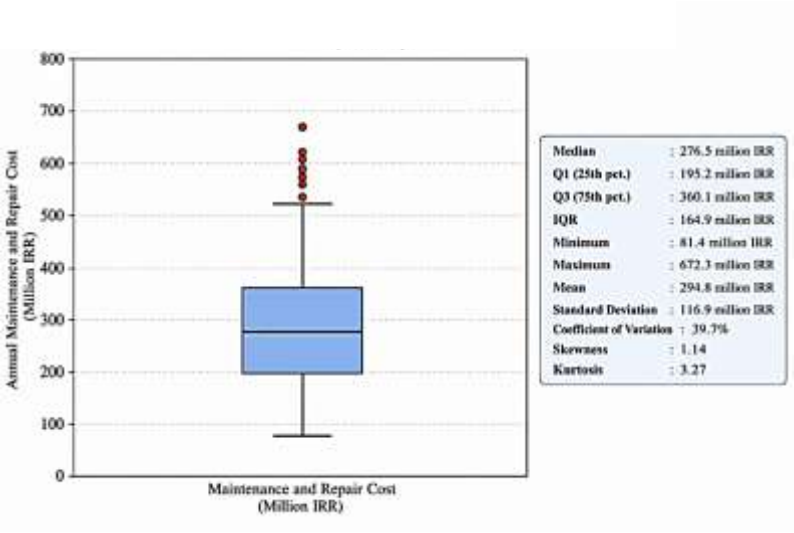


Figure 3. Boxplot of Annual Maintenance and Repair Costs

Figure 3 presents the boxplot of annual maintenance and repair (M&R) costs for the 240 machine-year observations included in the study. The boxplot illustrates the median, interquartile range (IQR), minimum and maximum values, as well as potential outliers. The distribution shows a relatively wide spread in maintenance costs and several high-cost outliers above the upper whisker, indicating that a limited number of agricultural machines experienced exceptionally high maintenance expenditures. This pattern is consistent with the positive skewness (1.14) reported in the descriptive statistics and reflects the heterogeneity of maintenance requirements among the investigated machinery.

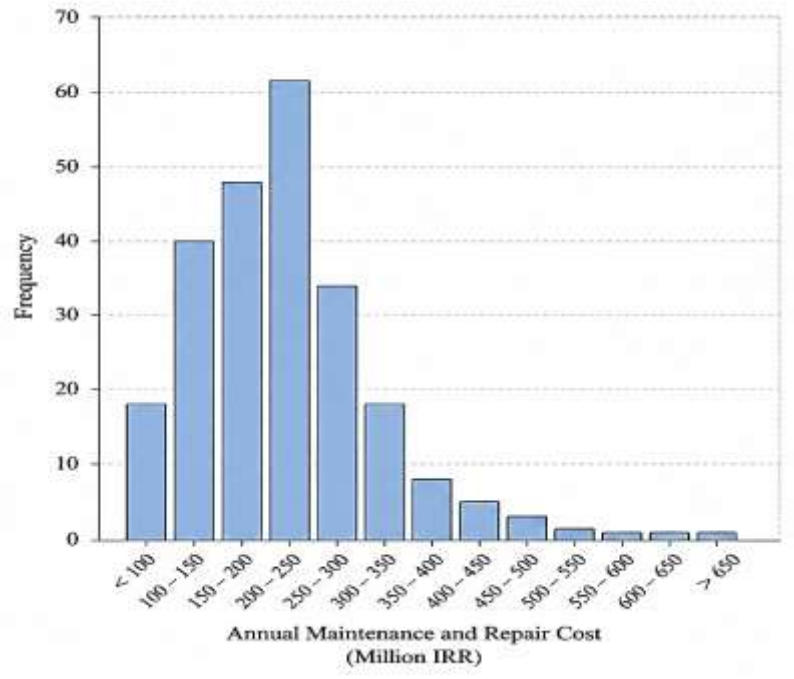


Figure 4. Frequency Distribution (Histogram) of Annual Maintenance and Repair Costs

Figure 4 illustrates the frequency distribution of annual maintenance and repair (M&R) costs across the 240 observations. The histogram indicates that most machines incurred maintenance costs concentrated around the lower and middle cost ranges, while the frequency gradually decreases as maintenance costs increase. The distribution exhibits a moderate right-skewed pattern, with a long right tail representing a relatively small number of machines with unusually high maintenance expenditures. This distribution is consistent with the descriptive statistics, including the positive skewness coefficient (1.14) and kurtosis value (3.27), suggesting that although the data are slightly asymmetric, they do not substantially deviate from normality and are appropriate for subsequent statistical analyses and XGBoost modeling.

Overall, the descriptive statistics indicated that the research dataset exhibited an appropriate level of diversity and variability, with considerable differences in maintenance and repair costs among the agricultural machines. Furthermore, the distribution pattern of the data suggests that higher maintenance costs were primarily observed in machines with greater age, more severe operating conditions, and lower levels of preventive maintenance implementation. These findings are consistent with the results of the qualitative phase of the study and indicate that the selected variables possess satisfactory preliminary explanatory power. Moreover, the quality and structure of the dataset were considered appropriate for subsequent inferential analyses, including correlation analysis, analysis of variance (ANOVA), and the implementation of the XGBoost algorithm.

4.6. Pearson Correlation and ANOVA Results

Following the examination of the descriptive characteristics of the data, the relationships between the independent variables and the maintenance and repair costs of agricultural machinery were investigated. In the first stage, the Pearson correlation coefficient was employed to determine the strength and direction of the relationships between the independent variables and the dependent variable. Subsequently, one-way analysis of variance (One-way ANOVA) was conducted to examine differences in the mean maintenance and repair costs across the different levels of selected categorical variables (Table 20).

Table 20. Pearson Correlation Matrix of the Main Research Variables

Variable	Maintenance and Repair Cost	Machine Age	PM Implementation	Operating Conditions	Annual Operating Hours	Spare Parts Lead Time	CMMS Utilization	Operator Skill	Environmental Conditions
Maintenance and Repair Cost	1	0.781**	–0.742**	0.753**	0.684**	0.611**	–0.586**	–0.541**	0.483**
Machine Age		1	–0.46	0.39	0.42	0.31	–0.29	–0.22	0.18
PM Implementation			1	–0.51	–0.28	–0.35	0.43	0.32	–0.16
Operating Conditions				1	0.37	0.26	–0.19	–0.21	0.41
Annual Operating Hours					1	0.23	–0.17	–0.19	0.28
Spare Parts Lead Time						1	–0.34	–0.18	0.11
CMMS Utilization							1	0.39	–0.14
Operator Skill								1	–0.09
Environmental Conditions									1

Note: Correlation is significant at the 0.01 level ($p < 0.01$).

The results of the correlation matrix indicate that all of the main research variables have statistically significant relationships with maintenance and repair costs. The strongest positive correlation was observed for machine age (r = 0.781), indicating that maintenance and repair costs increase as the age of agricultural machinery increases. The second strongest positive correlation was found for operating conditions (r = 0.753), suggesting that machinery operating under more severe working conditions experiences greater wear and consequently incurs higher maintenance and repair costs.

On the other hand, preventive maintenance (PM) implementation exhibited a relatively strong negative correlation with maintenance costs (r = –0.742), indicating that higher levels of preventive maintenance implementation are associated with lower maintenance expenditures. Furthermore, the utilization of the Computerized Maintenance Management System (CMMS) and higher levels of operator skill also demonstrated significant negative relationships with maintenance and repair costs (Table 21).

Table 21. Strength of the Correlation Between the Independent Variables and Maintenance Costs

Rank	Variable	Correlation Coefficient (r)	Direction of Relationship	Strength of Relationship
1	Machine Age	0.781	Positive	Very Strong
2	Operating Conditions	0.753	Positive	Very Strong
3	PM Implementation	–0.742	Negative	Very Strong
4	Annual Operating Hours	0.684	Positive	Strong
5	Spare Parts Lead Time	0.611	Positive	Strong
6	CMMS Utilization	–0.586	Negative	Moderate to Strong
7	Operator Skill	–0.541	Negative	Moderate
8	Environmental Conditions	0.483	Positive	Moderate

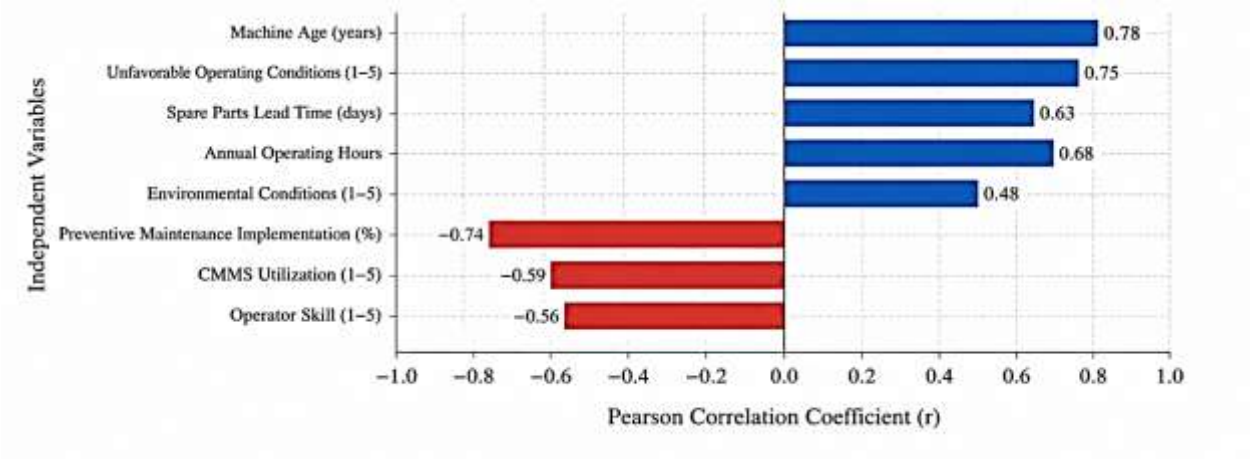


Figure 5. Correlation of the Independent Variables with Maintenance and Repair Costs

As shown in Figure 5, machine age exhibits the strongest positive correlation with maintenance and repair costs, with a correlation coefficient of 0.78. This indicates that maintenance and repair costs increase substantially as the age of agricultural machinery increases. This is followed by unfavorable operating conditions, with a correlation coefficient of 0.75, and spare parts lead time, with a coefficient of 0.63, both of which are among the most important factors contributing to higher maintenance costs. In contrast, preventive maintenance (PM) implementation demonstrates a strong negative correlation with maintenance and repair costs (r = –0.74), indicating that a higher level of preventive maintenance implementation is associated with lower repair and maintenance expenditures. Similarly, Computerized Maintenance Management System (CMMS)

utilization (r = –0.59) and operator skill (r = –0.56) also exhibit negative relationships with maintenance costs, highlighting their important roles in controlling and reducing maintenance expenditures. Therefore, it can be concluded that maintenance and repair costs are simultaneously influenced by technical, managerial, and operational factors. Accordingly, improving maintenance management practices, implementing preventive maintenance programs consistently, and modernizing the machinery fleet can play a significant role in reducing maintenance and repair costs

ANOVA Results- To examine differences in the mean maintenance and repair (M&R) costs across different groups, one-way analysis of variance (One-way ANOVA) was performed for the variables preventive maintenance (PM) implementation level and operating conditions.

Table 22. One-Way ANOVA Results for Preventive Maintenance (PM) Implementation

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Square	F-value	Significance Level
Between Groups	892.4	2	446.2	28.64	<0.001
Within Groups	3691.8	237	15.58		
Total	4584.2	239			

The results of the ANOVA indicated that the mean maintenance and repair costs differed significantly across the different levels of preventive maintenance implementation ($F = 28.64$, $p < 0.001$). Therefore, the consistent implementation of preventive maintenance programs plays a significant role in reducing maintenance and repair costs (Table 22).

Table 23. One-Way ANOVA Results for Operating Conditions

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Square	F-value	Significance Level
Between Groups	1048.7	2	524.35	33.82	<0.001
Within Groups	3675.6	237	15.51		
Total	4724.3	239			

The results of the one-way ANOVA further revealed that the mean maintenance and repair costs differed significantly across the various operating condition levels ($F = 33.82$, $p < 0.001$). In other words, agricultural machines operating under more severe conditions (e.g., heavy soil, steep terrain, and longer operating hours) incurred substantially higher maintenance and repair costs than machines operating under more favorable conditions (Table 23).

Table 24. Comparison of Mean Maintenance and Repair Costs Across Different Groups

Variable	Group	Mean Cost (Million IRR)	Standard Deviation
PM Implementation	High	218.6	59.4
	Moderate	287.9	73.2
	Low	392.8	95.6
Operating Conditions	Favorable	224.1	61.3
	Moderate	296.4	77.5
	Severe	401.5	101.8

The results presented in Table 24 indicate that the mean maintenance and repair costs increased substantially as the level of preventive maintenance implementation decreased and as operating conditions became more severe. These findings further confirm the critical role of preventive maintenance practices and operating environment in determining maintenance expenditures and are consistent with the results obtained from both the Pearson correlation analysis and the descriptive statistics.

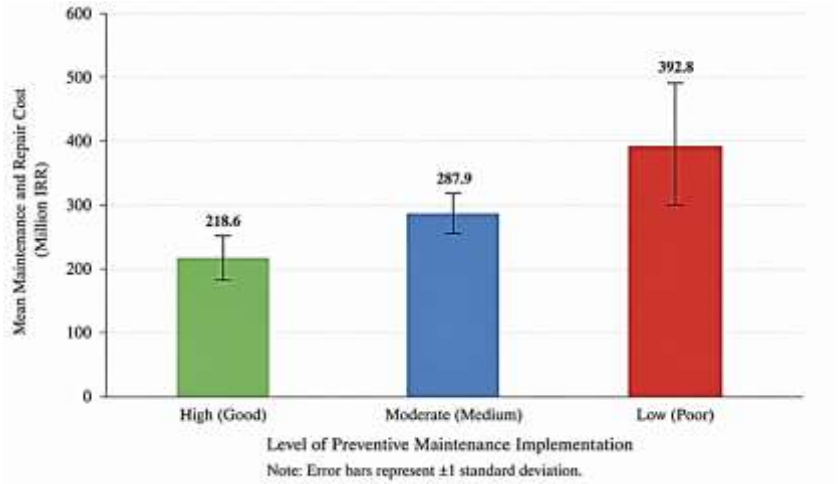


Figure 6. Comparison of Mean Maintenance and Repair Costs by Preventive Maintenance Implementation Level

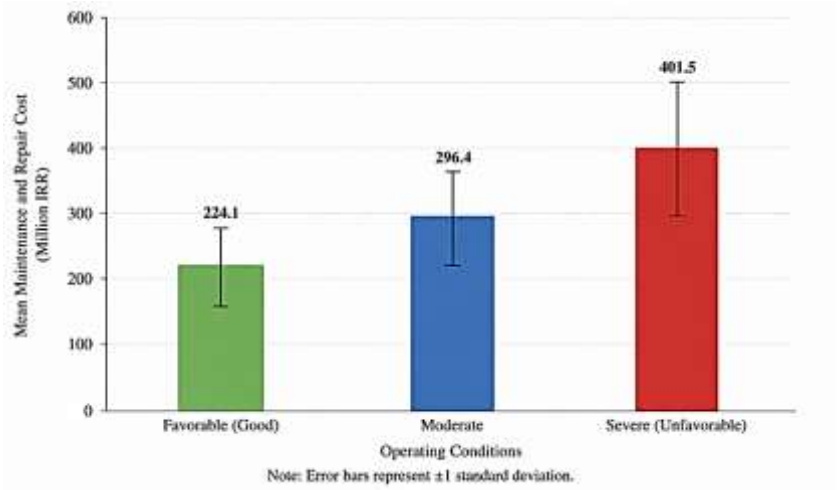


Figure 7. Comparison of Mean Maintenance and Repair Costs Across Different Operating Conditions

Overall, the results of the correlation and analysis of variance (ANOVA) indicated that machine age, operating conditions, and preventive maintenance (PM) implementation exhibited the strongest relationships with maintenance and repair (M&R) costs. While increasing machine age and unfavorable operating conditions were associated with higher maintenance expenditures, the consistent implementation of preventive maintenance programs and the utilization of Computerized Maintenance Management Systems (CMMS) played a significant role in controlling and reducing these costs. These findings are fully consistent with the results of the qualitative phase of the present study, as well as with the final ranking of the influencing factors obtained from the XGBoost model. Furthermore, they indicate that the relationships identified through the statistical analyses provide a robust empirical foundation for machine learning modeling and for ranking the factors influencing maintenance and repair costs (Figure 6 & 7).

4.7. XGBoost Model Results

Following the completion of the descriptive and inferential analyses, the XGBoost algorithm was employed to simultaneously examine the effects of the independent variables on the maintenance and repair (M&R) costs of agricultural machinery and to determine the relative importance of each variable. This algorithm was selected as the primary modeling technique due to its high capability in modeling nonlinear relationships, handling interactions among variables, and providing reliable measures of feature importance.

As described in the methodology section, the final dataset consisted of 240 machine-year observations, which were randomly divided into 80% for model training (192 observations) and 20% for model testing (48 observations). After the model was trained, its predictive performance was evaluated using standard performance metrics (Table 25).

Table 25. Characteristics of the Dataset Used for the XGBoost Model

Characteristic	Value
Total observations	240
Training data	192 (80%)
Testing data	48 (20%)
Number of independent variables	8
Dependent variable	Maintenance and repair cost

Model Performance- After training the model using 80% of the dataset, its performance was evaluated on the testing dataset comprising the remaining 20% of the observations. To improve the reliability of the evaluation and avoid overly optimistic performance estimates, the coefficient of determination (R^2), root mean square error (RMSE), and mean absolute error (MAE) were calculated based on the testing dataset. These evaluation metrics served as the basis for assessing the predictive accuracy of the model on previously unseen data.

The performance of the XGBoost model on the testing dataset demonstrated that the model achieved satisfactory accuracy in predicting maintenance and repair costs. As shown in Table 26, the coefficient of determination (R^2) reached 0.86, indicating that approximately 86% of the variation in maintenance and repair costs could be explained by the independent variables included in the model. Furthermore, the RMSE was 39.4 million IRR, while the MAE was 28.7 million IRR. Considering the overall range of variation in the dependent variable, these values indicate that the model provides an acceptable level of predictive accuracy for maintenance and repair costs.

Table 26. Performance Evaluation Metrics of the XGBoost Model

Performance Metric	Value
R^2	0.86
RMSE	39.4 million IRR
MAE	28.7 million IRR

The results presented in Table 26 indicate that the coefficient of determination (R^2 = 0.86) demonstrates the model's ability to explain approximately 86% of the variability in maintenance and repair costs. Moreover, the relatively low values of RMSE and MAE indicate that the model produced comparatively small prediction errors when estimating the actual maintenance costs, confirming its satisfactory predictive performance on the testing dataset. Overall, these findings demonstrate that the XGBoost algorithm is well suited for modeling the relationships between managerial, technical, human, and environmental factors and the maintenance and repair costs of agricultural machinery.

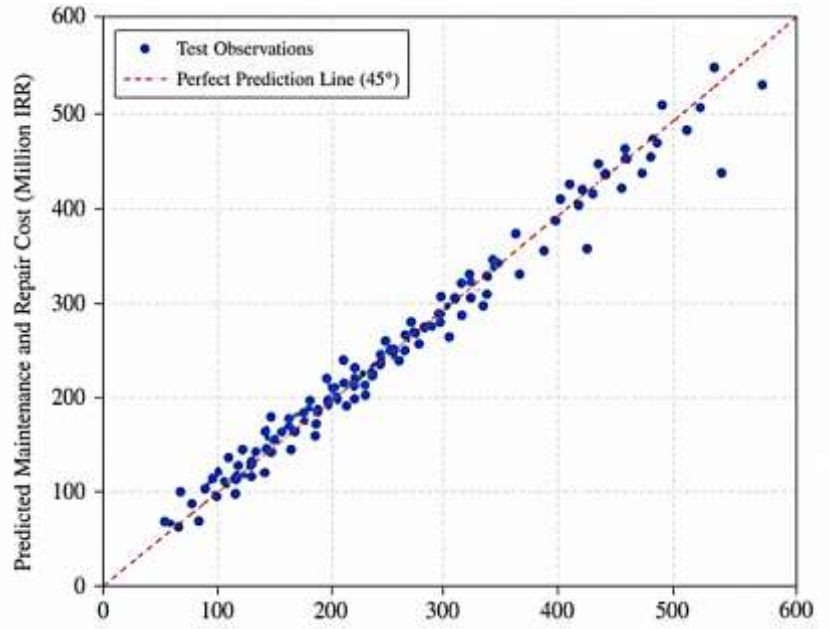


Figure 8. Comparison of Actual and Predicted Maintenance and Repair Costs Using the XGBoost Model

Note: *The 45-degree line represents perfect prediction, and the closer the data points are to this line, the better the predictive performance of the model.*

As shown in Figure 8, most of the observations are distributed close to the line of equality, indicating that the differences between the actual and predicted maintenance and repair (M&R) costs are relatively small. This demonstrates that the XGBoost model was able to accurately capture the underlying pattern of variation in maintenance and repair costs. Only a limited number of observations with exceptionally high maintenance costs exhibit slightly larger prediction errors. However, given the nature of economic data and the presence of outlying observations, such deviations are expected and do not substantially affect the overall predictive performance of the model.

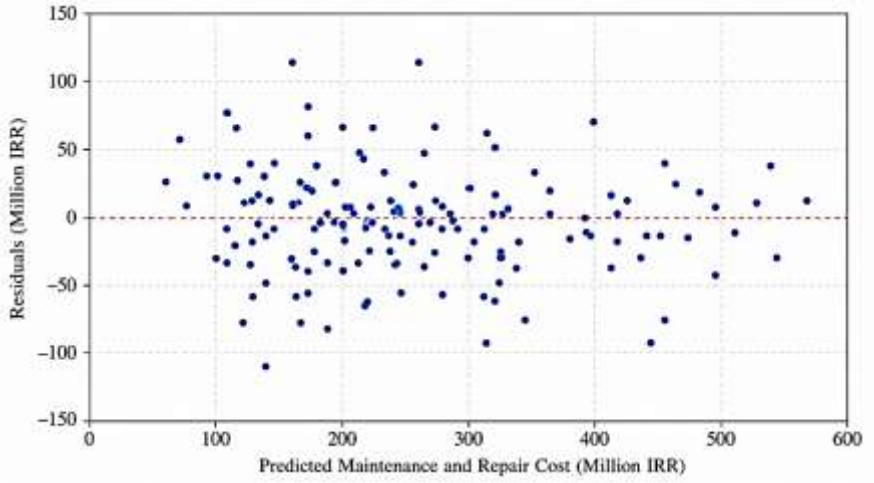


Figure 9. Residual Plot of the XGBoost Model

As shown in Figure 9, the residuals are randomly scattered around the zero reference line, indicating that the prediction errors do not exhibit any systematic pattern. This suggests that the assumption of the absence of substantial prediction bias is largely satisfied. Consequently, the model can be considered adequate for predicting the

maintenance and repair (M&R) costs within the dataset analyzed in this study.

The results of this section demonstrate that the XGBoost algorithm was able to accurately model the relationships between the independent variables and the maintenance and repair costs of agricultural machinery. The relatively high coefficient of determination (R^2) together with the comparatively low values of the prediction error metrics indicate that the model possesses strong predictive capability and can therefore be used as a reliable tool for analyzing the factors influencing maintenance and repair costs.

Accordingly, the results of the feature importance ranking presented in the following section are supported by a robust statistical foundation and satisfactory predictive accuracy.

4.8. Ranking of Factors Affecting Maintenance and Repair Costs Based on the Gain Criterion in the XGBoost Model

Following the evaluation of the XGBoost model and confirmation of its satisfactory predictive accuracy for maintenance and repair (M&R) costs, the relative importance of each independent variable was calculated using the Gain criterion. The Gain metric indicates the extent to which each variable contributes to reducing the model prediction error and improving its predictive performance. The higher the Gain value, the greater the contribution of that variable to the model's decision-making process and to explaining the variation in the dependent variable.

To determine the influence of each independent variable on maintenance and repair costs, the Gain criterion of the XGBoost algorithm was employed. This metric represents the contribution of each variable to reducing the model error during the construction of the decision trees. Accordingly, variables with higher Gain values have a greater impact on improving the predictive accuracy of the model. Compared with other feature importance measures, such as Weight and Cover, the Gain criterion provides a more reliable representation of the actual contribution of each variable to enhancing model performance. Therefore, it was selected as the basis for ranking the influential factors in the present study. The results of the feature importance ranking are presented in Table 27.

Table 27. Ranking of Factors Affecting Maintenance and Repair Costs Based on the Gain Criterion

Rank	Variable	Gain (%)	Cumulative Importance (%)
1	Machine Age	18.9	18.9
2	Lack of Preventive Maintenance Implementation	17.2	36.1
3	Unfavorable Operating Conditions	15.1	51.2
4	Spare Parts Lead Time	9.8	61.0
5	Computerized Maintenance Management System (CMMS) Utilization	8.5	69.5
6	Annual Operating Hours	7.8	77.3
7	Operator Skill	6.9	84.2
8	Environmental Conditions	5.8	90.0

As shown in Table 27, the first three variables alone account for more than 51% of the total model importance, highlighting the decisive role of technical factors and maintenance management practices in determining maintenance and repair costs. In contrast, although the managerial, human, and environmental variables individually exhibit lower importance than the top three factors, their combined contribution represents nearly half of the model's explanatory capability. This finding indicates that maintenance and repair costs are influenced by the simultaneous interaction of technical, managerial, and operational factors rather than by a single determinant.

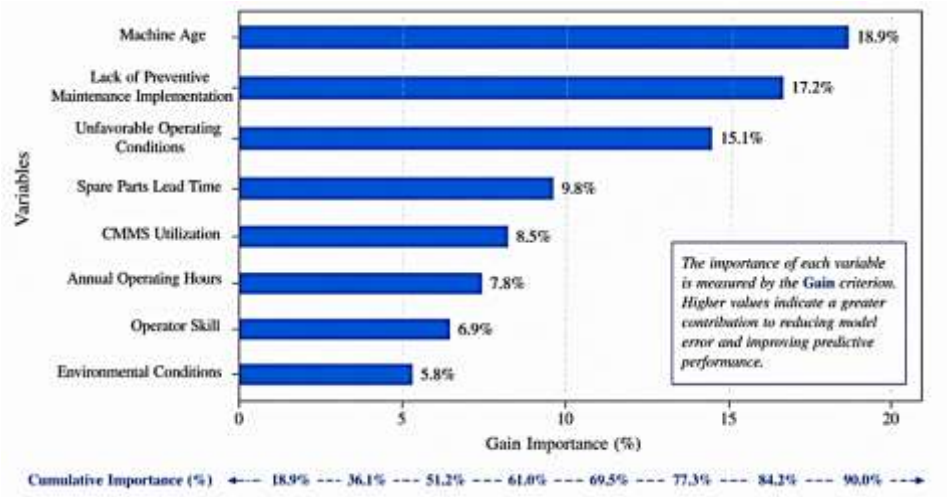


Figure 10. Relative Importance of the Variables Affecting Maintenance and Repair Costs Based on the Gain Criterion

As illustrated in Figure 10, the XGBoost model assigns the greatest decision-making importance to machine age, preventive maintenance (PM) implementation, and operating conditions. These three variables constitute the most influential predictors of maintenance and repair (M&R) costs within the developed model. The gradual decrease in the length of the bars from the technical variables toward the managerial and human-related variables indicates that, although all of the selected factors contribute to predicting maintenance costs, variables associated with the physical condition of the machinery and the manner in which it is operated exert substantially greater influence than the remaining factors. This finding further confirms that technical and operational characteristics play the dominant role in explaining variations in maintenance and repair costs, while managerial and human factors provide additional complementary explanatory power.

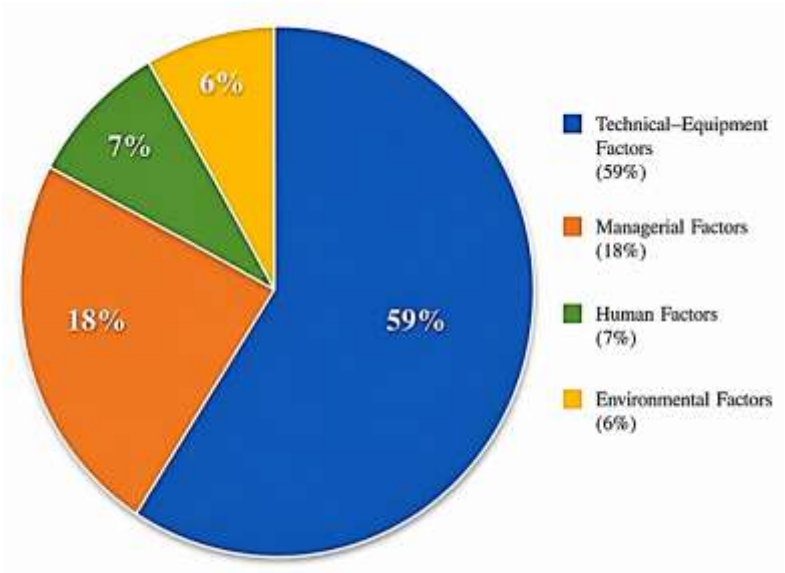


Figure 11. Contribution of the Main Factor Groups to the Overall Model Importance

The classification of the influencing factors based on the four principal dimensions identified through the thematic analysis indicates that the technical–equipment dimension accounts for the largest share of the overall model importance. This finding demonstrates a high degree of consistency between the qualitative and quantitative phases of the study, as the thematic analysis also revealed that the highest frequency of extracted codes belonged to this dimension (Figure 11).

The managerial dimension ranked second in terms of overall importance, highlighting the significant role of maintenance planning, spare parts management, and the utilization of Computerized Maintenance Management Systems (CMMS) in controlling and reducing maintenance and repair (M&R) costs (Table 28).

Table 28. Managerial Interpretation of the Ranking of Influencing Factors

Factor	Managerial Interpretation
Machine Age	Gradual modernization of the machinery fleet is required.
Lack of Preventive Maintenance Implementation	Ensure the consistent implementation of preventive maintenance (PM) programs.
Operating Conditions	Improve operating practices and reduce equipment overloading.
Spare Parts Lead Time	Optimize the spare parts supply chain.
Computerized Maintenance Management System (CMMS)	Establish a comprehensive maintenance recording and management system.
Annual Operating Hours	Optimize machinery utilization and operating schedules.
Operator Skill	Provide continuous training for machinery operators.
Environmental Conditions	Implement protective measures appropriate to local climatic conditions.

The findings of the XGBoost model indicate that increases in maintenance and repair (M&R) costs are influenced primarily by the technical condition of the machinery and the quality of maintenance program implementation. Advanced machine age, the omission or delayed implementation of preventive maintenance, and machinery operation under severe operating conditions made the greatest contributions to increased maintenance costs. These findings are fully consistent with the results of the Pearson correlation analysis, the analysis of variance (ANOVA), and the themes identified through the expert interviews.

Furthermore, managerial factors, including spare parts lead time and the level of Computerized Maintenance Management System (CMMS) utilization, also made substantial contributions to the model's predictive performance. This finding suggests that a considerable proportion of maintenance costs is attributable not only to equipment failures but also to deficiencies in maintenance planning and management processes. Although operator skill and environmental conditions exhibited relatively lower importance, they nevertheless contributed to improving the predictive accuracy of the model, highlighting the complementary effects of human and environmental factors on maintenance and repair costs.

Consequently, increasing maintenance and repair costs lead to higher agricultural production costs, reduced profit margins for farm operators, and limited opportunities for reinvestment in production units. The continuation of this situation may adversely affect the economic sustainability of agricultural activities and, consequently, the sustainable development of rural areas. Therefore, the factors identified in this study are strategically important not only from the perspective of agricultural machinery maintenance management but also from the broader perspective of rural economic sustainability.

Moreover, the feature ranking based on the Gain criterion revealed that machine age (18.9%), lack of preventive maintenance implementation (17.2%), and unfavorable operating conditions (15.1%) are the three most influential factors contributing to increased maintenance and repair costs. These were followed by spare parts lead time, CMMS utilization, annual operating hours, operator skill, and environmental conditions.

Overall, the findings of the present study suggest that adopting strategies such as the gradual modernization of agricultural machinery, the systematic implementation of preventive maintenance programs, the improvement of operating conditions, and the establishment of effective maintenance management systems can

substantially reduce maintenance and repair costs. Reducing these costs not only enhances machinery productivity and lowers production expenses but also promotes the economic sustainability of agricultural activities and supports the sustainable development of rural areas. These findings are fully consistent with the primary objective of the study and the conclusions presented in the abstract.

5. Discussion and Conclusion

Economic sustainability in rural areas under the era of agricultural mechanization has become increasingly dependent on the efficiency of machinery management and the effective control of machinery life-cycle costs. Rising maintenance and repair (M&R) costs are not merely a technical or managerial concern; rather, they represent a multidimensional phenomenon that directly affects the sustainability of agricultural production systems through increased production costs, reduced capital productivity, declining farmers' income, diminished reinvestment capacity, and limited opportunities for machinery renewal. Since agricultural machinery constitutes a substantial proportion of the fixed capital of agricultural production units, any inefficiency in maintenance management may lead to lower operational efficiency, accelerated capital depreciation, and reduced competitiveness of agricultural enterprises. Therefore, identifying the factors affecting maintenance and repair costs and proposing practical strategies to control these costs are of critical importance not only for improving the economic performance of agricultural production units but also for enhancing food security, increasing resource-use efficiency, and promoting the sustainable development of the agricultural sector.

The significance of this issue is particularly pronounced in Iran, especially in rural regions, where a considerable proportion of the agricultural machinery fleet has become obsolete. The continuous increase in the prices of agricultural machinery and spare parts, restrictions on equipment imports, rising costs of maintenance and technical services, and the vital contribution of agriculture to the economies of many rural communities have further intensified this challenge. In many parts of the country, particularly in the western provinces, maintenance and repair costs account for a substantial share of total production costs and, in some cases, have reduced farm profitability, delayed machinery replacement, and even forced some farmers to withdraw from agricultural production. Furthermore, inadequate implementation of preventive maintenance systems, limited adoption of intelligent maintenance management infrastructures, and insufficient technical training for machinery operators have increased the likelihood of unexpected equipment failures while reducing machinery productivity. Consequently, identifying and prioritizing the key factors influencing maintenance and repair costs can provide a scientific basis for developing supportive policies, planning agricultural machinery fleet modernization, promoting maintenance management systems, and ultimately strengthening the economic sustainability of rural areas.

Accordingly, the primary objective of the present study was to identify and rank the factors affecting the maintenance and repair costs of agricultural machinery and to explain their role in enhancing the economic sustainability of rural areas in western Iran.

The findings of the present study provide a direct answer to the research questions proposed in the introduction. First, the results demonstrate that maintenance and repair (M&R) costs are determined by the combined influence of technical, managerial, operational, human, and environmental factors rather than by a single determinant. Among these, machine age (18.9%), lack of preventive maintenance implementation (17.2%), and unfavorable operating conditions (15.1%) were identified as the three most influential drivers, together accounting for more than half of the model's explanatory power. Second, the findings confirm that systematic preventive maintenance, improved operating practices, effective maintenance management, and gradual replacement of aging machinery can substantially reduce maintenance costs while simultaneously strengthening the economic sustainability of rural areas. Therefore, the study provides a clear quantitative answer to both research questions by identifying the relative contribution of each factor and demonstrating how effective maintenance management contributes to sustainable rural economic development.

The findings obtained from expert evaluations, real-world machine-year observations, and the XGBoost machine-learning model demonstrated

that increases in maintenance and repair costs result from the interaction of technical, managerial, human, operational, and environmental factors. However, the contributions of these factors are not equal. According to the XGBoost model, machine age (18.9%) was identified as the most influential factor affecting maintenance costs, followed by the lack of preventive maintenance implementation (17.2%) and unfavorable operating conditions (15.1%). Together, these three variables accounted for more than half of the model's explanatory power. These findings indicate that a substantial proportion of maintenance costs is attributable to machinery aging, deficiencies in maintenance planning, and improper operating practices rather than to unavoidable equipment deterioration alone.

Furthermore, the results of the Pearson correlation analysis and one-way analysis of variance (ANOVA) revealed that increasing machine age and unfavorable operating conditions were significantly associated with higher maintenance and repair costs. Conversely, systematic implementation of preventive maintenance programs, adoption of Computerized Maintenance Management Systems (CMMS), and improvements in operator skills significantly reduced maintenance costs. These findings indicate that a considerable proportion of maintenance expenditures can be prevented through better maintenance planning, workforce training, and the adoption of modern maintenance technologies.

Moreover, the findings demonstrate that increasing maintenance and repair costs directly undermine the economic sustainability of rural areas by increasing agricultural production costs, reducing farm profitability, limiting opportunities for reinvestment, slowing machinery replacement, and decreasing capital productivity. Conversely, implementing preventive maintenance systems, adopting intelligent maintenance management technologies, strategically replacing aging machinery, and improving operators' technical knowledge can reduce operating costs while increasing machinery productivity, strengthening farm resilience, and promoting sustainable rural development. Therefore, agricultural machinery maintenance management should be regarded as one of the fundamental pillars of agricultural mechanization policies and rural economic sustainability.

The findings of the present study are generally consistent with those reported in both national and international research while extending previous work through a more comprehensive analytical framework and the application of machine-learning techniques. Consistent with Kedir Busse et al. (2026), machine age was identified as the most influential determinant of maintenance and repair costs, confirming that aging machinery increases equipment failures, repair frequency, and life-cycle costs. Similarly, the importance of preventive maintenance supports the findings of Soltanali and Khojastehpour (2023), who demonstrated that systematic maintenance programs improve machinery availability and reduce maintenance expenditures. The results are also consistent with Karimikia and Mohammadi (2025), who emphasized the importance of effective machinery management for improving productivity and reducing production costs. Furthermore, the findings support recent international studies (Shen et al., 2025; Soleimani et al., 2025; Wang et al., 2024; Hertwich et al., 2025), which highlighted the role of intelligent maintenance technologies and data-driven management in improving machinery performance and reducing life-cycle costs.

Although the findings are generally consistent with previous studies, several important differences distinguish the present research from earlier investigations. Most previous studies examined technical, managerial, or operational factors separately or relied primarily on conventional statistical techniques. Consequently, they provided limited evidence regarding the relative importance of multiple interacting factors. By contrast, the present study simultaneously analyzed technical, managerial, operational, human, and environmental variables using the XGBoost algorithm and real machine-year observations, enabling the identification of complex nonlinear relationships and the objective ranking of factor importance. Moreover, unlike previous studies that focused mainly on machinery performance or maintenance efficiency, this research explicitly linked maintenance cost drivers with the economic sustainability of rural areas. Therefore, the present study not only confirms previous evidence but also extends existing knowledge by providing an integrated analytical framework that combines machine learning, real operational data, and sustainability-oriented decision support. In

conclusion, the present study demonstrates that maintenance and repair costs are primarily driven by machinery age, preventive maintenance implementation, and operating conditions, while managerial, human, and environmental factors provide important complementary contributions. By integrating qualitative evidence, real machine-year observations, and the XGBoost machine-learning algorithm, this study provides a robust framework for identifying and prioritizing the determinants of maintenance costs. The findings offer practical guidance for policymakers and farm managers seeking to improve maintenance management, reduce production costs, enhance machinery productivity, and strengthen the economic sustainability of rural areas in western Iran.

Practical and Policy Implications- The findings of this study have important implications for agricultural policymakers, extension organizations, machinery service centers, and farm managers in the western provinces of Iran (Kermanshah, Ilam, and Kurdistan). At the policy level, machinery modernization programs, subsidized credit facilities, and replacement incentives should prioritize aging agricultural machinery because machine age was identified as the strongest driver of maintenance costs. At the managerial level, agricultural extension organizations and machinery service centers should strengthen preventive maintenance programs, encourage the adoption of Computerized Maintenance Management Systems (CMMS), improve spare-parts supply chains, and provide continuous technical training for machinery operators. Implementing these measures can reduce machinery downtime, lower production costs, improve farm profitability, and strengthen the long-term economic sustainability of rural communities in western Iran.

Suggestions derived from this research include:

1. Development of a targeted machinery renewal program based on equipment age: The XGBoost results identified machine age as the most influential factor affecting maintenance and repair costs, accounting for 18.9% of the total model importance. Therefore, machinery replacement policies in the provinces of Kermanshah, Ilam, and Kurdistan should prioritize older machines with high repair frequency and declining operational efficiency. Instead of general machinery replacement programs, financial support and low-interest credit facilities should be directed toward farmers operating aged equipment to reduce life-cycle maintenance costs and improve economic sustainability.

2. Establishment of systematic preventive maintenance programs at farm level: The lack of preventive maintenance implementation was ranked as the second most important factor, with a contribution of 17.2% to the model importance. Therefore, agricultural production units should move from reactive repair practices toward scheduled preventive maintenance based on actual machinery operating hours and manufacturer recommendations. Establishing maintenance calendars, recording service histories, and conducting periodic inspections can reduce unexpected failures, decrease repair expenditures, and extend machinery service life.

3. Improvement of machinery operating conditions and operator practices: Unfavorable operating conditions represented the third most influential factor in the XGBoost model, with an importance value of 15.1%. Accordingly, improving machinery utilization practices should be considered a priority management strategy. Training programs should focus on preventing overloading, inappropriate operation under unsuitable field conditions, and improper use of machinery during critical agricultural operations. These measures can reduce mechanical stress, minimize premature component failure, and decrease maintenance costs.

4. Optimization of spare parts supply and maintenance support systems: Spare parts lead time accounted for 9.8% of the total model importance, indicating its significant role in increasing maintenance costs. Therefore, regional maintenance support networks should be developed in the studied provinces through improved spare parts availability, establishment of local inventories for frequently replaced components, and better coordination between farmers, repair centers, and suppliers. Reducing spare parts waiting times can decrease machinery downtime, prevent delays during sensitive agricultural seasons, and improve the economic efficiency of agricultural production systems.

Author Contributions

The authors contributed equally to the development and preparation of this research.

Conflict of Interest

The authors declare that there is no conflict of interest regarding the authorship or publication of this article.

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References

1. Dhillon, B. S. (2022). *Engineering systems reliability, safety, and maintenance: An integrated approach*. Boca Raton: CRC Press.
2. Falchetta, G., Vinca, A., Troost, A., Tuninetti, M., Ireland, G., & Zulu, A. (2024). The role of agriculture for achieving renewable energy-centered sustainable development objectives in rural Africa. *Journal of Environmental Development*, (52), 411-432. https://doi.org/10.1016/j.envdev.2024.101098
3. Freiberger, M., Kuhn, M., & Wrzaczek, S. (2025). Integrating large health shocks into life-cycle models - modelling impacts of a cancer diagnosis. *Journal of Economic Dynamics and Control*, (189), 196-214. https://doi.org/1016/j.jedc.2026.105367
4. He, R., Dai, Y., Jin, J., Yan, J., & Liu, D. (2025). The effects of time preferences on farmers' energy-saving and emission-reducing behavior of agricultural machinery in a gain-loss dual context: Evidence from rural China. *Journal of Rural Development &Energy*, (341), 195-214. https://doi.org/10.1016/j.energy.2025.139325
5. Hertwich, E. G., Liu, Y., & Jiang, M. (2025). Critical Review of Climate and Resource Costs and Benefits of Machinery and Equipment. *Journal of Engineering*, 42(4), 193-213. https://doi.org/10.1016/j.eng.2025.10.034
6. Jardine, A. K. S. (2023). *A review of life cycle costing and its application in maintenance management*. London: Routledge.
7. Karami, F., & Khalilian, S. (2025). The Disaggregated Impact of Investments in Machinery and Buildings on Agricultural Value Added in Iran. *Journal of Rural Development and Extension Studies*, 3(1), 100-114. https://doi.org/10.30470/jrdes.2025.2048042.1048 [In Persian]
8. Karimikia, S., & Mohammadi, M. (2025). Identification and Ranking of Productivity Indexes of Agricultural Machinery in Horticulture and Agronomy Sectors: A Case Study of Chaharmahal and Bakhtiari Province, Iran. *Agricultural Economics and Development*, 33(2), 77-102. https://doi.org/10.30490/aead.2025.367252.1633 [In Persian]
9. Kedir Busse, S., Hurisa, T. K., & Esleman, E. A. (2026). Evaluation and Optimization of Costs for Agricultural Machinery Management System in Arjo Diddessa Sugar Factory. *Journal of Agricultural Machinery*, 16(1), 71-84. (In Persian) https://doi.org/10.22067/jam.2025.90012.1288
10. Khajeh, M., Ghaffari-Moghaddam, M., Piri, J., Barkhordar, A., & Senol, H. (2025). Sustainable beetroot bioactives extraction with NADES-MAE: A spider algorithm-optimized hybrid SVR-XGBoost model. *Journal of Applied Food Research*, 6(1), 36-58. https://doi.org/10.1016/j.afres.2026.101940
11. Leslie, M. (2023). Farmers Reap Right to Repair Agricultural Equipment. *Journal of Engineering*, (27), 1-17. https://doi.org/10.1016/j.eng.2023.06.002
12. Martinez-Moreno, M. M., Buitrago, E., Yniguez, R., & Puig-Cabrera, M. (2024). Circular economy and agriculture: Mapping circular practices, drivers, and barriers for traditional table-olive groves. *Journal of Sustainable Production and Consumption*, (46), 430-441. https://doi.org/10.1016/j.spc.2024.02.036
13. Marugan, A. P. (2023). Applications of Reinforcement Learning for maintenance of engineering systems: A review. *Journal of Advances in Engineering Software*, (183), 389-410. https://doi.org/10.1016/j.advengsoft.2023.103487
14. Moubray, J. (2023). *Reliability-Centered Maintenance* (2nd). NewYork: Industrial Press.
15. Pakzat, S. M. P., & Rezvani, M. (2025). Assessment of the Relationships Between the Agricultural Sector and the Macroeconomy in Iran with Emphasis on Structural Breaks. *Parliament and Economy*, 3(1), 264-277. https://doi.org/10.22034/mec.2025.17746.1104 [In Persian]
16. Pilanawithana, N. M., Feng, Y., London, K, A., & Zhang, P. (2024). Drivers of resilience for safety management systems of building repair and maintenance companies: An empirical study. *Journal of Safety Science*, (202), 14-30. https://doi.org/10.1016/j.ssci.2026.107275
17. Rana, M., Kiminami, L., & Furuzawa, S. (2025). An analysis of factors affecting farmers' capacity building for sustainable rural and agricultural development in Bangladesh. *Journal of Regional Science Policy & Practice*, 17(8), 1-18. https://doi.org/10.1016/j.rspp.2025.100202
18. Rausand, M. (2023*). Risk assessment: Theory, methods, and applications*. New Jersey: Wiley.
19. Rizzo, D., Vinatier, F., Jacob, F., Ferchichi, I., Mekki, I., & Bailly, J. S. (2025). A framework for the sustainable maintenance of permanent runoff management structures in rainfed agriculture under climate change. *Journal of Environmental Management*, (377), 340-358. https://doi.org/10.1016/j.jenvman.2025.124718
20. Salvati, L., Salvia, R., Sateriano, A., Escriva-Saneugenio, F., Doukas, Y., Ciaschini, C., & Maialetti, M. (2025). Rural development and sustainable agriculture in advanced economies: socioeconomic realities environmental efficiency nexus. *Journal of Environmental Sustainability and Global Change*, 36(4), 115-130. https://doi.org/1016/B978-0-443-31596-1.00010-6

21. Seifollahi, N. (2026). Designing a Model of the Consequences of the Use of Digital Technologies on the Sustainability of Production and Market Performance of Agricultural Products. *Iranian Journal of Agricultural Economics and Development Research*, 57(1), 115-135. https://doi.org/10.22059/ijaedr.2026.407336.669402 [In Persian]
22. Shen, J., Zhang, Z., & Li, H., (2025). Cost-benefit analysis of remanufacturing of used agricultural machinery parts in China. *Journal of Cleaner Production*, (533), 217-238. https://doi.org/10.1016/j.jclepro.2025.146944
23. Soleimani, A., Abbaspourfard, M. H., & Sapkota, R. (2025). Artificial intelligence in agricultural machinery & robotics: A systematic review and future outlook. *Journal of Applied Soft Computing*, (194), 435-452. https://doi.org/10.1016/j.asoc.2026.114889
24. Soltanali, H., & Khojastehpour, M. (2023). Identifying and Prioritizing the Key Factors Affecting the Efficient Maintenance Management in the Agricultural Industry Based on Empirical Studies. *Journal of Agricultural Machinery*, 13(4), 427-45. https://doi.org/10.22067/jam.2022.76333.1104 [In Persian]
25. Takeshima, H. (2025). Agricultural mechanization. *Journal of Agriculture and Food Systems,* 24(2), 61-88. https://doi.org/10.1016/B978-0-443-15976-3.00080-5
26. Wang, B., Zhu, J., Chai, X., Liu, B., Zhang, G., & Yao, W. (2024). Research status and development trend of key technology of agricultural machinery chassis in hilly and mountainous areas. *Journal of Computers and Electronics in Agriculture*, (226), 129-155. https://doi.org/10.1016/j.compag.2024.109447
27. Wang, K. J., Aji Basuki, S. S., & Kurniati, N. (2023). A life-cycle asset management model by response surface method based optimization. *International Journal of Production Economics*, (263), 441-458. https://doi.org/10.1016/j.ijpe.2023.108957
28. Weiss, M., Raddatz, F., & Wende, G. (2024). Predictive Maintenance for Life Cycle Engineering Using I4.0 Technologies in MRO Data Systems. *Journal of Procedia CIRP*, (140), 677-689. https://doi.org/10.1016/j.procir.2026.05.114
29. Wu, C., Li, D., Zhang, X., Pan, J., Quan, L., Yang, L., Yang, W., & Zhai, W. (2023). China's agricultural machinery operation big data system. *Journal of Computers and Electronics in Agriculture*, (205), 506-528. https://doi.org/10.1016/j.compag.2022.107594
30. Yang, Y., Wang, Z., & Luo, R. (2025). Financial innovation and agricultural Investment: Drivers of sustainable growth in China's rural economy with regional variations. *Journal of International Review of Economics & Finance*, (101), 389-410. https://doi.org/10.1016/j.iref.2025.104230
31. Yousefi Taleghani A, Molaei Hashjin N, Rezaei P. Explaining the economic and social factors affecting land use changes in peripheral rural settlements of Rasht. *Journal Space Economy & Rural Development*, 11(39),163-182. http://serd.khu.ac.ir/article-1-3806-fa.html [In Persian]
32. Zaccarine, S. A., Wang, Z., & Klaus, D. (2024). Monitoring, maintenance and fault management considerations for self-sufficient deep-space habitat operations. *Journal of Acta Astronautica*, (225), 376-389. https://doi.org/10.1016/j.actaastro.2024.07.055

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Original Article

رتبه‌بندی محرک‌های هزینه‌های نگهداری ماشین‌آلات کشاورزی و تأثیر آنها بر پایداری اقتصادی روستایی در غرب ایران

خلیل جایدری[۱]، صادق فیض‌اللهی*[۲]، علیرضا ایرج‌پور[۳]

۱. دانشجوی دکترای مدیریت صنعتی، دانشگاه آزاد اسلامی واحد قزوین، قزوین، ایران.
۲. استادیار مدیریت صنعتی، دانشگاه آزاد اسلامی واحد ایلام، ایلام، ایران.
۳. استادیار مدیریت صنعتی، دانشگاه آزاد اسلامی واحد قزوین، قزوین، ایران.

چکیده مبسوط

۱. مقدمه

توسعه پایدار روستایی تا حد زیادی به بهره‌وری و پایداری اقتصادی فعالیت‌های کشاورزی وابسته است. در این میان، مکانیزاسیون کشاورزی با افزایش بهره‌وری عملیات، کاهش نیاز به نیروی کار و بهبود استفاده از منابع، نقش مهمی در تقویت اقتصاد روستایی دارد. بااین‌حال، افزایش هزینه‌های نگهداری و تعمیر ماشین‌آلات کشاورزی، به‌ویژه در شرایط فرسودگی ناوگان، محدودیت منابع مالی، افزایش قیمت قطعات یدکی و دشواری دسترسی به خدمات تخصصی، به یکی از چالش‌های مهم تولیدکنندگان کشاورزی تبدیل شده است. افزایش این هزینه‌ها ضمن کاهش سودآوری، ظرفیت سرمایه‌گذاری مجدد و نوسازی ماشین‌آلات را محدود کرده و در نهایت پایداری اقتصادی خانوارها و سکونتگاه‌های روستایی را تضعیف می‌کند. اگرچه مطالعات پیشین عوامل متعددی همچون سن ماشین‌آلات، شرایط بهره‌برداری، اجرای نگهداری پیشگیرانه، مدیریت قطعات یدکی، مهارت اپراتور و مدیریت نگهداری را شناسایی کرده‌اند، بخش عمده آنها عوامل فنی، مدیریتی یا عملیاتی را به‌صورت جداگانه بررسی کرده و از روش‌های آماری متعارف استفاده نموده‌اند. در نتیجه، شواهد محدودی درباره اهمیت نسبی عوامل متعدد و روابط غیرخطی میان آنها وجود دارد. پژوهش حاضر با هدف شناسایی و رتبه‌بندی عوامل مؤثر بر هزینه‌های نگهداری و تعمیر ماشین‌آلات کشاورزی و تبیین پیامدهای آنها برای پایداری اقتصادی مناطق روستایی غرب ایران انجام شده است. نوآوری اصلی پژوهش، تلفیق دانش خبرگان، داده‌های واقعی ماشین-سال و الگوریتم یادگیری ماشین XGBoost در یک چارچوب تحلیلی یکپارچه است.

۲. مبانی نظری تحقیق

چارچوب نظری پژوهش بر تلفیق «نظریه چرخه عمر دارایی» و «نظریه قابلیت اطمینان و تعمیرپذیری» استوار است. نظریه چرخه عمر دارایی بر این اصل تأکید دارد که عملکرد و هزینه‌های یک دارایی در تمام مراحل عمر آن، از خرید و بهره‌برداری تا نگهداری، نوسازی و جایگزینی، شکل می‌گیرد؛ بنابراین تمرکز صرف بر هزینه اولیه خرید ماشین‌آلات نمی‌تواند هزینه واقعی چرخه عمر را تبیین کند. در این چارچوب، افزایش سن ماشین‌آلات و نزدیک‌شدن آنها به پایان عمر مفید، اهمیت تصمیمات مربوط به نگهداری، بازسازی و جایگزینی را افزایش می‌دهد. در مقابل، نظریه قابلیت اطمینان و تعمیرپذیری بر رابطه میان نرخ خرابی، زمان توقف، شرایط بهره‌برداری، سهولت تعمیر و هزینه‌های نگهداری تأکید دارد. بر این اساس، افزایش خرابی و پیچیدگی تعمیرات، هزینه‌های نگهداری و تعمیر را افزایش می‌دهد؛ درحالی‌که نگهداری پیشگیرانه، پایش وضعیت، مهارت نیروی انسانی و نظام‌های مدیریت نگهداری می‌توانند قابلیت اطمینان ماشین‌آلات را افزایش و هزینه‌های چرخه عمر را کاهش دهند. تلفیق این دو دیدگاه امکان تحلیل هم‌زمان ویژگی‌های فنی و چرخه عمر ماشین‌آلات با عوامل مدیریتی و عملیاتی و پیامدهای اقتصادی آنها را فراهم می‌کند.

۳. روش تحقیق

پژوهش حاضر از نظر هدف، کاربردی و از نظر طرح، توصیفی ـ پیمایشی و با رویکرد آمیخته کیفی ـ کمی انجام شده است. قلمرو مکانی تحقیق شامل مناطق روستایی استان‌های کرمانشاه، ایلام و کردستان است. در مرحله کیفی، ابتدا با مرور نظام‌مند مطالعات، ۴۷ عامل اولیه در چهار حوزه فنی ـ تجهیزاتی، مدیریتی، انسانی و محیطی ـ عملیاتی شناسایی شد. سپس برای بومی‌سازی و پالایش عوامل، با ۲۴ نفر از خبرگان مکانیزاسیون کشاورزی به شیوه نمونه‌گیری هدفمند مصاحبه نیمه‌ساختاریافته انجام شد. تحلیل مضمون مصاحبه‌ها به استخراج ۱۲۸ کد اولیه، ۱۸ مقوله فرعی و چهار مضمون اصلی منجر شد و در نهایت، با توجه به قابلیت اندازه‌گیری و دسترسی به داده‌های معتبر، متغیرهای قابل استفاده در تحلیل کمی انتخاب شدند. در مرحله کمی، اطلاعات واقعی نگهداری و تعمیرات ۸۰ دستگاه ماشین‌آلات کشاورزی دارای سوابق کامل در یک دوره سه‌ساله گردآوری شد. واحد تحلیل «ماشین-سال» و حجم

*. نویسندهٔ مسئول:
دکتر صادق فیض‌اللهی
آدرس: گروه مدیریت صنعتی، دانشکده مدیریت، دانشگاه آزاد اسلامی واحد ایلام، ایلام، ایران.
پست الکترونیکی: Email: Sadegh.feizollahi@iau.ac.ir

داده‌ها ۲۴۰ مشاهده بود. پس از تحلیل‌های توصیفی و محاسبه ضریب همبستگی پیرسون، الگوریتم (XGBoost) برای مدل‌سازی هزینه‌های نگهداری و تعمیر و رتبه‌بندی اهمیت متغیرها به کار گرفته شد. داده‌ها به دو بخش آموزشی ۸۰ درصدی و آزمون ۲۰ درصدی تقسیم شدند و اهمیت متغیرها با معیار Gain سنجیده شد.

۴. یافته‌های تحقیق

یافته‌های مرحله کیفی نشان داد که هزینه‌های نگهداری و تعمیر حاصل تعامل مجموعه‌ای از عوامل است و نمی‌توان آن را صرفاً به فرسودگی ماشین‌آلات نسبت داد. از میان ۱۲۸ کد استخراج‌شده، عوامل مدیریتی با ۳۰.۵ درصد و عوامل فنی ـ تجهیزاتی با ۲۸.۱ درصد بیشترین فراوانی را داشتند و پس از آنها عوامل انسانی با ۲۱.۱ درصد و اقتصادی ـ محیطی با ۲۰.۳ درصد قرار گرفتند. مهم‌ترین مسائل شناسایی‌شده شامل نبود برنامه نوسازی ناوگان، ضعف برنامه‌ریزی تعمیرات اساسی، ناکارآمدی مدیریت قطعات یدکی، نبود سیستم مدیریت نگهداری رایانه‌ای(CMMS)، فرسودگی ماشین‌آلات، عدم اجرای نگهداری پیشگیرانه، شرایط سخت بهره‌برداری، کمبود نیروی متخصص و محدودیت‌های مالی بود. نتایج تحلیل کمی نیز بر اهمیت عوامل فنی، عملیاتی و مدیریتی تأکید کرد. بیشترین همبستگی مثبت با هزینه‌های نگهداری و تعمیر مربوط به سن ماشین‌آلات (۰.۷۸۱) و شرایط بهره‌برداری (۰.۷۵۳) بود؛ درحالی‌که اجرای نگهداری پیشگیرانه با ضریب ۰.۷۴۲- رابطه منفی و قوی با هزینه‌ها داشت. مدل XGBoost عملکرد پیش‌بینی مطلوبی نشان داد و در داده‌های آزمون به ضریب تعیین ۰.۸۶، RMSE برابر ۳۹.۴ میلیون ریال و MAE برابر ۲۸.۷ میلیون ریال دست یافت. رتبه‌بندی بر اساس معیار Gain نشان داد که سن ماشین‌آلات (۱۸.۹ درصد)، عدم اجرای نگهداری پیشگیرانه (۱۷.۲ درصد) و شرایط نامطلوب بهره‌برداری (۱۵.۱ درصد) سه عامل اصلی هستند و در مجموع ۵۱.۲ درصد اهمیت مدل را تشکیل می‌دهند. پس از آنها، زمان تأمین قطعات یدکی (۹.۸ درصد)، استفاده از CMMS(۸.۵ درصد)، ساعات کار سالانه (۷.۸ درصد)، مهارت اپراتور (۶.۹ درصد) و شرایط محیطی (۵.۸ درصد) قرار گرفتند.

۵. بحث و نتیجه‌گیری

نتایج نشان می‌دهد که هزینه‌های نگهداری و تعمیر ماشین‌آلات کشاورزی پدیده‌ای چندبعدی است که بیش از همه تحت تأثیر سن ماشین‌آلات، اجرای نگهداری پیشگیرانه و شرایط بهره‌برداری قرار دارد. این یافته با چارچوب نظری چرخه عمر دارایی و قابلیت اطمینان و نیز نتایج مطالعات پیشین همخوان است، اما پژوهش حاضر با استفاده هم‌زمان از داده‌های واقعی ماشین-سال و XGBoost، امکان شناسایی روابط پیچیده و رتبه‌بندی عینی اهمیت عوامل را فراهم کرده است. همچنین، پیوند مستقیم هزینه‌های نگهداری با پایداری اقتصادی روستایی، وجه تمایز مهم این مطالعه محسوب می‌شود. از منظر سیاستی، نوسازی تدریجی ماشین‌آلات فرسوده، استقرار برنامه‌های نظام‌مند نگهداری پیشگیرانه، بهبود شرایط بهره‌برداری، مدیریت بهینه زنجیره تأمین قطعات یدکی، توسعه سیستم‌های CMMS و آموزش مستمر اپراتورها باید در اولویت قرار گیرد. به‌ویژه، سیاست‌های تسهیلات اعتباری و مشوق‌های نوسازی بهتر است ماشین‌آلات با سن بالا و هزینه تعمیرات زیاد را هدف قرار دهند. اجرای این اقدامات می‌تواند با کاهش توقف ماشین‌آلات و هزینه تولید، افزایش سودآوری و ظرفیت سرمایه‌گذاری مجدد کشاورزان و در نهایت تقویت پایداری اقتصادی فعالیت‌های کشاورزی، به توسعه پایدار مناطق روستایی غرب ایران کمک کند.

کلیدواژه‌ها: ماشین‌آلات کشاورزی، هزینه‌های نگهداری و تعمیر، الگوریتم XGBoost، پایداری اقتصادی، توسعه روستایی، مکانیزاسیون کشاورزی.

تشکر و قدردانی

مطالعه حاضر حامی مالی نداشته و حاصل فعالیت علمی نویسنده است.

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Original Article

Assessing Elderly Tourists' Satisfaction Based on Infrastructural, Social, and Environmental Factors Using Structural Equation Modeling (Case Study: Khabr, Baft County)

Mehri Jahansoozi*[1], Neda Dehghani[2]
1- Ph.D. graduate in Geography & Rural Planning, University of Zanjan, Zanjan, Iran.
2- Ph.D. graduate in Geography & Rural Planning, University of Zanjan, Zanjan, Iran

Abstract
Purpose- Population aging has increased the importance of senior tourism as a distinct and growing segment of the tourism market. However, elderly tourists may have specific requirements related to accessibility, social interaction, safety, comfort, and environmental quality. This study aims to examine the relationships between infrastructural, social, and environmental dimensions and elderly tourists' satisfaction and to assess these relationships within an integrated structural framework in Khabr District, Baft County, Kerman Province, Iran.
Design/methodology/approach- The study employed an applied, quantitative, descriptive-analytical research design. The statistical population consisted of elderly tourists aged 60 years and above, with the individual tourist serving as the unit of analysis. Data were collected from 375 elderly tourists through a structured questionnaire using random sampling. The measurement model comprised three latent constructs—infrastructural, social, and environmental dimensions—measured through nine observed indicators. Data were analyzed using descriptive statistics, confirmatory factor analysis, and Structural Equation Modeling (SEM). The reliability and validity of the measurement model were assessed using standardized factor loadings, Composite Reliability (CR), Average Variance Extracted (AVE), and discriminant validity.
Findings- The results demonstrated that all three dimensions had positive and statistically significant relationships with elderly tourists' satisfaction. The social dimension showed the strongest effect ($\beta = 0.38$, C.R. = 5.76, $P < 0.001$), followed by the infrastructural dimension ($\beta = 0.31$, C.R. = 4.82, $P < 0.001$) and the environmental dimension ($\beta = 0.24$, C.R. = 3.91, $P < 0.001$).
Originality/Value- The findings indicate that elderly tourists' satisfaction is a multidimensional phenomenon shaped by the interaction of social, infrastructural, and environmental conditions. The study's originality lies in integrating these three dimensions into a unified SEM framework rather than examining them independently. The findings provide empirical support for age-sensitive tourism planning and suggest that developing senior-friendly destinations requires coordinated attention to social participation, accessible infrastructure, and safe, clean, and attractive environments.
Keyword: Senior tourism, Leisure, Satisfaction, Tourism development, Khabr District.

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Corresponding Author:
Jahansoozi, Mehri, Ph.D.
Address: Department of Geography, Faculty of Humanities, University of Zanjan, Zanjan, Iran.
Tel: +989017212206
Email: m.jahansoozi86@gmail.com

1. Introduction

Today, both developed countries and several developing nations are facing the phenomenon of population aging, which presents numerous opportunities for diverse economic activities (Le Serre & Chevalier, 2012). Among these activities, tourism stands out as one of the largest and most varied global industries (Zahmatkesh Saredorahi et al., 2022). In recent decades, the tourism industry has emerged as a pivotal and fundamental sector in the global economy due to its capacity to generate income, employment, and tax revenues (Pérez-Calderón et al, 2020; Camilleri, 2018). This is because it contributes significantly to the economic and social development of countries (Bharti, 2019) and is regarded as a primary driver of economic growth (Ashrafi & Hadi, 2019). Within the various branches of tourism, senior tourism has attracted substantial attention owing to its distinctive capabilities and competitive advantages (Asadi, 2016). One of the key achievements of the current century, stemming from advancements in healthcare systems, disease prevention, and increased life expectancy, is the phenomenon of population aging. This demographic shift has resulted in longer lifespans and a consequent rise in the global elderly population (Zahmatkesh Saredorahi et al., 2022). Thanks to progress in medical sciences and rapid technological development, people today enjoy longer lives accompanied by improved health and quality of life, with global life expectancy rising from 50 years in the 1950s to 71.4 years in 2017 (Otoo, Felix & Kim, Seongseop, 2020). According to United Nations projections, by 2050, individuals over the age of 65 will constitute one-sixth of the world population, numbering approximately 2.1 billion, compared to one-eleventh in 2019. Although aging is more pronounced in developing countries, the United Nations warns that this challenge will affect almost all countries worldwide, necessitating greater scholarly engagement to address it effectively (Nielsen, 2014).

Aging, an inevitable and integral aspect of human development, has accelerated dramatically in contemporary times. Among the activities conducive to enhancing the physical and mental well-being of older adults, travel and tourism are particularly beneficial (Tabrizi, Nozarasl, naghavi & Esmaeeli, 2018). Accordingly, the tourism and travel industry must evolve in tandem with the aging trend. By nature, humans are not sedentary; they continuously strive for growth and fulfillment. Tourism and travel facilitate this dynamism across diverse environmental, spiritual, social, and cultural contexts, especially for seniors who often have more leisure time (Alén, Losada, & Domínguez, 2016). Although the physical and psychological health of elderly individuals is vulnerable to illness, providing a safe and comfortable environment enables them to engage in recreational and tourism activities (Gobbens & van Assen, 2018).

The growth of tourism participation among the elderly, compared to their non-elderly counterparts, is attributable to rapid health improvements within this demographic, greater available leisure time, and personal motivations such as escaping daily routines, socializing, seeking knowledge, and nostalgia (Nemati, Cheraghi, FeyzolahPour & Abbasi, 2025). Given the potential of active aging to foster positive health outcomes—including physical, mental, and social well-being—stimulating activities such as tourism have emerged as a critical area of research within the field of elderly health (Qiao et al., 2022). Older adults display a higher propensity to participate in recreational and tourism activities and, compared to younger generations, prioritize travel as a key life goal (Nemati et al., 2025). In fact, with the growth of the aging population, seniors are more active travelers than previous generations (Friman & Olsson, 2020), indicating that the proportion of elderly tourists is likely to continue increasing (Losada, Alen, Cotos-Yanez, & Dominguez, 2019).

The intersection of the two fields mentioned—aging and tourism—gives rise to the concept of senior tourism, which has gained increasing significance due to the simultaneous growth of the elderly population on one hand, and the expansion and flourishing of the tourism industry on the other. The importance of senior tourism can be examined from two key perspectives: economic and social. From an economic standpoint, a large proportion of countries that serve as tourist sources are experiencing population aging, moving toward an older demographic structure. Consequently, the

new generation of seniors typically enjoys greater leisure time, better health status, higher disposable income, and fewer social responsibilities, which collectively lead to a heightened propensity for travel-related activities and expenditures in the travel market. Moreover, given the seasonal nature of tourism products, the senior tourism market presents a strategic opportunity to balance demand fluctuations by bridging low and peak seasons effectively. Simultaneously, the development of senior tourism is especially critical in developing countries like Iran, which face challenges such as mono-product economies and foreign exchange constraints. From a social perspective, travel plays a significant role in enhancing the quality of life for older adults by improving their psychological well-being and helping them feel connected to society despite their age. Enhancing quality of life in this demographic indirectly contributes to better health outcomes and, consequently, reduces community healthcare costs (Kord, Karoubi, Ghaderi & Yavari Gohar, 2024).

In the global trend of population aging, Iran is no exception. In 2020, approximately 6% of Iran's total population consisted of elderly individuals, with projections estimating this figure to reach around 30% by 2050 (Mehri, Messkoub & Kunkel, 2020). According to United Nations forecasts (2019), in 2020, approximately 5 million people aged over 65 constituted part of Iran's 83.4 million population, with this number expected to increase to 20.3 million out of a total 92.2 million by 2050 (Kord et al., 2024).

Effective management within the tourism sector ensures that seniors are not marginalized and continue to play active roles in society. In this context, organized senior trips and tours can serve as fundamental strategies enabling the elderly to fulfill their diverse desires and needs across different communities, particularly in Iran. This approach could significantly contribute to the revitalization and advancement of the tourism industry, which has often been overlooked in the country (Khaligh, Alizadeh & Jafari, 2024). Demographic shifts necessitate comprehensive planning to address the evolving needs of the aging population. Given the positive impacts of travel and tourism on physical and mental health, as well as overall well-being of seniors, there is a pressing need for targeted research in this domain (Tavangar & Hashemian, 2024). Khabr District in Baft County, Kerman Province, is a scenic destination with considerable tourism and ecotourism potential. The area contains diverse natural and recreational attractions and receives visitors from different locations. However, the development of senior tourism in such destinations requires a better understanding of whether the existing tourism environment adequately responds to the needs and expectations of older visitors.

Previous studies have examined various aspects of senior tourism, including tourists' motivations, preferences, accessibility, tourism experiences, and satisfaction. However, much of the existing research has considered these issues either separately or primarily from a descriptive perspective. Less attention has been paid to examining how different characteristics of the tourism environment are simultaneously associated with elderly tourists' satisfaction within an integrated analytical framework. In particular, the relationships among infrastructural, social, and environmental dimensions and elderly tourists' satisfaction require further empirical investigation in local tourism destinations. This gap is important because satisfaction among elderly tourists may not be determined by a single characteristic of a destination; rather, it may reflect the combined influence of physical and infrastructural conditions, social interactions and services, and environmental characteristics.

Against this background, the present study seeks to address this gap by developing and empirically examining an integrated measurement and structural framework comprising infrastructural, social, and environmental dimensions in relation to elderly tourists' satisfaction. Rather than treating these dimensions solely as descriptive characteristics of the destination, the study examines their structural relationships with satisfaction using Structural Equation Modeling (SEM). The theoretical contribution of the study lies in bringing these dimensions together within a unified analytical framework and empirically examining their relationships with elderly tourists' satisfaction. This integrated approach provides a more systematic understanding of how different dimensions of the tourism environment are associated with the satisfaction of older visitors and extends the discussion beyond the isolated examination of individual tourism characteristics.

Accordingly, the central research problem addressed in this study is the limited empirical understanding of how infrastructural, social, and environmental conditions are associated with elderly tourists' satisfaction and how these dimensions can be examined jointly within tourism planning. This problem is particularly relevant because older tourists may have specific requirements related to accessibility, safety, comfort, social interaction, and environmental conditions. Identifying the relationships between these dimensions and satisfaction can provide empirical evidence for more responsive and age-sensitive tourism planning and policymaking.

Therefore, the main objective of this study is to examine the relationships between infrastructural, social, and environmental dimensions and elderly tourists' satisfaction and to assess the adequacy of the proposed measurement and structural model. To achieve this objective, data were collected from 375 elderly tourists aged 60 years and above, and Structural Equation Modeling was employed to evaluate the measurement model and examine the hypothesized structural relationships among the study constructs. Accordingly, the study addresses the following research question:

To what extent do infrastructural, social, and environmental dimensions influence elderly tourists' satisfaction in the study area?

By linking the research question directly to the conceptual framework and the SEM approach, this study seeks to provide empirical evidence that can inform more evidence-based and age-responsive tourism planning and policymaking in the study area.

2. Research Theoretical Literature

Seniors represent one of the important groups that should be considered in tourism development planning, as population aging has become a major demographic issue. Although population aging initially emerged as a prominent phenomenon in industrialized countries, it has gradually become a global issue and is increasingly evident in developing countries as well (Zahmatkesh Saredorahi et al., 2022). The concept of aging encompasses multiple dimensions, including chronological, biological, psychological, and social aspects. Aging is a natural stage of the human life cycle (Dugarova, 2017). According to the World Health Organization, older age is generally defined as age 60 years and above (Mahdavi, Emadzadeh & Ansari, 2018). The growth of the older population does not necessarily imply a decline in their inclination to travel; rather, population aging has contributed to the emergence of older adults as an increasingly important target market within the tourism industry, particularly since the late twentieth century. This demographic trend has attracted the attention of researchers, planners, and tourism marketers. Consequently, understanding the characteristics and needs of senior tourists has become increasingly important for tourism planning and destination development (Zielińska-Szczepkowska, 2021; Hou Ren, Li & Yao, 2025). Travel can contribute to identity affirmation and life satisfaction among older adults (Sanmargaraja & Wee, 2015). Older adults may have particular conditions that influence their participation in tourism, including greater availability of leisure time after retirement and, for some individuals, greater financial resources and fewer work-related obligations (Mahdavi et al., 2018). In this regard, senior tourists have increasingly been recognized as an important market segment in the tourism industry. The development of senior tourism has attracted growing attention for several reasons: (1) the continued growth of the older population has increased the potential size of this market; (2) some older adults have greater availability of leisure time and financial resources for tourism activities; and (3) the travel patterns and duration of trips may vary according to older tourists' health, financial circumstances, and physical conditions (Mahdavi et al., 2018; Zahmatkesh Saredorahi et al., 2022). Therefore, understanding the characteristics and needs of older tourists is important for tourism planners and destination managers in developing tourism services and facilities appropriate for this market segment.

The travel motivations of older adults may be influenced by their income, health status, age, and physical conditions, which can also affect the duration and characteristics of their trips. Among tourists over the age of 65, changes in income and physical health may contribute to variations in travel frequency and duration. As physical limitations become more common with advancing age, recognizing the specific needs and constraints of older tourists is important for the development and segmentation of senior tourism markets. Many tourism destinations have increasingly considered senior tourism as an important market segment and

have sought to develop tourism products and services that are better adapted to older tourists' needs. Senior tourism can provide opportunities for recreation, social interaction, and engagement in tourism activities suited to older adults' capabilities and preferences. Therefore, the growing number and life expectancy of older adults have increased the importance of this market segment for tourism planners and destination managers (Nasiri Hendeh Khaleh & Mohagheghpour, 2024; Zahmatkesh Saredorahi et al., 2022; Liew, Hussin & Abdullah, 2021).

Travel and excursions can provide opportunities for recreation, social interaction, and engagement with new environments for people of different ages, including older adults. For seniors, tourism can be particularly relevant as a form of leisure and social participation after retirement. Older adults may have distinct travel needs and expectations due to their age, health conditions, physical capabilities, and previous life experiences. Senior tourism can be defined as the totality of phenomena and relationships arising from interactions among elderly tourists, tourism suppliers and vendors, governments, and host communities during the process of attracting and hosting older tourists (Tavangar & Hashemian, 2024). Seniors may therefore seek different values and benefits from tourism experiences. A better understanding of their expectations and values can enable destination managers to improve destination attributes according to the needs of senior tourists or to focus on market segments whose motivations are compatible with the characteristics and resources of the destination (Chen & Shoemaker, 2014).

In senior tourism, improving recreational and welfare facilities near tourist attractions can contribute to the comfort and safety of older tourists. Preserving the value and attractiveness of tourism resources, improving accessibility through appropriate signage indicating distances, routes, and directions, enhancing pathways and road conditions, providing scenic views and suitable rest areas, ensuring adequate sanitation facilities, and providing access to food and beverages, shops, and appropriate transportation can contribute to a more suitable tourism environment for older adults (Liew et al., 2021; Bagus & Utama, 2012). These destination attributes are particularly relevant to senior-friendly tourism because accessibility, safety, cleanliness, amenities, and supporting services can influence the suitability of tourism destinations for older visitors.

Senior tourists may have several characteristics and requirements that should be considered in tourism planning. These include adequate financial resources for travel, the possibility of travelling throughout different seasons depending on their individual circumstances, the importance of social interaction and communication during travel, and access to medical and health services throughout the trip. In particular, access to appropriate health and support services can be an important consideration for older tourists when selecting and experiencing tourism destinations (Vila, Darcy, & González, 2015; Zielińska-Szczepkowska, 2021).

Tourism has increasingly become an important leisure and social activity in modern societies. For older adults, participation in tourism can provide opportunities for recreation, social interaction, engagement with cultural and natural environments, and participation in activities suited to their interests and capabilities. Accordingly, tourism development for older adults should extend beyond economic considerations and take into account the social, environmental, accessibility, and service-related conditions that shape their tourism experiences. In this context, the development of senior-friendly tourism requires appropriate tourism resources, accessible facilities, transportation, accommodation, safety, and support services that respond to the specific needs of older tourists (Liew et al., 2021; Zielińska-Szczepkowska, 2021; Hou et al., 2025).

2.1 Review of Literature

Numerous studies have investigated senior tourism from different perspectives and within different geographical and social contexts. Bagus & Utama (2012), in a study entitled "Motivation and Satisfaction of Senior Tourists Visiting Bali (an Indonesian Tourism Destination)," employed statistical and multivariate techniques, including structural equation modeling, to identify the motivational factors influencing the satisfaction of foreign senior tourists during their holidays in Bali. The findings revealed that several motivational factors significantly influenced tourists' satisfaction, with relaxation and the desire to explore new places among the most prominent motivations.

Ghalamkari (2015) proposed strategies for the development of senior tourism based on market segmentation using neural networks. The study identified different segments of senior tourists, including young seniors, affluent seniors, and collectivist seniors, highlighting the heterogeneity of the senior tourism market and the importance of considering differences among older tourists when developing tourism strategies.

Woo, Kim & Uysal (2016), in their study entitled "A Measure of Quality of Life in Elderly Tourists," examined the relationship between the travel behaviors of elderly tourists and their quality of life. Focusing on tourists aged 65 years and older who were retired, the study used structural equation modeling to examine the relationships among travel motivation, travel constraints, leisure-life domain satisfaction, and overall life satisfaction. The findings showed that travel motivation positively influenced satisfaction with the leisure-life domain, while satisfaction with the leisure-life domain was associated with overall life satisfaction. However, travel constraints did not significantly affect leisure-life domain satisfaction. In a subsequent study, Wu, Wang, Wingate & Guo (2017) examined the sustainable development of the senior tourism market in China. Based on a review of the literature on senior tourism consumption, they applied the 4C marketing framework to develop recommendations for promoting the senior tourism industry. Their recommendations emphasized four key dimensions of marketing: customer needs, cost, convenience, and communication. The study highlighted the importance of adapting tourism products and marketing strategies to the characteristics and needs of older consumers.

Asadi, Boroumandzad & Malekinejad, (2017) concluded that insurance, health standards, security, special services, and transportation play pivotal roles in senior tourism development. Mahdavi et al. (2018), in their study on identifying and forecasting the senior tourist market based on expected values, showed that market segmentation facilitates improved travel package development and more effective strategies, identifying conservative, affluent, and young seniors via neural networks. Saeida Ardakani, Pezeshki Najaf Abadi, Alhosseini Almodarresi & Hosseini (2019), examined the cognitive structure of Iranian senior tourists regarding accommodation centers using the Means-End Chain theory. The study focused on the attributes and values considered important by senior tourists when selecting accommodation facilities.

Zieliska-Szczepkowska (2021), in her study entitled "What Are the Needs of Senior Tourists? Evidence from Remote Regions of Europe," investigated the tourism behavior, motivations, and decision-making factors of senior tourists in 11 remote regions across nine European countries. The study analyzed data from 1,705 questionnaires and used a mixed-methods approach combining survey data and interviews. The findings showed that rest and tranquility were important motivations for senior tourists. Safety, natural environments, historical sites, service quality, and convenient transportation connections were among the main factors considered when selecting a destination. The study also identified several barriers to the development of senior tourism in remote regions, including difficulties in reaching older tourists with tourism offers, insufficient promotion of tourism products designed for seniors, and limited financial resources for local tourism development projects.

Boonpat, Yolthasart & Utchaya (2022), investigated the development of wellness tourism activities to promote the tourism market for elderly tourists in Chiang Rai Province, Thailand. Using questionnaires, interviews, and focus groups, the study examined the travel behavior and tourism preferences of elderly tourists. The findings showed that the variety of tourist attractions, ethnic and cultural diversity, scenic beauty, architectural heritage, friendliness of local residents, quality of tourism services and facilities, and accessibility to destinations were among the factors that contributed to positive tourism experiences among elderly tourists. The study also identified cultural and religious activities, meditation, and nature-based activities as relevant forms of wellness tourism for this market segment.

Hu et al. (2023) through an interdisciplinary literature review and conceptual model, examined the potential role of tourism in promoting healthy aging among older adults. Their findings indicated that tourism can help older adults maintain functional abilities and quality of life through physical, cultural, sporting, and recreational activities, social participation, adequate nutrition, and positive emotions. The authors argued that tourism can contribute to healthy aging by supporting health and well-being among older adults and extending their healthspan. Tavangar & Hashemian (2024), in their study titled "Senior Tourism as a Strategy to Promote Elderly Well-being," examined tourism patterns of elderly in Khorasan Razavi province, demonstrating that tourism patterns constitute the primary basis for market segmentation.

They argued that the development of domestic tourism, especially quiet tourism, providing special services to seniors at tourist sites, designing recreational and health villages with dedicated senior facilities, and organizing affordable tours via activating relevant communication networks and senior membership can transform senior tourism into an effective tool for enhancing seniors' health levels.

More recent research has further strengthened this line of inquiry. Nergiz & Toker (2025) systematically reviewed 66 studies concerning healthy aging in tourism and highlighted the increasing academic attention to older adults as an important tourism market. Their review emphasized the importance of considering older tourists' specific needs and health status when developing tourism services and market segmentation strategies. The authors also identified senior tourism and healthy aging as an evolving research area requiring further empirical investigation into the experiences, needs, and preferences of older tourists.

Ruiz-Moreno Rodriguez-Sanchez, Bagnato & Ali (2026), in their study entitled "Mapping Seniors' Paths to Sustainable Tourism: An Enhanced Goal-Directed Behavior Approach," investigated the factors influencing seniors' participation in sustainable tourism using an extended goal-directed behavior model. Based on data collected from 1,202 senior tourists in Western and Eastern Europe, the findings revealed that all the variables examined significantly increased seniors' intentions to participate in sustainable tourism. The study emphasizes the importance of understanding the motivational and behavioral factors influencing seniors' participation in sustainable tourism and provides valuable evidence for developing tourism strategies that are more responsive to the characteristics and needs of senior tourists.

Qiao et al. (2026), in their study entitled "The Impact of Smart Tourism Technologies on Senior Tourists' Perceptions of Equity and Memorable Experiences," investigated how smart tourism technologies shape senior tourists' perceptions of equity and memorable tourism experiences. Using a mixed-methods approach, the study first identified four dimensions of technology-mediated equity perceptions among senior tourists and subsequently developed and tested a model examining their effects on memorable tourism experiences. The findings provide evidence that perceived equity in interactions between senior tourists and smart tourism technologies is an important factor in understanding memorable tourism experiences in smart tourism contexts.

3. Research Methodology

3.1 Geographical Scope of the Recsearch

The Khabr District in Baft County covers an area of approximately 16,920 hectares, of which 12,000 hectares are designated as Khabr National Park, while the remainder belongs to the Roghun Wildlife Refuge. This district is situated about 40 kilometers southwest of Baft city, located at the southern terminus of the Zagros mountain range. The confluence of springs on the eastern side of the village forms a permanent river known as the Khabr River.

In recent years, tourism has become a significant source of income for this rural district. On the eastern and southern outskirts of the village lies Khabr National Park, which is recognized as the eleventh national park registered in Iran. From a tourism perspective, visiting the stunning landscapes of the area—especially the majestic Khabr Mountains, deep valleys, and towering cliffs—leaves an enduring impression on visitors. Prominent natural attractions within the area include the high peaks of Chah Barf, Borj Shom, and Serito, as well as several notable springs such as Shah Velayat, Gharo, and Gerdu. The region also features caves like Shabpareh within the park and Dehsard on its periphery. Visitors can enjoy spectacular views of diverse vegetation, including both cold- and warm-climate species growing side by side, along with abundant and beautiful wildlife. These natural attributes contribute significantly to the area's appeal.From a cultural tourism standpoint, historical sites such as the stone fortress of Khabr, the earthen fortress of Kaht, and the Mil Tower, along with the presence of the Siyah Chador nomadic tribes and their traditional lifestyles, are among the region's most important attractions (Figure 1).

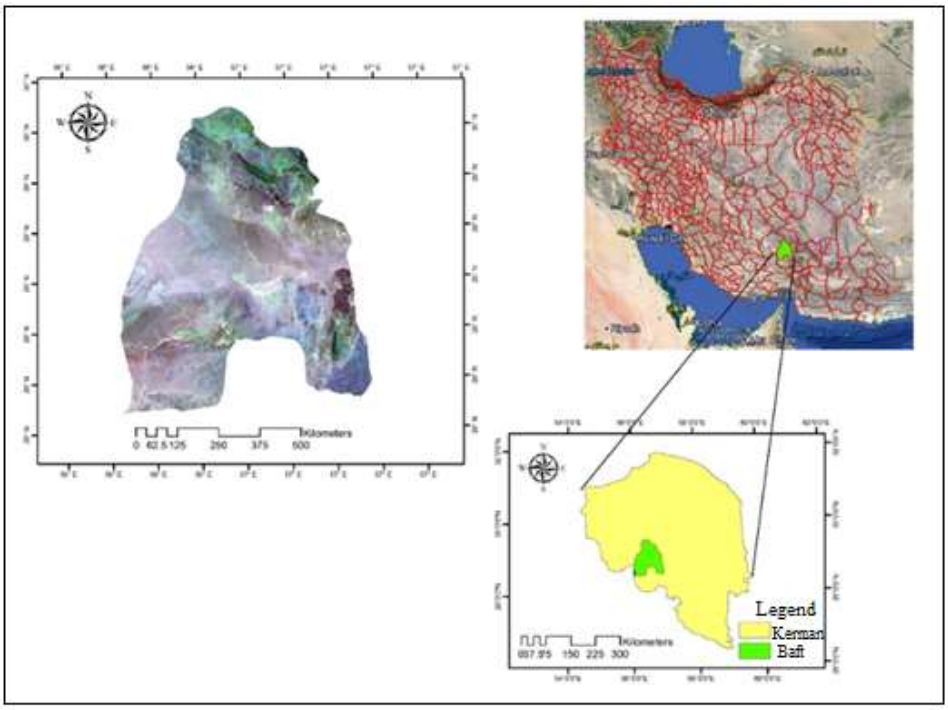


Figure 1. Geographical location of Baft County

3.2 Research Method

This study employed an applied, quantitative, descriptive-analytical research design to examine the factors associated with elderly tourists' satisfaction. The statistical population consisted of elderly tourists in the study area, and the individual elderly tourist constituted the unit of analysis. A total of 375 questionnaires were collected through random sampling. All 375 questionnaires were fully completed and considered suitable for subsequent analysis. Data were collected using a structured questionnaire developed based on the theoretical foundations and previous studies related to senior tourism and tourist satisfaction. The questionnaire was designed to measure the main constructs examined in the study (Table 1).

The measurement model included three main constructs: infrastructural, social, and environmental dimensions. Each construct was measured using three observed indicators, resulting in a total of nine observed indicators in the measurement model. The validity and reliability of the measurement instrument were assessed using standardized factor loadings, Composite Reliability (CR), and Average Variance Extracted (AVE). Standardized factor loadings of 0.50 or higher were considered acceptable. CR values above 0.70 were considered indicative of satisfactory construct reliability, whereas AVE values above 0.50 were considered evidence of adequate convergent validity. Discriminant validity was also assessed to ensure that the constructs were empirically distinguishable from one another.

The collected data were analyzed using descriptive statistics and Structural Equation Modeling (SEM). First, descriptive statistics were used to summarize the characteristics of the respondents and the observed variables. Subsequently, Confirmatory Factor Analysis (CFA) was employed to assess the measurement model and examine the relationships between the observed indicators and their corresponding latent constructs. CFA was selected because the measurement structure was theoretically specified in advance based on the theoretical foundations and previous empirical studies on senior tourism and tourist satisfaction. Therefore, the purpose of CFA was to assess the adequacy of the theoretically specified measurement structure rather than to explore an unknown factor structure. SEM was employed because the research framework involves multiple latent constructs measured through several observed indicators and examines the structural relationships among these constructs and elderly tourists' satisfaction. SEM enables the simultaneous assessment of the measurement and structural models, thereby allowing the adequacy of the measurement

indicators and the hypothesized relationships among the constructs to be evaluated within a unified analytical framework. The reliability and convergent validity of the constructs were assessed using standardized factor loadings, CR, and AVE, while discriminant validity was subsequently examined. Finally, SEM was used to evaluate the structural relationships among the study constructs and to test the proposed relationships in the conceptual model. The overall model fit was evaluated using commonly reported fit indices, including the chi-square-to-degrees-of-freedom ratio (χ^2/df), Comparative Fit Index (CFI), Incremental Fit Index (IFI), and Root Mean Square Error of Approximation (RMSEA) (Table 1).

Table 1. Measurement indicators for the dimensions of senior tourists' satisfaction

Dimension	Component	Abbreviation	Items (Statements)
Infrastructural	Tourist Satisfaction (Structural Performance Dimension)	A1	- Satisfaction with facilities and quality of healthcare services tailored to senior tourists - Satisfaction with facilities and appropriate treatment of senior tourists - To what extent are you satisfied with accommodation facilities? - To what extent are you satisfied with restaurants and catering services? - To what extent are you satisfied with public transportation facilities? - To what extent are you satisfied with services offered in various shops? - To what extent are you satisfied with parking facilities in the city? - To what extent are you satisfied with mobile phone connectivity? - To what extent are you satisfied with internet access and its speed? - To what extent are you satisfied with healthcare and medical services? - To what extent are you satisfied with accessibility and proximity to gas stations? - To what extent are you satisfied with financial services (banks, ATMs)? - To what extent are you satisfied with access to green spaces and parks?
	Tourist Satisfaction (Access and Communication Networks)	A2	- To what extent are you satisfied with easy and appropriate access to attractions? - How satisfied are you with city streets, alleys, and lanes? - How satisfied are you with traffic signs along tourist routes and attractions? - How satisfied are you with the safety of urban pathways? - To what extent are you satisfied with the areas you visit? - To what extent are you satisfied with access to automotive services such as repair shops and tire services? - To what extent are you satisfied with access to public transportation services in the city?
	Infrastructure Development	A3	- Provision of welfare facilities tailored to senior tourists - Development of tourism programs - Security, comfort, and relaxation for tourists - Use of experienced specialists in senior tourism - Resolving problems and confusion among seniors - Attention to seniors' health (nutrition) - Creating infrastructure suitable for senior tourist welfare - Creating lively and enjoyable spaces to improve mood
Environmental	Tourist Satisfaction (Tourism Attractions)	H1	- To what extent are you satisfied with the beauty and diversity of attractions? - Satisfaction with authentic and traditional elements in the city - Satisfaction with guidance and introduction to attractions - Satisfaction with availability of nighttime tourism services - Satisfaction with tranquility and number of attractions - Satisfaction with quality of access to health and hygiene facilities - Level of interaction with tourists from other regions - Satisfaction with tourism planning in the area
	Tourist	H2	- Satisfaction with the beauty of the environment and urban fabric

Dimension	Component	Abbreviation	Items (Statements)
	Satisfaction (Visual Dimension)		- Satisfaction with harmony of constructions in the city - Satisfaction with nighttime lighting - Satisfaction with pleasantness of tourist environments and sites - Satisfaction with cleanliness of streets and recreational areas - Extent of calmness and rest opportunities in urban and attraction environments
	Tourist Satisfaction (Environmental Dimension)	H3	- Comfort level with local residents - Satisfaction with drinking water quality - Satisfaction with air quality - Satisfaction with quality of green spaces - Satisfaction with cleanliness, waste absence, and waste collection - Satisfaction with environmental beauty
Social	Tourist Satisfaction (Social Environment)	B1	- Satisfaction with local hospitality - Satisfaction with traditional customs and ceremonies - Satisfaction with cooperation of locals and guides - Level of mutual trust between locals and tourists - Satisfaction with cultural attractiveness - Satisfaction with urban security - Feeling of liveliness and joy in the city - Satisfaction with availability of social interaction spaces
	Tourist Satisfaction (Environmental Dynamism)	B2	- Satisfaction with peace and quiet in the city - Business prosperity and economic activity levels - Reasonableness of ticket and tour prices in relation to seniors' income - Volume of tourist presence in the city - Fairness and honesty of the host community - Hospitality and warmth of the host community - Politeness and friendliness of the host community - Level of cooperation and guidance from locals - Willingness to revisit the area
	Training and Information	B3	- Training and informing people on appropriate behavior towards senior tourists - Proper information dissemination about tourist sites and suitable tourism and sports activities for seniors

4. Research Findings

4.1. Descriptive Findings

In this study, data analysis was conducted using both descriptive and inferential statistics. Initially, descriptive statistics were employed to examine the demographic characteristics of the sample population in terms of gender, age, and educational level. Subsequently, hypothesis testing and further analysis were performed using inferential statistical methods. Out of the 375 respondents, 293 individuals (78%) were male, and 82 individuals (22%) were female. Regarding age distribution, 25 respondents (6.7%) were aged between 55 and 60 years, 173 respondents (46.1%) between 60 and 65 years, 123 respondents (32.8%) between 65 and 70 years, and 54 respondents (14.4%) were 70 years or older. In terms of educational attainment, 66 respondents (17.6%) were illiterate or had primary education, 92 respondents (24.5%) had completed middle school, 110 respondents (29.3%) had secondary education or diploma, 82 respondents (21.8%) held an associate degree, and 25 respondents (6.6%) had a bachelor's degree or higher.

4.2. Measurement Model and Confirmatory Factor Analysis

The measurement model was evaluated using Confirmatory Factor Analysis (CFA). The standardized factor loadings of the observed indicators ranged from 0.62 to 0.81, indicating acceptable relationships between the observed indicators and their corresponding latent constructs. For the infrastructural dimension, the standardized factor loadings were 0.78, 0.72, and 0.75. For the social dimension, the corresponding factor loadings were 0.79, 0.81, and 0.62. The factor loadings for the environmental dimension were 0.76, 0.68, and 0.74 (Figure 2).

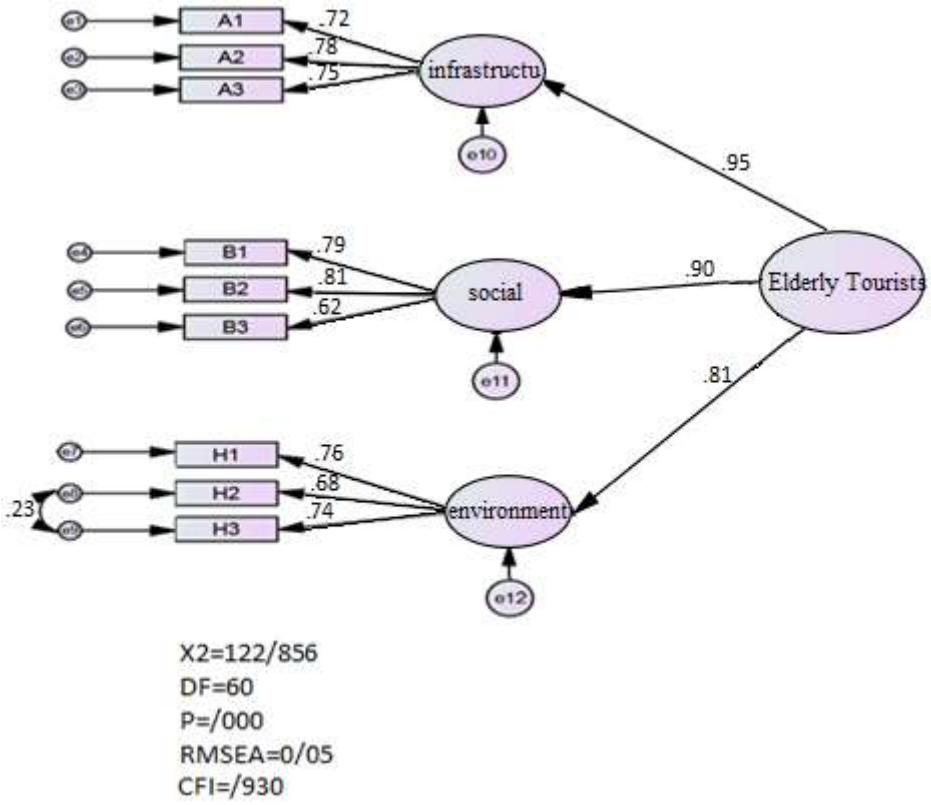


Figure 2. Final Model Explaining the Level of Satisfaction among Elderly Tourists

4.3. Composite Reliability and Convergent Validity

The reliability and convergent validity of the measurement model were assessed using Composite Reliability (CR) and Average Variance Extracted (AVE). As presented in (Table 2), The measurement model demonstrated satisfactory reliability and convergent validity. All standardized factor loadings exceeded the acceptable threshold of 0.50, ranging from 0.62 to 0.81. Composite Reliability (CR) values ranged from 0.771 to 0.794, exceeding the recommended threshold of 0.70. Moreover, the Average Variance Extracted (AVE) values ranged from 0.529 to 0.563, which were above the recommended minimum of 0.50. These results indicate satisfactory internal consistency and convergent validity for the infrastructural, social, and environmental constructs (Table 2).

Table 2. Reliability and Convergent Validity Assessment of the Measurement Model

Structure	Factor loadings	Standard coefficient	CR	AVE
Infrastructural	A1	0.794	0.794	0.563
	A2	0.78		
	A3	0.75		
Social	B1	0.79	0.787	0.555
	B2	0.81		
	B3	0.62		
Environment	H1	0.76	0.771	0.529

4.4. Discriminant Validity

Discriminant validity was assessed using the Heterotrait–Monotrait (HTMT) ratio. As presented in (Table 3), all HTMT values were below the recommended threshold of 0.85, indicating satisfactory discriminant validity among the infrastructural, social, and environmental constructs (Table 3).

Table 3. HTMT Results for Discriminant Validity

Constructs	Infrastructural	Social	Environmental
Infrastructural	-	0.71	0.68
Social	0.71	-	0.74
Environment	0.68	0.74	-

4.5. Model Fit

The model fit indices indicate an acceptable overall fit between the proposed measurement model and the observed data. The chi-square to degrees-of-freedom ratio was 2.047, which is below the commonly recommended threshold of 3. The Comparative Fit Index (CFI) and Incremental Fit Index (IFI) were both 0.93, exceeding the recommended value of 0.90. In addition, the RMSEA was 0.05, indicating a close and acceptable approximation of the model to the observed data. Taken together, these indices provide support for the adequacy of the proposed measurement model and allow the structural relationships among the latent dimensions to be interpreted (Table 4).

Table 4. Measurement Model Fit Results Based on Fit Indices

Fit Index	Recommended Criterion	Research Results
Chi-square / Degrees of Freedom (χ^2/df)	Less than 3.0	2.047
Comparative Fit Index (CFI)	Greater than or equal to 0.90	0.93
Incremental Fit Index (IFI)	Greater than or equal to 0.90	0.93
Root Mean Square Error of Approximation (RMSEA)	Less than 0.10	0.05

4.6. Structural Model and Hypothesis Testing

Following the assessment of the measurement model, the structural model was examined to test the hypothesized relationships among the study constructs. The standardized path coefficients (β), critical ratios (C.R.), and significance levels (P-values) were used to evaluate the proposed hypotheses. As shown in (Table 5), the infrastructural dimension had a positive and statistically significant effect on elderly tourists' satisfaction ($\beta = 0.31$, C.R. = 4.82, $P < 0.001$). This finding indicates that improvements in tourism-related infrastructure can contribute to higher levels of satisfaction among elderly tourists. The social dimension also showed a positive and statistically significant relationship with elderly tourists' satisfaction ($\beta = 0.38$, C.R. = 5.76, $P < 0.001$). Among the examined relationships, this path showed a relatively stronger standardized coefficient, suggesting that social conditions and interactions may play an important role in shaping the tourism experience of elderly visitors. Furthermore, the environmental dimension had a positive and statistically significant effect on elderly tourists' satisfaction ($\beta = 0.24$, C.R. = 3.91, $P < 0.001$). Although the magnitude of this relationship was lower than those of the infrastructural and social dimensions, the statistically significant coefficient indicates that environmental conditions remain relevant to elderly tourists' satisfaction. Overall, the findings suggest that infrastructural, social, and environmental dimensions are positively associated with elderly tourists' satisfaction. Therefore, the proposed relationships in the structural model are supported (Table 5).

Table 5. Structural Model Results and Hypothesis Testing Hypothesis

Structure	Structural path	B	C.R	P-value	Decision
H1	Infrastructural → Satisfaction	0.31	4.82	<0.001	Supported
H2	Social → Satisfaction	0.38	5.76	<0.001	Supported
H3	Environmental → Satisfaction	0.24	3.91	<0.001	Supported

5. Discussion and conclusion

The findings of this study provide empirical evidence regarding the factors associated with elderly tourists' satisfaction and highlight the importance of considering infrastructural, social, and environmental dimensions in senior tourism planning. The structural model indicates that all three dimensions have positive and statistically significant relationships with elderly

tourists' satisfaction, although the strength of these relationships varies. This finding suggests that the tourism experience of older adults is multidimensional and cannot be explained solely by the availability of tourism attractions. Rather, satisfaction is shaped by the interaction of destination infrastructure, social conditions, and environmental quality. The results showed that the infrastructural dimension had a positive and statistically significant effect on elderly tourists' satisfaction ($\beta = 0.31$, C.R. = 4.82, $P < 0.001$). This finding highlights the importance of providing appropriate and accessible infrastructure for older tourists. Elderly visitors may have greater accessibility and mobility requirements than other tourist groups; therefore, the availability of suitable transportation, safe pathways, rest areas, sanitation facilities, accommodation, and other supportive services can contribute to greater comfort and perceived safety. This finding is consistent with Asadi et al. (2017), who emphasized the importance of insurance, health standards, security, specialized services, and transportation in senior tourism development. It is also consistent with Saeida Ardakani et al. (2019), who identified cleanliness, location, security, and price as important considerations for Iranian senior tourists. Similarly, Zieliska-Szczepkowska (2021) highlighted convenient transportation and adequate facilities as important factors influencing the attractiveness of destinations for senior tourists. Thus, tourism infrastructure should be planned not only according to general tourism requirements but also according to the specific accessibility, safety, and comfort needs of older adults.

The social dimension demonstrated the strongest positive relationship with elderly tourists' satisfaction among the examined dimensions ($\beta = 0.38$, C.R. = 5.76, $P < 0.001$). This finding indicates that social interaction and supportive social environments are important components of the senior tourism experience. Tourism provides opportunities for communication, social participation, interpersonal interaction, and the strengthening of social relationships. This interpretation is consistent with Zhang & Zhang (2018), who found that leisure activities can strengthen interpersonal relationships and neighborhood connections among older adults. It is also consistent with Hu et al. (2023), who emphasized the contribution of social participation, recreational activities, and positive emotional experiences to maintaining the quality of life of older adults. In this regard, senior tourism should not be conceptualized solely as a form of leisure consumption. It can also function as a mechanism for maintaining social engagement and supporting the well-being of older adults. Therefore, tourism planning for seniors should incorporate opportunities for social interaction, participation, and communication alongside physical tourism facilities.

The environmental dimension also had a positive and statistically significant effect on elderly tourists' satisfaction ($\beta = 0.24$, C.R. = 3.91, $P < 0.001$). Although its standardized effect was lower than those of the social and infrastructural dimensions, the significant relationship confirms that environmental conditions remain an important component of the senior tourism experience. Older tourists may attach particular importance to cleanliness, tranquility, safety, accessible natural and recreational spaces, and the overall environmental quality of destinations. This finding is consistent with Zieliska-Szczepkowska (2021), who identified tranquility, safety, natural environments, and historical attractions among important factors in the selection of destinations by senior tourists. It also supports the broader argument of Liu, Wang & Li (2021) that contemporary tourism development should move beyond purely economic considerations and incorporate social and environmental dimensions. Taken together, the findings indicate that elderly tourists' satisfaction is influenced by a combination of physical, social, and environmental conditions. The relatively stronger role of the social dimension in the present model suggests that creating opportunities for interaction and participation may be particularly important in developing senior-friendly destinations. However, the significant effects of the infrastructural and environmental dimensions demonstrate that social interventions alone are insufficient. Social participation must be supported by accessible infrastructure and a safe, comfortable, and attractive environment. This integrated perspective is consistent with Tavangar & Hashemian (2024), who emphasized the importance of specialized services, appropriate tourism facilities, quiet tourism environments, and health-oriented facilities in improving elderly well-being through tourism. From a planning and policymaking perspective, the findings suggest that senior tourism should be incorporated into destination planning as a distinct and age-sensitive tourism segment. Tourism planners should improve accessibility through safe and convenient transportation, appropriate pathways, adequate

signage, rest areas, sanitation facilities, and age-sensitive accommodation and recreational services. At the same time, destination managers should provide opportunities for social interaction and participation, including group activities, community-based tourism experiences, and spaces that facilitate communication between elderly tourists and local residents. Environmental management should also emphasize cleanliness, tranquility, safety, preservation of natural and cultural attractions, and easy access to recreational environments. Accordingly, senior tourism policies should move from a general approach toward a more integrated and needs-oriented planning framework that considers the specific physical, social, and environmental requirements of an aging tourist population.

Overall, this study demonstrates that the development of senior tourism requires more than the provision of tourism attractions and should be approached through an integrated framework combining accessibility, social participation, and environmental quality. The findings indicate that the social dimension had the strongest relationship with elderly tourists' satisfaction, followed by the infrastructural and environmental dimensions. These findings highlight the multidimensional nature of elderly tourists' satisfaction and provide empirical support for age-sensitive tourism planning. From a practical perspective, the findings can assist tourism planners and policymakers in prioritizing infrastructure, strengthening social opportunities, and improving environmental conditions for older visitors. Nevertheless, this study has some limitations. The findings are based on data collected from the selected study area and should therefore be generalized to other destinations with caution. In addition, the study relies primarily on questionnaire-based responses and reflects the perceptions of participants during the study period. Future studies could examine senior tourism in different geographical contexts, compare the experiences of elderly tourists across destinations, and incorporate additional dimensions such as health services, economic accessibility, digital accessibility, and destination management. Overall, the findings emphasize that an integrated approach to infrastructure, social participation, and environmental quality can contribute to developing more accessible, comfortable, and satisfying tourism destinations for older adults.

Author Contributions

The authors contributed equally to the development and preparation of this research.

Conflict of Interest

The authors declare that there is no conflict of interest regarding the authorship or publication of this article.

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References

1. Alén, E., Losada, N., & Domínguez, T. (2016). The impact of ageing on the tourism industry: An approach to the senior tourist profile. *Social Indicators Research, 127*(1), 303–322. https://doi.org/10.1007/S11205-015-0966-X
2. Asadi, M M, Boroumandzad, Y & Malekinejad, A. (2017). An Analytical study of the development of elderly tourism with a cartographic approach (Case study: Yazd province). Tourism Planning and Development, 6 (22), 77-96. https://doi.org/10.22080/jtpd.2017.1708. [In Persian]
3. Asadi, M. M. (2016). Strategies for developing senior tourism with the Interpretive Structural Modeling (ISM) technique approach in Yazd province. *Social Studies in Tourism*, *4*(7), 1-10. http://fsh.fatemiyehshiraz.ac.ir/fa/Article/35171 [In Persian]
4. Ashrafi, A., & Hadi, F. (2019). The impact of tourism on developing Shiraz rural women entrepreneurship. *Universidad y Sociedad, 11*(4), 72-76. https://rus.ucf.edu.cu/index.php/rus/article/view/1294
5. Bagus, I. G., & Utama, R. (2012, September). Motivation and satisfaction of senior tourists for traveling overseas. In *Proceedings of the 13th International Conference on Academy and Business, Bali* (pp. 12-14).
6. Bharti, S. (2019). Economic impacts of rural tourism in Madhya Pradesh. *International Journal of Advance Research, Ideas and Innovations in Technology, 5* (1), 462-466. https://www.ijariit.com/manuscript/economic-impacts-of-rural-tourism-in-madhya-pradesh/
7. Boonpat, O., Yolthasart, S., & Utchaya, N. (2022). Wllness tourism activity model development to promote tourism market for the elderly tourist in Chiang Rai province. *Journal of Management Information & Decision Sciences*, *25*(2), 1-12. https://www.abacademies.org/articles/wellness-tourism-activity-model-development-to-promote-tourism-market-for-thai-elderly-tourists-in-chiang-rai-province-14236.html

8. Camilleri, M. A. (2018). Travel marketing, tourism economics and the airline product: An introduction to theory and practice. Springer International Publishing. https://link.springer.com/book/10.1007/978-3-319-49849-2
9. Chen, S.C., & Shoemaker, S. (2014). Age and cohort effects: The American senior tourism market. *Annals of Tourism Research, 48*, 58-75. https://doi.org/10.1016/j.annals.2014.05.007
10. Dugarova, E. (2017). Ageing, older persons and the 2030 agenda for sustainable development. United Nations Development Programme; New York.
11. Friman, M., & Olsson, L. E. (2020). Daily travel and wellbeing among the elderly. *International Journal of Environmental Research and Public Health, 17*(7), 2342. https://doi.org/10.3390/ijerph17072342
12. Ghalamkari, Sh. (2015). Strategies for developing senior tourism; approaches toward market segmentation using neural network. *Journal of Business Management Perspective*, *13*(4), 49-66. https://www.sid.ir/paper/850568/fa [In Persian]
13. Gobbens, R. J., & van Assen, M. A. (2018). Associations of environmental factors with quality of life in older adults. *The Gerontologist, 58*(1), 101-110. https://doi.org/10.1093/geront/gnx051
14. Hou, P., Ren, L., Li, Y., & Yao, J. (2025). Exploring senior-friendly tourism destination attributes—dimensions and prioritization. Humanities and Social Sciences Communications, 12, 1661. https://doi.org/10.1057/s41599-025-05919-0
15. Hu, F., Wen, J., Phau, I., Ying, T., Aston, J., & Wang, W. (2023). The role of tourism in healthy aging: An interdisciplinary literature review and conceptual model. *Journal of Hospitality and Tourism Management*, *56*, 356-366. https://doi.org/10.1016/j.jhtm.2023.07.013
16. Khaligh, A., Alizadeh, K., & Jafari, H. (2024). The Role of the Experience Economy in the Development of Senior Tourism Behavior (Case Study: Mashhad City) .*Tourism of Culture, 4*(15), 6-17. https://www.toc-sj.com/article_185409.html?lang=en. [In Persian]
17. Kord, A., Karoubi, M., Ghaderi, E., & Yavari Gohar, F. (2024). Categories of Senior Tourism Development; A meta-synthesis approach, *Journal of Social Development and Welfare Planning, 14*(57), 171-214. https://doi.org/10.22054/qjsd.2023.69449.2389
18. Le Serre, D. & Chevalier, C. (2012). Marketing travel services to senior consumers. *Journal of Consumer Marketing, 29*(4), 262 – 270. https://doi.org/10.1108/07363761211237335
19. Liew, S. L., Hussin, S. R., & Abdullah, N. H. (2021). Attributes of senior-friendly tourism destinations for current and future senior tourists: An importance-performance analysis approach. SAGE Open, 11(1), 1–19. https://doi.org/10.1177/2158244021998658
20. Liu, X., Wang, Y., & Li, M. (2021). How to identify future priority areas for urban development: An approach of urban construction land suitability in ecological sensitive areas. *International Journal of Environmental Research and Public Health, 18*(8), 4252. https://doi.org/10.3390/ijerph18084252
21. Losada, N., Alen, E., Cotos-Yanez, T. R., & Dominguez, T. (2019). Spatial heterogeneity in Spain for senior travel behavior. *Tourism Management, 70*, 444-452. https://doi.org/10.1016/j.tourman.2018.09.011
22. Mahdavi, S., Emadzadeh, M. & Ansari, A. (2018). Identifying and predicting the market for the "elderly" tourism with an approach to the expected values. *Tourism Management Studies*, *13*(44), 39-70. https://doi.org/10.22054/tms.2018.9642. [In Persian]
23. Mehri, N., Messkoub, M., & Kunkel, S. (2020). Trends, Determinants and the Implications of Population Aging in Iran. *Ageing International*, *45*(2020), 327–343. https://doi.org/10.1007/s12126-020-09364-z
24. Nasiri Hendeh Khaleh, E., Mohagheghpour, S.Y. (2024). Investigating Barriers to the Development of Senior Tourism Activities (Case Study of Qom City). *Journal of Geography and Planning*, *28* (87), 319-335. https://doi.org/10.22034/gp.2022.52253.3018. [In Persian]
25. Nemati, M.R., Cheraghi, M., FeyzolahPour, M., & Abbasi, M.J. (2025). Examining the role of tourism on the social health of the elderly, case study: Asara district, Alborz province. *Journal of Economic Geography Research, 6*(19), 71-84. https://doi.org/10.30470/jegr.2024.2025078.1162. [In Persian]
26. Nergiz, H. G., & Toker, F. (2025). Healthy aging in the tourism industry: A systematic literature review. SAGE Open, 15(3), 1–22. https://doi.org/10.1177/21582440251379664
27. Nielsen, K. (2014). Approaches to seniors' tourist behavior. *Tourism Review, 69*(2), 111-121. https://doi.org/10.1108/TR-05-2013-0021
28. Otoo, Felix E., & Kim, Seongseop (2020). Analysis of studies on the travel motivations of senior tourists from 1980 to 2017: progress and future directions. *Current Issues in Tourism, 23*(4), 393-417. https://doi.org/10.1080/13683500.2018.1540560
29. Pérez-Calderón, E., Prieto-Ballester, J. M., Miguel-Barrado, V., & Milanés-Montero, P. (2020). Perception of sustainability of spanish national parks: Public use, tourism and rural development. *Sustainability*, *12*(4), 1-14. https://doi.org/10.3390/su12041333

30. Qiao, G., Chen, Y., Wang, J., Liu, Z., & Shao, Z. (2026). The impact of smart tourism technologies on senior tourists' perceptions of equity and memorable experiences. Journal of Hospitality and Tourism Management, 66, 101415. https://doi.org/10.1016/j.jhtm.2026.101415
31. Qiao, G., Ding, L., Xiang, K., Prideaux, B., & Xu, J. (2022). Understanding the value of tourism to seniors' health and positive aging. *International journal of environmental research and public health, 19*(3), 1476. https://doi.org/10.3390/ijerph19031476
32. Ruiz-Moreno, F., Rodriguez-Sanchez, C., Bagnato, G., & Ali, A. A. (2026). Mapping seniors' paths to sustainable tourism: An enhanced goal-directed behavior approach. Journal of Travel Research. https://doi.org/10.1177/00472875251410232
33. Saeida Ardakani, S., Pezeshki Najaf Abadi, F., Alhosseini Almodarresi, S. M. & Hosseini, F. S. (2019). Extraction of cognitive structure of Iranian senior tourists towards Lodging: Means-End Chain approach. *Tourism Management Studies*, *14*(48), 179-210. https://doi.org/10.22054/tms.2020.32161.1922. [In Persian]
34. Sanmargaraja, S., & Wee, S. T. (2015). Accessible transportation system for the disabled tourist in the national park of Johor State, Malaysia. *International Journal of social science and Humanity*, *5*(1). 15-21. https://doi.org/10.7763/IJSSH.2015.V5.414
35. Tabrizi, N., Nozarasl, S., naghavi, M. & Esmaeeli, M. (2018). Assessment of elderly Tourists' views about Mashhad through "age-friendly city" factores. *Urban tourism*, *5*(3), 83-99. https://doi.org/10.22059/jut.2018.235473.337. [In Persian]
36. Tavangar, M., & Hashemian, M. (2024). Elderly Tourism: A Strategy for Promoting Elderly Health, Investigating the Elderly Tourism Pattern of Khorasan Razavi. *Human Geography Research Quarterly, 56* (4), 267-284. http://doi.org/10.22059/jhgr.2024.351470.1008568. [In Persian]
37. Vila, T. D., Darcy, S., & González, E. A. (2015). Competing for the disability tourism market–A comparative exploration of the factors of accessible tourism competitiveness in Spain and Australia. *Tourism management*, *47*, 261-272.https://doi.org/10.1016/j.tourman.2014.10.008
38. Woo, E., Kim, H. & Uysal, M. (2016). A Measure of Quality of Life in Elderly Tourists. *Applied Research in Quality of life*, *11*(1), 65-82. https://doi.org/10.1007/s11482-014-9355-x
39. Wu, S., Wang, Z., Wingate, N., & Guo, H. (2017). Developing the Elderly Tourism Market in China. *In 2017 International Conference on Education Science and Economic Management* (ICESEM 2017) (pp. 27-30). Atlantis Press. https://doi.org/10.2991/icesem-17.2017.7
40. Zahmatkesh Saredorahi, M., Basouli, M., siadatan, M., Ardian, A. & ovaisi, L. (2022). Identifying and Prioritizing the Factors Affecting Elderly Health Tourism in Yazd Province Using Fuzzy Cognitive Mapping Approach. *Journal of Tourism and Development*, *11*(4), 213-224. https://doi.org/10.22034/jtd.2020.236443.2061. [In Persian]
41. Zhang, L., & Zhang, J. (2018). Impacts of leisure and tourism on the elderly's quality of life in intimacy: A comparative study in Japan. *Sustainability*, *10*(12), 4861. https://doi.org/10.3390/su10124861
42. Zieliska-Szczepkowska, J. (2021). What Are the Needs of Senior Tourists? Evidence from Remote Regions of Europe. *Economies, 9*(4), 148. https://doi.org/10.3390/economies9040148

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Original Article

ارزیابی رضایت گردشگران سالمند برپایه عوامل زیرساختی، اجتماعی و محیطی با استفاده از مدل سازی معادلات ساختاری (مطالعه موردی: بخش خبر، شهرستان بافت)

مهری جهانسوزی*[1]، ندا دهقانی[2]

۱. دانش‌آموخته دکترای جغرافیا و برنامه‌ریزی روستایی، گروه جغرافیا، دانشگاه زنجان، زنجان، ایران.

۲. دانش‌آموخته دکترای جغرافیا و برنامه‌ریزی روستایی، گروه جغرافیا، دانشگاه زنجان، زنجان، ایران.

چکیده مبسوط

۱. مقدمه

افزایش جمعیت سالمندان در ایران و جهان، گردشگری سالمندان را به یکی از حوزه‌های مهم و رو به رشد صنعت گردشگری تبدیل کرده است. افزایش امید به زندگی، بهبود وضعیت سلامت و افزایش زمان فراغت سالمندان موجب شده است این گروه به بخش مهمی از بازار گردشگری تبدیل شوند. گردشگری علاوه بر ایجاد فرصت‌های تفریحی، می‌تواند از طریق تقویت تعاملات اجتماعی، مشارکت و ارتباط با محیط‌های طبیعی و فرهنگی، به بهبود سلامت و کیفیت زندگی سالمندان کمک کند. بااین‌حال، سالمندان به دلیل ویژگی‌های جسمانی، روان‌شناختی و اجتماعی خاص، در مقایسه با سایر گروه‌های سنی نیازهای متفاوتی در زمینه دسترسی، ایمنی، آسایش، خدمات و کیفیت محیطی دارند. ازاین‌رو، توجه به این نیازها در برنامه‌ریزی و سیاست‌گذاری گردشگری سالمندان اهمیت ویژه‌ای دارد .در ایران، روند فزاینده سالمندی جمعیت و ظرفیت‌های متنوع گردشگری، ضرورت توسعه مقاصد متناسب با نیازهای سالمندان را افزایش داده است. بخش خبر شهرستان بافت در استان کرمان با برخورداری از جاذبه‌های طبیعی و ظرفیت‌های گردشگری و طبیعت‌گردی، از قابلیت مناسبی برای توسعه گردشگری سالمندان برخوردار است. با وجود این ظرفیت‌ها، شناخت عواملی که رضایت گردشگران سالمند را شکل می‌دهند، برای برنامه‌ریزی مؤثر این نوع گردشگری ضروری است. بر این اساس، پژوهش حاضر با هدف بررسی رابطه این سه بعد با رضایت گردشگران سالمند و ارزیابی مدل اندازه‌گیری و ساختاری پیشنهادی انجام شد. پرسش اصلی پژوهش این است که ابعاد زیرساختی، اجتماعی و محیطی تا چه اندازه با رضایت گردشگران سالمند ارتباط دارند؟

۲. مبانی نظری

گردشگری سالمندان به‌عنوان یکی از حوزه‌های رو به رشد گردشگری، تحت تأثیر روند افزایش جمعیت سالمند و تغییر الگوهای زندگی و فراغت در جوامع مختلف اهمیت فزاینده‌ای یافته است. سالمندان به دلیل شرایط جسمی، روانی و اجتماعی متفاوت، در انتخاب مقصد و تجربه سفر نیازها و انتظارات خاصی دارند. عواملی مانند دسترسی مناسب، امنیت، امکانات بهداشتی، حمل‌ونقل، کیفیت خدمات، آرامش محیط، جاذبه‌های طبیعی و فرصت‌های تعامل اجتماعی می‌توانند بر کیفیت تجربه و رضایت آنان از مقصد تأثیرگذار باشند. بررسی مطالعات پیشین نشان می‌دهد که زیرساخت‌های گردشگری یکی از عناصر اساسی در توسعه گردشگری سالمندان است؛ زیرا دسترسی آسان، مسیرهای ایمن، امکانات استراحت، خدمات بهداشتی و اقامت مناسب می‌تواند احساس امنیت و آسایش سالمندان را افزایش دهد. همچنین، بعد اجتماعی از طریق فراهم کردن فرصت‌های ارتباط، مشارکت، تعامل با جامعه میزبان و فعالیت‌های گروهی می‌تواند به افزایش رضایت و بهزیستی سالمندان کمک کند. از سوی دیگر، کیفیت محیطی شامل پاکیزگی، آرامش، امنیت، زیبایی طبیعی و دسترسی به فضاهای تفریحی و طبیعی، از عوامل مؤثر بر تجربه گردشگری سالمندان محسوب می‌شود. در مجموع، ادبیات نظری نشان می‌دهد که رضایت گردشگران سالمند پدیده‌ای چندبعدی است و نمی‌توان آن را صرفاً بر اساس جذابیت‌های گردشگری یک مقصد توضیح داد.

۳. روش تحقیق

این پژوهش از نظر هدف، کاربردی و از نظر رویکرد، کمی و با طرح توصیفی–تحلیلی انجام شد. جامعه آماری پژوهش را گردشگران سالمند در منطقه مورد مطالعه تشکیل دادند و واحد تحلیل، گردشگر

*. نویسندهٔ مسئول:
مهری جهانسوزی
آدرس: گروه جغرافیا، دانشکده علوم انسانی، دانشگاه زنجان، زنجان، ایران.
پست الکترونیکی: Email: m.jahansoozi86@gmail.com

سالمند بود. در مجموع، ۳۷۵ پرسشنامه از طریق نمونه‌گیری تصادفی جمع‌آوری شد که تمامی پرسشنامه‌ها به‌طور کامل تکمیل و برای تحلیل آماری مناسب تشخیص داده شدند. داده‌ها با استفاده از پرسشنامه ساختاریافته‌ای گردآوری شد که بر اساس مبانی نظری و مطالعات پیشین مرتبط با گردشگری سالمندان و رضایت گردشگران طراحی شده بود. مدل اندازه‌گیری پژوهش شامل سه سازه اصلی زیرساختی، اجتماعی و محیطی بود که هر یک با سه شاخص مشاهده‌شده اندازه‌گیری شدند. برای ارزیابی پایایی و روایی همگرای سازه‌ها از بارهای عاملی استانداردشده، پایایی ترکیبی (CR) و میانگین واریانس استخراج‌شده (AVE) استفاده شد و روایی واگرا نیز مورد بررسی قرار گرفت. داده‌ها با استفاده از آمار توصیفی و مدل‌سازی معادلات ساختاری (SEM) تحلیل شدند. ابتدا تحلیل عاملی تأییدی (CFA) برای ارزیابی مدل اندازه‌گیری و سپس SEMبرای بررسی روابط ساختاری میان سازه‌های پژوهش و رضایت گردشگران سالمند به کار گرفته شد. برازش مدل نیز با استفاده از شاخص‌های χ^2/df، CFI، IFI و RMSEA ارزیابی شد.

۴. یافته‌های تحقیق

نتایج مدل ساختاری نشان داد که هر سه بعد مورد بررسی، رابطه‌ای مثبت و معنادار با رضایت گردشگران سالمند دارند. بعد اجتماعی با ضریب مسیر استاندارد ۰/۳۸ = β، مقدار ۵/۷۶ = C.R. و سطح معناداری ۰/۰۰۱> P، قوی‌ترین رابطه را با رضایت گردشگران سالمند نشان داد. این یافته بیانگر اهمیت تعاملات اجتماعی، مشارکت، ارتباط با دیگران و وجود محیط‌های اجتماعی حمایت‌کننده در شکل‌گیری تجربه گردشگری سالمندان است .بعد زیرساختی نیز رابطه‌ای مثبت و معنادار با رضایت گردشگران سالمند داشت (۰/۳۱ = β، ۴/۸۲ = C.R. و ۰/۰۰۱> P). این نتیجه نشان می‌دهد که دسترسی مناسب، حمل‌ونقل ایمن و راحت، مسیرهای مناسب، امکانات استراحت، خدمات بهداشتی و سایر زیرساخت‌های متناسب با نیازهای سالمندان، نقش مهمی در افزایش آسایش، امنیت و رضایت آنان ایفا می‌کنند .همچنین، بعد محیطی با ضریب مسیر ۰/۲۴ = β، مقدار ۳/۹۱ = C.R. و ۰/۰۰۱> P، رابطه‌ای مثبت و معنادار با رضایت گردشگران سالمند نشان داد. اگرچه شدت این رابطه در مقایسه با دو بعد اجتماعی و زیرساختی کمتر بود، اما همچنان اهمیت شرایط محیطی در تجربه گردشگری سالمندان را تأیید می‌کند. پاکیزگی، آرامش، امنیت، کیفیت فضاهای طبیعی و تفریحی و جذابیت کلی محیط از جمله عواملی هستند که می‌توانند رضایت گردشگران سالمند را افزایش دهند. در مجموع، نتایج نشان داد که رضایت گردشگران سالمند ماهیتی چندبعدی دارد و نمی‌توان آن را صرفاً بر اساس جذابیت‌های گردشگری مقصد توضیح داد. ترتیب اهمیت ابعاد بر اساس ضرایب استاندارد مدل به این صورت بود: بعد اجتماعی، بعد زیرساختی و بعد محیطی.

۵. نتیجه‌گیری

در مجموع، نتایج نشان می‌دهد که توسعه گردشگری سالمندان در منطقه مورد مطالعه نیازمند توجه همزمان به مشارکت و تعامل اجتماعی، زیرساخت‌های مناسب و کیفیت محیطی است. بر این اساس، برنامه‌ریزی برای گردشگری سالمندان نباید صرفاً بر توسعه جاذبه‌های گردشگری متمرکز باشد، بلکه باید شرایطی فراهم کند که سالمندان بتوانند با امنیت، آسایش و امکان مشارکت اجتماعی از مقصد استفاده کنند. از منظر برنامه‌ریزی و سیاست‌گذاری، بهبود دسترسی و حمل‌ونقل، توسعه امکانات و خدمات متناسب با سالمندان، ایجاد فضاهای مناسب برای تعامل اجتماعی و ارتقای کیفیت محیطی می‌تواند در افزایش رضایت آنان و توسعه مقاصد سالمندپسند مؤثر باشد. بنابراین، یافته‌های پژوهش بر ضرورت اتخاذ رویکردی یکپارچه و نیازمحور در برنامه‌ریزی و توسعه گردشگری سالمندان تأکید دارد.

کلیدواژه‌ها: گردشگری سالمندان، اوقات فراغت، رضایتمندی، توسعه گردشگری، بخش خبر

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فهرست مندرجات

عنوان	صفحه
▪ تبیین پیشران‌های اثرگذاری هوش مصنوعی بر توسعه کارآفرینی فناورانه (مطالعه موردی: نواحی روستایی شهرستان شمیرانات) علی‌اکبر عنابستانی- بهناز رحیمی	(۱۹-۱)
▪ تحلیل تطبیقی سازوکارهای حقوقی تعیین وضعیت ثبتی اراضی و ساختمان‌های فاقد سند رسمی مالکیت در حقوق ایران و آلمان، با تأکید بر کارایی نهادی نظام ثبت اراضی مهدی جدیدی- مهدی ذوالفقاری- احمدرضا بهنیافر	(۴۲-۲۱)
▪ برنامه توسعه اقتصادی و اشتغال‌زایی روستایی در استان خراسان شمالی (مطالعه موردی: دهستان آذری، شهرستان اسفراین) حسین قدرتی- مسعود سامیان	(۶۶-۴۳)
▪ تحلیل پدیده کولبری و شناسایی ظرفیت های توسعه اقتصادی جایگزین در نواحی روستایی (مطالعه موردی: دهستانهای سرکل و زریوار- شهرستان مریوان) سعدی محمدی- فریدون احمدی- شوبو کریمی	(۹۴-۶۷)
▪ رتبه‌بندی محرک‌های هزینه‌های نگهداری ماشین‌آلات کشاورزی و تأثیر آنها بر پایداری اقتصادی روستایی در غرب ایران خلیل جایدری- صادق فیض‌اللهی- علیرضا ایرج‌پور	(۱۳۰-۹۵)
▪ ارزیابی رضایت گردشگران سالمند برپایه عوامل زیرساختی، اجتماعی و محیطی با استفاده از مدل سازی معادلات ساختاری (مطالعه موردی: بخش خبر، شهرستان بافت) مهری جهانسوزی- ندا دهقانی	(۱۴۸-۱۳۱)

داوران این شماره به ترتیب حروف الفبا

دکتر منیژه احمدی (استادیار جغرافیا وبرنامه‌ریزی روستایی دانشگاه زنجان)

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۹. ۳. انواع نقل قول‌ها (مستقیم و غیر مستقیم)، نقل به مضمون و مطالب به دست آمده از منابع و مآخذ، با حروف نازک و استفاده از نشانه‌گذاری‌های مرسوم، مشخص شود و نام صاحبان آثار، تاریخ و شماره صفحات منابع و مآخذ، بلافاصله در میان پرانتز نوشته شود.

۱۰. مقالات برگرفته از رساله و پایان‌نامه دانشجویان با نام استاد راهنما، مشاوران و دانشجو به صورت توأمان و با مسؤولیت استاد راهنما منتشر می‌شود.

۱۱ . چنانچه مخارج تحقیق یا تهیه مقاله توسط مؤسسه‌ای تأمین مالی شده باشد، باید در بخش تشکر و قدردانی مشخص گردد.

۱۲ . شیوه ارزیابی مقالات: مقالات ارسالی که شرایط پذیرش را احراز کنند، برای داوران خبره در آن موضوع ارسال می‌شوند. داوران محترم، جدای از ارزشیابی کیفی مقالات، راهبردهای سازنده‌ای پیشنهاد می‌کنند. پیشنهادهای داوران محترم به طور کامل، اما بدون نام و نشان داور، برای نویسنده مقاله ارسال خواهد شد.

۱۳ . مجله حق رد یا قبول و نیز ویراستاری مقالات را برای خود محفوظ می‌دارد و مقالات مسترد نمی‌گردد. اصل مقالات رد یا انصراف داده شده پس از سه ماه از مجموعه آرشیو مجله خارج خواهد شد و مجله پژوهش و برنامه‌ریزی روستایی هیچ مسئولیتی در این ارتباط نخواهد داشت.

۱۴ . مسؤولیت ارائه صحیح مطالب مقاله بر عهده‌ی نویسندگان مقاله است. از این‌رو، نسخه‌ای از مقاله آماده چاپ برای انجام آخرین تصحیحات احتمالی به نشانی الکترونیکی نویسنده ارسال خواهد شد. چنانچه ظرف مدت یک هفته پاسخی از سوی نویسندگان واصل نگردید به معنای موافقت آنها با اصلاحات انجام شده تلقی و نسبت به چاپ آن اقدام می‌شود.

۱۵. دریافت مقاله صرفاً از طریق سامانه مجله (http://jrrp.um.ac.ir) خواهد بود و مجله از پذیرش مقالات دستی یا پستی معذور خواهد بود.

۱۶. نویسندگان گرامی، مقالاتی که مطابق فرمت مجله تهیه نشده باشند به نویسنده بازگردانده شده و در فرآیند ارزیابی قرار نخواهد گرفت.

۱۷. فایل های ضروری برای ارسال از طریق سامانه عبارتند از:

الف) فایل مشخصات نویسندگان: در محیط word شامل اسامی و مشخصات نویسندگان به فارسی و انگلیسی.

ب) فایل اصلی مقاله بدون مشخصات: در محیط word شامل متن اصلی مقاله بدون اسامی و مشخصات نویسندگان.

ج) فایل چکیده مبسوط (مکمل) مقاله: شامل چکیده مبسوط فارسی در قالب یک فایل در محیط Word.

۱۸. شرایط جزئی تر و دقیق تر نیز در فایل راهنمای نگارش و ارسال مقاله توسط نویسندگان ارائه شده است.

۱۹. مقاله پس از ارزیابی علمی به زبان انگلیسی برگردانده شده و نویسنده(گان) موظف به ترجمه آن در مراکز ویراستاری معتبر خواهند بود و تا قبل از انجام ترجمه، امکان ارسال گواهی پذیرش مقدور نمی‌باشد. لذا پیشنهاد می‌شود فارسی زبانان مقاله خود را به زبان فارسی تهیه و ارسال نموده و پس از طی فرایند ارزیابی علمی و پذیرش نسبت به ترجمه آن اقدام شود.

آدرس پستی: مشهد- میدان آزادی- پردیس دانشگاه فردوسی مشهد- دانشکده ادبیات و علوم انسانی- دفتر مجلهٔ پژوهش و برنامه‌ریزی روستایی.

کد پستی: ۹۱۷۷۹۴۸۸۸۳ تلفن و نمابر: ۰۵۱-۳۸۷۹۶۸۴۰ پست الکترونیکی Rplanning@um.ac.ir

وب سایت: http://jrrp.um.ac.ir/

فرم اشتراک (یک ساله/ دوشماره) **مجلهٔ پژوهش و برنامه‌ریزی روستایی**

این جانب ..... شغل ..... با ارسال فیش بانکی به مبلغ ..... ریال به حساب جاری شماره **۴۲۵۲۹۹۶۳۸** بانک تجارت شعبه دانشگاه مشهد کد **۴۲۵۰** به نام عواید اختصاصی دانشکده ادبیات و علوم انسانی، متقاضی اشتراک فصلنامه از شماره .....هستم. چنانچه صاحبان مقالات منتشر شده متقاضی دریافت مجلّه و تیراژه‌ی آن از طریق پست پیشتاز باشند، باید هزینه‌ی آن را به شماره حساب مذکور واریز و اصل فیش پرداختی را به نشانی دفتر مجلّه ارسال کنند.

نشانی: ..... کدپستی: .....

شرایط پذیرش مقاله

برای سرعت بخشیدن به امر داوری و چاپ مقالات، از همهٔ پژوهشگرانی که مایل به چاپ مقالات علمی خود در این نشریه هستند، درخواست می‌شود به نکات زیر توجه کافی داشته باشند:

۱ . مقالهٔ ارسال شده نباید قبلاً در هیچ نشریهٔ داخلی یا خارجی چاپ شده باشد. هیئت تحریریه انتظار دارد نویسندگان محترم تا هنگامی که جواب پذیرش از نشریه نرسیده است، مقالهٔ خود را به مجلهٔ دیگری برای چاپ ارسال نفرمایند.

۲ . مقالات انگلیسی با قلم نازک Times New Roman11 با نرم افزار Word تهیه شود. مقالات، روی کاغذ A4 (با حاشیه از بالا ۳ و پایین ۲ و راست ۲ و چپ ۲ سانتی‌متر) تایپ شود. متن به صورت دو ستونی با رعایت فاصله ۱ سانتی‌متر بین دو ستون و فواصل بین خطوط به صورت single باشد. ۳ . حجم مقاله نباید ازحدود ۹۵۰۰ کلمه و یا حداکثر ۱۵ صفحهٔ چاپی به قطع نشریه بیشتر باشد (با در نظر گرفتن محل جداول، اشکال، خلاصه فارسی و فهرست منابع).

۴ . عنوان مقاله با در نظرگرفتن فواصل بین کلمات نباید از ۶۰ حرف تجاوز کند و با قلم Times New Roman14 سیاه تایپ شود.

۵ . نام نویسندهٔ مقاله با قلم سیاه Times New Roman10 عنوان علمی یا شغلی او با قلم Times New Roman10 در زیر عنوان مقاله ذکر شود. ضمناً آدرس الکترونیکی و شماره تلفن نویسندهٔ مسؤول در پاورقی آورده شود.

۶ . چکیدهٔ مقاله ساختاریافته با قلم نازک Times New Roman 11 به صورت تک ستونی باشد.

۷ . شکل‌ها و نمودارهای مقاله حتماً اصل و دارای کیفیت مطلوب باشد. فایل اصلی اشکال (تحت Word ،PDF ،Excel) و با دقت ۳۰۰ dpi ارائه شود. اندازهٔ قلم‌ها خصوصاً در مورد منحنی‌ها (legend) به گونه‌ای انتخاب شوند که پس از کوچک‌شدن مقیاس شکل برای چاپ نیز خوانا باشند.

۸ . ساختار مقاله شامل عناصر زیر است:

۸. ۱ صفحهٔ عنوان: در صفحهٔ شناسنامه باید عنوان مقاله، نام و نام خانوادگی نویسنده (نویسندگان)، درجهٔ علمی، نشانی دقیق (کد پستی، تلفن، دورنگار و پست الکترونیکی)، محل انجام پژوهش، مسؤول مقاله و تاریخ ارسال) درج شود. عهده‌دار مکاتبات باید با علامت ستاره مشخص شود.

۸. ۲ چکیده: شامل چکیده‌های فارسی ساختار یافته (شامل هدف؛ روش؛ یافته‌ها؛ محدودیت‌ها؛ راهکارهای عملی؛ اصالت و ارزش و واژگان کلیدی (۳ تا ۶ کلمه)) است. تا حد امکان چکیدهٔ مقاله از ۳۰۰ کلمه تجاوز نکند . علاوه بر چکیده ساختار یافته، لازم است چکیدهٔ مبسوط فارسی بین ۷۵۰ تا ۱۰۰۰ کلمه نیز حاوی مقدمه، مبانی نظری، روش، نتایج و بحث، نتیجه‌گیری و کلیدواژه‌های مقاله تهیه شود، به طوری که حاوی اطلاعاتی از کل مقاله باشد و بتوان جداگانه آن را چاپ کرد. با توجه به این که مقاله بعدا به صورت کامل به انگلیسی برگردانده خواهد شد، نیازی به ترجمه چکیده مبسوط به انگلیسی نیست.

۸. ۳ مقدمه: شامل ۱- طرح مسئله؛ ۲- اهمیت و ضرورت؛ ۳- اهداف و سوالات اصلی تحقیق.

۸. ۴ ادبیات نظری تحقیق: شامل ۱- تعاریف و مفاهیم؛ ۲- دیدگاه‌ها و مبانی نظری؛ ۳- پیشینه نظری تحقیق و ... .

۸. ۵ روش‌شناسی تحقیق: در برگیرندهٔ ۱- محدوده و قلمرو پژوهش؛ ۲- روش تحقیق و مراحل آن (روش تحقیق، جامعهٔ آماری، روش نمونه‌گیری، حجم نمونه و روش تعیین آن، ابزار گردآوری داده‌ها و اعتبارسنجی آن‌ها)؛ ۳- سؤال‌ها و فرضیه‌ها؛ ۴- معرفی متغیرها و شاخص‌ها؛ ۵- کاربرد روش‌ها و فنون.

۸. ۶ یافته‌های تحقیق: ارائهٔ نتایج دقیق یافته‌های مهم با رعایت اصول علمی و با استفاده از جداول و نمودارهای لازم.

۸. ۷ بحث و نتیجه‌گیری: شامل آثار و اهمیت یافته‌های پژوهش و یافته‌های پژوهش‌های مشابه دیگر با تأکید بر مغایرت‌ها و علل آن، توضیح قابلیت تعمیم‌پذیری و کاربرد علمی یافته‌ها و ارائهٔ رهنمودهای لازم برای ادامهٔ پژوهش در ارتباط با موضوع، نتیجه‌گیری و توصیه‌ها و پیشنهادهای احتمالی.

۸. ۸ تشکر و قدردانی: قبل از منابع مورد استفاده ارائه شود و از ذکر عناوین دکتر و مهندس خودداری شود.

۹. نحوهٔ ارجاعات: منابع و مآخذ باید به صورت درون‌متنی و همچنین در پایان مقاله ذکر شود.

۹. ۱ ارجاعات در متن مقاله باید به شیوهٔ داخل پرانتز (APA) نسخه ۶ باشد؛ به گونه‌ای که ابتدا نام مؤلف یا مؤلفان، سال انتشار و صفحه ذکر شود. شایان ذکر است که ارجاع به کارهای چاپ شده فقط به زبان فارسی بوده و در اسامی لاتین معادل آن در زیر نویس همان صفحه ارائه شود. به عنوان نمونه: (شکوئی، ۱۳۸۷، ص. ۵۰) یا (وودز، ۲۰۰۵، ص. ۲۷).

۹. ۲ در پایان مقاله، منابع مورد استفاده در متن مقاله، به ترتیب الفبایِ نام خانوادگی نویسنده بر اساس الگوی فهرست نویسی APA تنظیم گردد.

نمونه فارسی:

- رضوانی، م. ر. (۱۳۹۰). *برنامه‌ریزی توسعهٔ روستایی در ایران*. چاپ چهارم. تهران: نشر قومس.

- عنابستانی، ع. ا.، شایان، ح.، و بنیادداشت، ا. (۱۳۹۰). بررسی نقش اعتبارات بر تغییر الگوی مسکن در نواحی روستایی (مطالعهٔ موردی: شهرستان بهمئی). *مجلهٔ برنامه‌ریزی فضایی*، ۱ (۳)، ۸۰-۶۳.

نمونهٔ انگلیسی:

- Bourne, L. S. (1981). *The geography of housing*. London: Edward Arnold.

- Turgat, H. (2001). Culture, continuity and change: Structural analysis of the housing pattern in squatter settlement. *Global Environment Research (GBER)*, *1*(1), 17-25.

بسم الله الرحمن الرحيم

دانشکده ادبیات و علوم انسانی

مجلّهٔ پژوهش و برنامه‌ریزی روستایی

سال پانزدهم، شمارهٔ ۲، بهار ۱۴۰۵، شمارهٔ پیاپی ۵۳

صاحب امتیاز: دانشگاه فردوسی مشهد

مدیر مسئول: دکتر حمید شایان

سردبیر: دکتر علی‌اکبر عنابستانی

هیئت تحریریه (به ترتیب حروف الفبا) :

کریستوفر برایانت	استاد برنامه‌ریزی روستایی و توسعه (دانشگاه مونترال کانادا)
خدیجه بوزرجمهری	دانشیار جغرافیا و برنامه‌ریزی روستایی (دانشگاه فردوسی مشهد)
سعید پیراسته	دانشیار جغرافیا و مدیریت محیطی (دانشگاه واترلو کانادا)
جعفر جوان	استاد جغرافیای روستایی (دانشگاه فردوسی مشهد)
محمدرضا رضوانی	استاد جغرافیا و برنامه‌ریزی روستایی (دانشگاه تهران)
عبدالرضا رکن‌الدین افتخاری	استاد جغرافیا و برنامه‌ریزی روستایی (دانشگاه تربیت مدرس)
عباس سعیدی	استاد جغرافیای روستایی (دانشگاه شهید بهشتی)
حمید شایان	استاد جغرافیای روستایی (دانشگاه فردوسی مشهد)
خدیجه شکرالله	دانشیار جغرافیا (کالج مسیحی فورمن/پاکستان)
سید اسکندر صیدایی	دانشیار جغرافیا و برنامه‌ریزی روستایی (دانشگاه اصفهان)
علی عسگری	استاد مدیریت بحران (دانشگاه یورک کانادا)
علی‌اکبر عنابستانی	استاد جغرافیای انسانی و آمایش (دانشگاه شهید بهشتی)
آنا فرمینو	استاد جغرافیا و برنامه‌ریزی منطقه‌ای (دانشگاه لیسبون جدید پرتغال)
ماریجا ماسکین	استاد موسسه معماری و شهرسازی و برنامه‌ریزی فضایی صربستان
مجتبی قدیری معصوم	استاد جغرافیای روستایی (دانشگاه تهران)
دو-چول کیم	استاد مدیریت محیط زیست روستایی (دانشگاه اوکایاما ژاپن)
سیدحسن مطیعی لنگرودی	استاد جغرافیای روستایی (دانشگاه تهران)

مقالات نمودار آرای نویسندگان است و به ترتیب وصول و تصویب درج می‌شود.

دستیار سردبیر: مهدی جوانشیری

ویراستار انگلیسی: مرکز ویراستاری ادبیات

مدیر اجرایی: زهرا بنی‌اسد

حروف‌نگاری و صفحه‌آرایی : معصومه ایرانپاک

شمارگان: ۵۰ نسخه

نشانی: مشهد، دانشگاه فردوسی مشهد، دانشکدهٔ ادبیّات و علوم انسانی دکتر علی شریعتی، کد پستی ۹۱۷۷۹۴۸۸۸۳ ، نمابر: ۳۸۷۹۶۸۴۰ (۰۵۱)

بها: داخل کشور: ۲۰۰۰۰۰ ریال (تک‌شماره) خارج کشور: ۲۵ دلار (آمریکا- سالانه)، ۲۰ دلار (سایر کشورها- سالانه)

درگاه الکترونیکی: http://jrrp.um.ac.ir/ E-mail:Rplanning@um.ac.ir

*** این مجله در جلسهٔ کمیسیون بررسی نشریات علمی کشور مورخ ۱۳۹۲/۲/۲۵ رتبهٔ علمی- پژوهشی دریافت و طی نامهٔ شمارهٔ ۳/۱۸/۳۵۷۲۸ در تاریخ ۱۳۹۲/۳/۱۳ ابلاغ گردیده است.**

این مجلّه در پایگاه های زیر نمایه می‌شود:

- **پایگاه استنادی علوم جهان اسلام (ISC)**
- **پایگاه اطلاعات علمی جهاد دانشگاهی (SID)**
- **پایگاه بانک اطلاعات نشریات کشور (Magiran)**
- **فهرست دسترسی آزاد مجلات (Doaj)**
- **Index Copernicus- RICeST- ISI-Noormags- Googlescholar- Civilica- Oaji**

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مجله پژوهش و برنامه ریزی روستایی

سال پانزدهم، شماره ۲ بهار ۱۴۰۵، شماره پیاپی ۵۳

■ **تحلیل تجربی اثر زنجیره تأمین خدمات گردشگری بر توسعه پایدار روستایی (مطالعه موردی: روستای برغان، استان البرز)** ۱

علی‌اکبر عنابستانی- بهناز رحیمی

■ **تحلیل تطبیقی سازوکارهای حقوقی تعیین وضعیت ثبتی اراضی و ساختمان‌های فاقد سند رسمی مالکیت در حقوق ایران و آلمان، با تأکید بر کارایی نهادی نظام ثبت اراضی** ۲۱

مهدی جدیدی- مهدی ذوالفقاری- احمدرضا بهنیافر

■ **برنامه توسعه اقتصادی و اشتغال‌زایی روستایی در استان خراسان شمالی (مطالعه موردی: دهستان آذری، شهرستان اسفراین)** ۴۳

حسین قدرتی- مسعود سامیان

■ **تحلیل پدیده کولبری و شناسایی ظرفیت های توسعه اقتصادی جایگزین در نواحی روستایی (مطالعه موردی: دهستانهای سرکل و زریوار- شهرستان مریوان)** ۶۷

سعدی محمدی- فریدون احمدی- شوبو کریمی

■ **رتبه‌بندی محرک‌های هزینه‌های نگهداری ماشین‌آلات کشاورزی و تأثیر آنها بر پایداری اقتصادی روستایی در غرب ایران** ۹۵

خلیل جایدری- صادق فیض‌اللهی- علیرضا ایرج‌پور

■ **ارزیابی رضایت گردشگران سالمند برپایه عوامل زیرساختی، اجتماعی و محیطی با استفاده از مدل سازی معادلات ساختاری (مطالعه موردی: بخش خبر، شهرستان بافت)** ۱۳۱

مهری جهانسوزی- ندا دهقانی

شاپا: ۲۷۹۱-۲۷۸۳