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Scenario Planning for Employment Development Strategies in the Agricultural Sector

1. Sirus. Safarnia : Department of Management, As.C., Islamic Azad University, Astara, Iran
2. Seyed Hamed. Hashemi*: Assistant Professor, Department of Public Administration, Payam Noor University, Tehran, Iran
3. Bahman. Kargar Shahamat : Department of Management, As.C., Islamic Azad University, Astara, Iran

*corresponding author's email: hamed.hashemi@pnu.ac.ir

ABSTRACT

The purpose of the present study was to conduct scenario planning for employment development strategies in the agricultural sector. The required data were collected through a Delphi questionnaire and extracted from the viewpoints of experts and specialists, leading to the identification of key drivers influencing employment-development strategies in agriculture. Considering these elements and integrating them into agricultural development strategies using a futures-studies approach can create an enabling environment for sustainable job creation and higher productivity in this sector. For this purpose, the cross-impact analysis matrix method was employed. Among the significant drivers, 22 were identified as the most important: market and product prices; infrastructure and technology; training and consulting; cooperation development; risk management and market monitoring; facilities and services; technological innovations; online platforms; advanced technologies; intelligent systems; product quality management; environmental research; development of information systems; climate change and its impacts; sustainable resource use; awareness-raising and education; natural resource management; pollution reduction and quality preservation; training and awareness; promotion of agricultural culture and identity; cultural activities and festivals; economic and livelihood development; and cultural development and promotion. Using the identified drivers, the scenario space was developed, and five scenarios with the highest likelihood of occurrence were identified and formulated. Among them, the first scenario, with a 66% probability, was selected as the most plausible scenario. Ultimately, it can be concluded that the first scenario—centered on infrastructure development, market stability, and human-resource training—represents the most desirable pathway and is capable of influencing more than 60% of sustainable employment development in this sector. Therefore, achieving this preferred vision requires national commitment and the formulation of integrated strategies focused on strengthening these key drivers simultaneously.

Keywords: Scenario planning, strategy, employment development, agriculture.

Introduction

Agricultural development has historically served as the backbone of rural economies, shaping employment structures, household livelihoods, and national food security. In contemporary development discourse, the transformation of the agricultural sector is increasingly tied to technological progress, institutional innovation, human-capital enhancement, and sustainable resource management, making employment-generation strategies more complex and multidimensional than ever before. Scholars emphasize that strengthening agricultural systems requires a future-oriented vision to anticipate emerging disruptions and opportunities, particularly in the context of global climate volatility, digital transformation, and shifting labor markets (1). As agricultural systems evolve into

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more interconnected and knowledge-driven structures, governments and development planners face the urgent challenge of crafting adaptive strategies that not only stimulate employment but also enhance resilience and maintain competitiveness within rapidly changing rural landscapes (2).

Recent empirical evidence highlights the crucial relationship between agricultural revitalization efforts and employment creation. Studies from diverse national contexts indicate that targeted investments in agricultural modernization, service expansion, and value-chain strengthening often result in increased productivity and broader labor-demand effects (3). For example, findings from Nigeria demonstrate that revitalizing agricultural activities through structural support and market facilitation contributes substantially to employment generation and sustainable output growth (3). Similar patterns emerge in evaluations of agricultural commercialization programs, where expanded market linkages and improved production practices significantly reduce rural poverty and promote pro-poor growth (4). These findings underscore the strategic role of agriculture as a catalyst for inclusive economic development, particularly in societies with large rural populations and limited non-agricultural employment opportunities.

Parallel to these structural economic dynamics, the revitalization of rural areas has been identified as a central component of national development strategies across several countries. In China, rural revitalization policies have been designed to reverse rural decline, expand employment opportunities, and eliminate poverty through integrated approaches emphasizing infrastructure, education, innovation, and governance reform (5). Such cross-sector initiatives are aligned with the broader goals of rural transformation that emphasize multi-dimensional progress—social, economic, institutional, and environmental—thus providing a framework for rethinking agricultural employment strategies within a more holistic development paradigm.

The sustainability dimension further reinforces the complexity of employment-generation strategies in agriculture. Given the mounting environmental pressures and resource constraints affecting global agricultural systems, a shift toward circular-economy models and sustainable resource use is essential for safeguarding long-term employment opportunities. Research on circular-economy implementation in agriculture reveals that resource-efficient strategies, waste-reduction mechanisms, and ecological stewardship can create new employment niches while simultaneously reducing environmental burdens (6). In addition, the growing influence of European integration standards on agricultural sustainability frameworks, as observed in Ukraine, underscores the necessity of aligning national agricultural policies with international sustainability principles to enhance sectoral competitiveness and labor-market resilience (7).

Strategic foresight and scenario planning have emerged as powerful tools for navigating uncertainties and informing long-term agricultural strategies. Scholars argue that scenario planning not only expands the strategic imagination of policymakers but also enhances organizational preparedness in the face of systemic shocks (8). Although scenario planning creates valuable insights by identifying plausible future trajectories, it also paradoxically reveals the constraints of prediction when dealing with complex adaptive systems (8). This paradox highlights the importance of integrating dynamic systems thinking into agricultural policy design. The conceptualization of agricultural systems as complex adaptive systems—characterized by feedback loops, nonlinear interactions, and emergent behaviors—provides a foundation for strategic policymaking that acknowledges uncertainty while promoting adaptive capacity (9).

Institutional frameworks and legal systems also play a decisive role in shaping agricultural employment strategies. The transition toward European standards in agricultural governance demonstrates that institutional

harmonization, legal reforms, and cross-border coordination can enable sustainable sectoral transformation and resilience-building in rural communities (7). Furthermore, effective rural planning and alignment with green-agenda principles in EU member states illustrate the significance of adopting integrated territorial strategies that support circularity, ecosystem protection, and regional employment diversification (10). These shifts underscore the need for agricultural policies that are structurally attuned to broader socio-environmental developments and capable of leveraging regional integration to boost labor potential in rural economies.

Employment creation in rural areas is also closely tied to entrepreneurial ecosystems and human-capital development. Rural entrepreneurship has increasingly been recognized as a core driver for employment expansion, livelihood improvement, and community welfare (11). Entrepreneurship not only creates new jobs but also encourages innovation and market diversification, making rural regions more resilient to economic stresses. However, the development of entrepreneurial capacities requires comprehensive labor-potential strategies supported by agricultural policies that invest in skills, institutional reforms, and capacity development (12). Thus, employment-generation strategies must integrate both agricultural and non-agricultural pathways to strengthen labor markets in rural communities.

Workforce development has likewise become a central pillar of rural revitalization efforts. Experiences in rural Ontario illustrate that diverse workforce-development strategies—such as multisector partnerships, vocational programs, and community-driven initiatives—enhance employment outcomes and contribute to sustainable rural growth (13). Comparable insights emerge from rural development programs in Vietnam, where vocational training is identified as a critical mechanism for addressing employment challenges among rural workers (14). These cases reveal that agricultural employment strategies cannot be decoupled from broader human-resource development systems, which influence labor mobility, skills acquisition, and long-term labor-force participation.

At the same time, agricultural policy reforms in the European Union demonstrate that coherent policy alignment and supportive regulatory environments can significantly improve rural employment outcomes (15). Strong institutional frameworks enhance farmer incentives, reduce operational uncertainties, and stimulate innovation and investment in rural areas. Moreover, strategic rural-planning models offer valuable insights into how spatial policy, green-agenda commitments, and place-based strategies can support employment opportunities while maintaining environmental safeguards (10).

Beyond institutional reforms, the transformation of modern agriculture is increasingly influenced by digital technologies and smart-farming systems. The emergence of digital agriculture, including precision technologies, sensor systems, and data-driven management tools, is reshaping labor roles, reducing inefficiencies, and creating specialized employment opportunities (16). Despite concerns about automation-induced job displacement, digital agriculture often leads to job restructuring rather than reduction, emphasizing the importance of new skill sets, training programs, and workforce adaptability. Similarly, the dynamic-capabilities framework highlights the role of organizational competencies, technological learning, and adaptive capabilities in responding to environmental change and in shaping long-term employment strategies (17). This theoretical perspective is particularly relevant for agricultural firms and institutions navigating technological disruption and shifting resource conditions.

Rural development literature further points to the importance of aligning household aspirations with national policy directions, especially when designing employment strategies for marginalized farming communities. Research from South Africa reveals that mismatches between rural households' aspirations and national development policies can undermine participation, reduce effectiveness, and limit the impact of rural employment

programs (18). Agricultural planning must therefore be sensitive to local contexts, cultural norms, and livelihood priorities to ensure that employment strategies are both inclusive and sustainable.

Complementing these insights, strategic analyses of agricultural business development underscore the importance of institutional coordination, innovation support, and market facilitation in creating employment opportunities at local and regional levels (19). Similar findings apply to the development of agricultural service cities, where targeted interventions in infrastructure, training, and market support create diversified economic bases capable of generating sustained employment (20). Furthermore, foresight-driven macro-strategies for agricultural export development highlight the importance of long-term visioning, scenario analysis, and strategic forecasting in guiding policy decisions that affect rural labor markets (21).

Taken together, the literature emphasizes that agricultural employment strategies must integrate sustainability, digital innovation, institutional coordination, rural entrepreneurship, human-capital development, and foresight-based policymaking. Each of these dimensions shapes the capacity of agricultural systems to adapt, grow, and provide stable employment opportunities in increasingly uncertain environments.

Accordingly, the aim of this study is to develop strategic future-oriented scenarios for enhancing employment generation in the agricultural sector based on the identification and analysis of key driving forces.

Methods and Materials

This study is a futures-studies research with an analytical–exploratory approach that, through combining qualitative and quantitative methods, sought to identify key drivers and develop strategic scenarios for employment development in the agricultural sector. The statistical population consisted of 15 experts in the fields of agriculture and futures studies, selected through purposive sampling based on criteria such as a minimum of 10 years of professional experience. The required data were collected through semi-structured interviews, open and closed questionnaires, and brainstorming sessions. To achieve expert consensus, the Delphi method was applied in three rounds. In the first round, the initial variables were identified; in the subsequent rounds, these variables were evaluated, ranked, and ultimately finalized when a 75% agreement coefficient was obtained. In the analysis stage, the Cross-Impact Matrix Analysis (MICMAC) method was used to identify key drivers and map their interrelationships. For this purpose, a cross-impact matrix was constructed, and its data were processed using MICMAC specialized software. The output of this analysis resulted in the identification of 22 key drivers with the greatest influence on the system, which were then used as the basis for scenario development. Finally, by combining the different states of the key drivers (optimistic, intermediate, and pessimistic), the probable future scenarios of employment development were formulated. The reliability and validity of the research instrument were confirmed through expert approval and by calculating a Cronbach's alpha coefficient of 0.82. Quantitative data analysis was conducted using MICMAC and SPSS version 26.

Findings and Results

In the first step, and based on interviews with experts, a comprehensive set of strategies and drivers affecting employment development in the agricultural sector was identified in the form of 50 factors and categorized into four main domains (economic, technological, environmental, and socio-cultural). This categorization provided an overall picture of the complex and interconnected dimensions of the employment issue in agriculture.

Out of the 50 selected drivers, 22 drivers that were located in the first quadrant were selected. The degree of influence of these drivers was higher than their level of dependence and included: market and product prices, infrastructure and technology, training and consulting, cooperation development, risk management and market monitoring, facilities and services, technological innovations, online platforms, advanced technologies, intelligent systems, product quality management, environmental research, development of information systems, climate change and its impacts, sustainable use of resources, awareness-raising and education, natural resource management, pollution reduction and quality preservation, training and awareness-raising, promotion of agricultural culture and identity, cultural activities and festivals, economic and livelihood development, and cultural development and promotion (Figure 1).

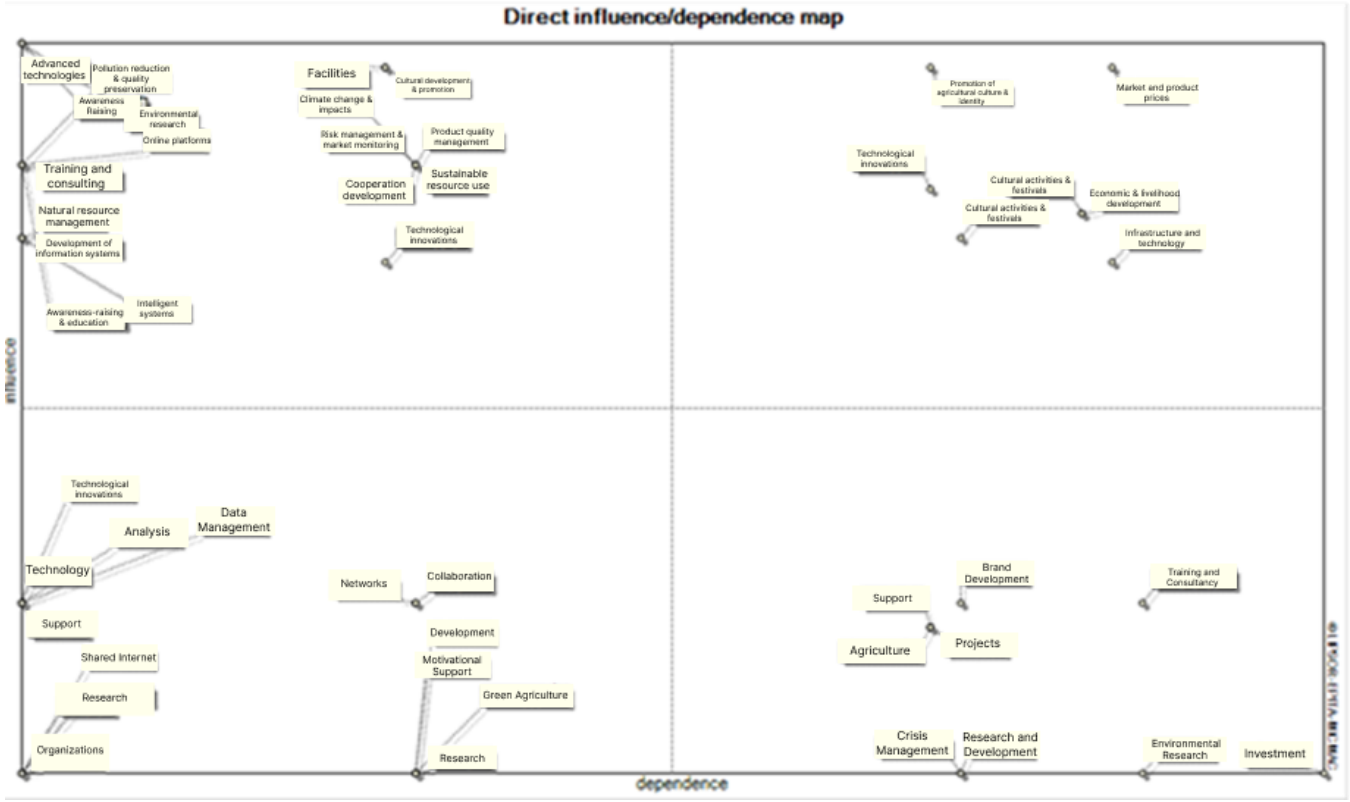

Figure 1. Scatter Map of Variables According to Their Level of Influence and Dependence in Employment-Development Strategies in the Agricultural Sector

Figure (1) is a scatter map of variables produced using the Cross-Impact Matrix Analysis (MICMAC) method, showing variables affecting employment-development strategies in the agricultural sector based on their levels of influence and dependence. This map was designed within the framework of the study “Scenario-Based Mapping of Employment-Development Strategies in the Agricultural Sector Using a Futures-Studies Approach” to identify key drivers, analyze relationships among variables, and ultimately formulate strategic scenarios for effective policymaking in agricultural employment. The map is divided into four quadrants, each representing a different role of variables in the system: influential variables (upper-left quadrant), dependent variables (upper-right quadrant), linkage variables (lower-right quadrant), and independent or low-priority variables (lower-left quadrant).

In Table (1), the drivers extracted from the MICMAC software with the highest level of influence are presented, including indicators that create influential relationships among drivers and other indicators, indicators affected by relationships among the key drivers, indicators that do not play a major key role but still require attention, and

indicators that have the greatest role in inter-variable relationships for employment-development strategies in the agricultural sector. It should be noted that the questionnaire assessed the influence of each driver under the following three conditions: remaining unchanged (intermediate), developing (optimistic), and weakening (pessimistic). Their influence levels were evaluated using limiting characteristics categorized as strongly constraining, no effect, strongly reinforcing, moderately reinforcing, and weakly reinforcing, scored from +3 to −3. For the 22 main drivers, ten states were defined, and their optimistic, intermediate (most likely), and pessimistic conditions were assessed based on expert opinions using the Delphi method and quantitative weighting analyses, with corresponding strategies proposed for each. After collecting the questionnaires and analyzing the data, the following scenarios were identified (Table 1).

Table 1. Probable Scenarios for Employment-Development Strategies in the Agricultural Sector

Component	Code	S1 Opt	S1 Int	S1 Pes	S2 Opt	S2 Int	S2 Pes	S3 Opt	S3 Int	S3 Pes	S4 Opt	S4 Int	S4 Pes	S5 Opt	S5 Int	S5 Pes
Market and product prices	1	•					•		•				•			•
Infrastructure and technology	2	•			•			•					•			•
Training and consulting	3	•				•			•			•		•		
Cooperation development	4	•				•			•		•				•	
Risk management & market monitoring	5		•				•			•			•			•
Facilities and services	6	•				•				•			•			•
Technological innovations	7		•		•			•					•	•		
Online platforms	8		•		•				•				•			•
Advanced technologies	9		•		•			•					•	•		
Intelligent systems	10		•		•			•					•			•
Product quality management	11		•			•		•					•			•
Environmental research	12	•					•		•				•		•	
Development of information systems	13		•			•		•				•				•
Climate change & impacts	14			•			•			•			•	•		
Sustainable resource use	15	•					•			•			•	•		
Awareness-raising & education	16	•				•			•			•		•		
Natural resource management	17			•			•			•			•	•		
Pollution reduction & quality preservation	18			•			•			•			•		•	
Promotion of agricultural culture & identity	19	•					•			•			•		•	
Cultural activities & festivals	20	•					•			•			•		•	
Economic & livelihood development	21	•				•			•				•		•	
Cultural development & promotion	22	•					•			•			•		•	

Based on the information presented in Table (1), the scenarios are categorized into four main groups, each focusing on specific aspects of employment-development policymaking. Ultimately, the table illustrates the probable scenarios for employment-development strategies in the agricultural sector under three conditions—optimistic, intermediate, and pessimistic—for the 22 key drivers (such as market and product prices, infrastructure and technology, climate change, and others). Each scenario was constructed by combining these conditions for the drivers, and then, according to the percentages assigned to each condition, a total score was calculated. The interpretation of the scoring for each scenario and the score obtained for each is described below:

– **Scenario One (Desirable):** As Figure (2) clearly shows, the diagram for Scenario One exhibits the greatest expansion along the “optimistic” axis and the least expansion on the “pessimistic” axis. This balanced and positive pattern explains its highest total score (66%). This scenario represents an ideal future in which most drivers are in their best possible state.

– **Scenario Three (Mid-range with Good Potential):** This scenario also demonstrates a relatively balanced pattern but at a level lower than Scenario One. Its considerable expansion on the optimistic axis, along with constraints on the pessimistic axis, results in a score of 56%, making it a plausible and relatively stable option.

– **Scenarios Two and Five (Weak Mid-range):** These two scenarios display similar shapes on the diagram, indicating a lack of balance. Although both include some optimistic conditions, the share of pessimistic conditions is noticeably higher compared to Scenarios One and Three. This imbalance reduces their scores to 46% and 48%, respectively.

– **Scenario Four (Warning):** The diagram clearly illustrates the weakness of this scenario. Its shape is the smallest and most compressed around the central axis, reflecting the lowest share of optimistic conditions and a high proportion of intermediate and pessimistic conditions. This pattern confirms why this scenario, with a score of 34%, is considered the worst possible outcome.

It should be noted that Figure (2) is generated in Excel and presented as a radar chart, providing a visual comparison of the two scenarios in the development of employment in the agricultural sector. The optimistic scenario (green), with broad coverage ranging between 80–100 percent across most drivers—such as market, technology, training, cooperation, risk, facilities, innovation, resources, and culture—indicates an ideal state supported by strong governmental backing, technological progress, and sustainable management. In contrast, the pessimistic scenario (red), with very limited area and values mostly below 40 percent, indicates serious challenges in the same drivers, arising from resource shortages, infrastructural weakness, labor migration, and the negative impacts of climate change. The stark difference in area between the two regions reveals the substantial gap between the best and worst possible outcomes and underscores the need for preventive policymaking.

Drivers such as “innovation” and “technology” are at their peak in the optimistic scenario, while they drop to their lowest level in the pessimistic scenario. “Cooperation development” is the only relative strength in the pessimistic scenario, indicating the potential for cross-sector collaboration even under crisis conditions. This chart warns policymakers that without strengthening infrastructure, training, and risk management, achieving sustainable agricultural employment will be impossible. Ultimately, moving toward the optimistic scenario requires targeted investment, continuous innovation, and resilience in the face of climate change.

Figure 2. Scenario Planning of Employment-Development Strategies in the Agricultural Sector

Discussion and Conclusion

The purpose of this study was to develop future-oriented strategic scenarios for employment development in the agricultural sector by identifying key drivers and examining how their optimistic, intermediate, and pessimistic states can shape probable futures. The results revealed that among the five formulated scenarios, the first scenario—characterized by strong infrastructure development, stable markets, effective training systems, technological advancement, and enhanced cultural engagement—was identified as the most desirable and most probable future trajectory. With a dominant optimistic profile and minimal pessimistic tendencies, Scenario One received the highest overall score of 66%, significantly outperforming the other scenarios. This finding aligns with existing literature on agricultural transformation, which consistently emphasizes the centrality of systemic investments in infrastructure,

innovation, training, market integration, and resilience-building for ensuring broad-based employment generation (3-5).

The strong performance of Scenario One can be understood in light of broader theoretical and empirical insights. Research underscores that rural revitalization and agricultural modernization depend heavily on the combined effects of infrastructure provision, technological diffusion, and human-capital enhancement (5, 20). Stable market conditions reduce risks, improve price predictability, and incentivize farmers and agribusinesses to expand production and employment offerings. These findings resonate with studies demonstrating that well-designed agricultural development strategies—especially those supported by strong institutional coordination—can significantly increase productivity and stimulate rural labor markets (3, 19). The convergence between the empirical results of the present study and past research reinforces the notion that employment-enhancing agricultural policies must integrate both structural and human-capacity elements.

Scenario Three, which received a moderate score of 56%, presented a balanced but less robust optimistic profile. This scenario reflects a future in which technological development, digital platforms, quality management, and environmental research are moderately strengthened, while limitations persist in system-wide coordination, innovation adoption, and resource sustainability. The relative performance of Scenario Three matches theoretical expectations from digital agriculture and rural workforce literature, which emphasizes that partial modernization without adequate alignment of institutional, technological, and human-capital domains results in only incremental improvements (14, 16, 22). Digital tools alone cannot create significant employment effects unless paired with training systems, cooperative networks, and enabling institutions. This partially optimistic basis explains why Scenario Three performs better than Scenarios Two and Five but remains less transformative compared to Scenario One.

Scenarios Two and Five, scoring 46% and 48% respectively, represented weak mid-range trajectories characterized by structural imbalances between optimistic and pessimistic conditions. Although both scenarios exhibited moderate strengths in areas such as innovation, cooperation, and digital platforms, they also suffered from substantial weaknesses in resource sustainability, risk management, and environmental adaptation. These imbalances mirror challenges highlighted in rural development research, where insufficient alignment between household needs, labor-market dynamics, and national development strategies can undermine policy effectiveness (12, 18). Additionally, weak risk-management systems and unstable market conditions have been widely associated with reduced investment incentives and diminished capacity for employment expansion (4, 6). The study's results thus reinforce the importance of integrated, cross-sectoral frameworks for agricultural employment development.

Scenario Four, which scored the lowest at 34%, clearly illustrated the consequences of systemic fragility. Dominated by pessimistic and intermediate conditions across technological, environmental, infrastructural, and cultural drivers, this scenario represents a future where agricultural employment faces contraction rather than expansion. This result is consistent with literature on complex adaptive systems, which shows that agricultural economies lacking innovation, institutional support, and resilience structures are highly vulnerable to external shocks such as climate change, market instability, and demographic transitions (2, 9). The pessimistic profile of Scenario Four closely resembles real-world situations where agricultural systems fail to keep pace with technological advancements and climate stressors, leading to labor displacement, reduced productivity, and weakened rural economies. Studies also suggest that without supportive policies grounded in foresight-based

strategies, rural regions are less capable of adapting to changing economic and environmental conditions, further intensifying employment challenges (8, 21).

Taken collectively, the scenario analysis highlights the interconnected nature of the 22 identified drivers and emphasizes the need for holistic policy approaches. Drivers such as innovation, digital infrastructure, environmental sustainability, risk management, and cultural engagement play central roles in shaping the agricultural employment landscape. These findings align with the capability theory of the firm, which posits that strategic development, innovation capacity, and dynamic resource configurations are crucial for long-term competitiveness and job creation (17). The results also correspond to rural employment frameworks that underscore the importance of entrepreneurship, skill development, and institutional coordination in creating diversified and stable labor markets (11, 13). Employment strategies rooted in foresight and scenario planning are therefore well-positioned to navigate uncertain futures, allowing policymakers to proactively design interventions that support innovation, protect natural resources, and ensure sustainable rural livelihoods.

Furthermore, the study's results echo international experiences with green-agenda implementation, circular-economy-based agricultural systems, and integrated territorial planning. For instance, European models demonstrate that sustainable agricultural development requires coordinated action across legal systems, environmental frameworks, and technological infrastructures (7, 10). Similarly, circular-economy frameworks highlight the potential to create new employment streams through resource efficiency, recycling, and ecological innovation (6). The optimistic elements reflected in Scenario One closely resemble these integrated models, which combine environmental protection, technological innovation, and human-resource development to generate employment opportunities.

Finally, the study underscores the importance of aligning national agricultural strategies with global shifts in the nature of work. As emphasized by the World Development Report, structural changes in labor markets require new skills, flexible workforce-planning models, and more resilient forms of employment that can withstand technological and economic disruptions (1). Similarly, foresight perspectives argue that scenario planning is indispensable for preparing agricultural systems for future uncertainties and ensuring that employment strategies remain dynamic, inclusive, and adaptable (8). The alignment between the study's findings and broader global evidence thus reinforces the relevance and applicability of the scenarios developed in this research.

This study, while comprehensive, is subject to several limitations. The reliance on expert judgment through the Delphi method introduces subjectivity, as the assessment of driver states and weights depends on the perspectives and experiences of the selected experts. Additionally, the scenario-development process is constrained by the availability and specificity of the data on agricultural employment trends, limiting the ability to model highly granular or localized scenarios. Another limitation concerns the static nature of scenario scoring, which may not fully capture emerging disruptions or nonlinear changes that could significantly reshape agricultural labor markets.

Future studies should consider expanding the pool of experts to include a broader range of stakeholders such as local farmers, agribusiness entrepreneurs, environmental specialists, and rural community leaders. More advanced quantitative modeling techniques, such as system-dynamics simulations or agent-based modeling, could also be applied to enhance the predictive power of scenarios. Additionally, future research could conduct comparative scenario analyses across multiple regions or countries to uncover contextual differences and identify globally transferable strategies.

Policymakers should prioritize integrated strategies that strengthen infrastructure, support continuous innovation, and enhance workforce skills. Strategic investment in digital agriculture, climate-resilient technologies, and rural entrepreneurship is essential for sustainable employment growth. Furthermore, long-term institutional coordination and community engagement should be emphasized to ensure that agricultural employment strategies remain inclusive, resilient, and aligned with local needs.

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Authors' Contributions

All authors equally contributed to this study.

Declaration of Interest

The authors of this article declared no conflict of interest.

Ethical Considerations

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

Transparency of Data

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

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