Journal of Agricultural Economics & Development

Homepage: https://jead.um.ac.ir

Research Article
Vol. 38, No. 4, Winter 2025, p. 413-429

Compilation of Sustainable Agricultural Development Scenarios in Zayandeh-Rud River Watershed- Isfahan Province of Iran

Z. Zarei Dastgerdi[1], Kh. Kalantari[2*], A. Asadi[2]

1- Instructor of Agriculture Department, Payam Noor University, Tehran, Iran
2- Professor Department of Agricultural Management and Development, Faculty of Agriculture, University of Tehran, Tehran, Iran
(*- Corresponding Author Email: khkalan@ut.ac.ir)

Received:	23-09-2024	**How to cite this article:** Zarei Dastgerdi, Z., Kalantari, Kh., & Asadi, A. (2025). Compilation of sustainable agricultural development scenarios in Zayandeh-Rud River watershed- Isfahan province of Iran. *Journal of Agricultural Economics & Development*, *38*(4), 413-429. https://doi.org/10.22067/jead.2024.89627.1292
Revised:	01-11-2024	
Accepted:	17-11-2024	
Available Online:	17-11-2024	

Abstract

The agricultural sector in developing countries plays an important role in promoting national development and rational policy making and strategic planning to advance the sustainable development of this sector are of main concerns of the relevant institutional actors. In this regard, the current research was conducted with the aim of identifying scenarios of sustainable agricultural development in the catchment area of Zayandeh River in Isfahan province. The present research was applied, of descriptive-survey type. The statistical population was experts related to agricultural development in the province. To collect data, library sources, questionnaires and interviews were used. Delphi method and interviews with elites and executives were used to identify the primary components and drivers effective on the sustainable development of agriculture in the Zayandeh River watershed of Isfahan province. The snowball technique was used to select the experts. Finally, 8 key drivers were identified and separated in order to explain the research variables in a strategic format. Based on this, in the section related to the expression of research priorities in two direct and indirect modes, these 8 key factors have been repeated in different priorities. Questionnaires were distributed among 25 experts. In this study, five plausible scenarios were identified for forecasting the future of sustainable agricultural development by considering potential outcomes based on key factors and their similarities or differences across the categories of favorable, static, and critical scenarios. Based on their total scores, which range from 85 to 109, two scenarios were identified as the most likely: one favorable scenario and one critical scenario.

Keywords: Agricultural development, Foresight, Scenario planning, Zayandeh-Rud watershed

https://doi.org/10.22067/jead.2024.89627.1292

Introduction

The agricultural sector in developing countries plays an important role in promoting national development and rational policy making and strategic planning to advance the sustainable development of this sector is one of the main concerns of the relevant institutional actors. The agricultural sector accounts for 7% of the gross national product, 14% of employment and providing food for more than 80% of the people in the society therefore, it plays an important role in the country's economy (Bahrami & Asadi, 2020). On one hand, the complexity of human-driven changes, variable environmental factors, and the unpredictability of the global economy impacting agricultural activities pose significant challenges. On the other hand, the strategic importance of food security and poverty reduction further intensifies the difficulties in achieving sustainable agricultural development. The growing trend of globalization of agricultural trade and extensive competition in this field, which has transformed the framework of market equilibrium, all components of the agricultural industry undergo fundamental and structural changes. The impact of environmental factors and climate change has already led to fundamental shifts in agriculture, and in the near future, it is certain to have the most destructive effects on agricultural activities. Considering the link of the listed components in the future, policymakers and practitioners in the field of agriculture, despite their lack of preparation, will face increasing and unpredictable challenges (Sharifzadeh & Hosseini, 2009). Therefore, it is necessary that the developed strategies to deal with these issues are based on comprehensive and optimal analysis which examines the main dimensions of agriculture and food sector in an integrated way. These patterns should create a tool for integrated and dynamic planning which can enable transparent cross-sectoral analyzes of policy effects and enable exploration of their long-term implications for social, economic, and environmental development (Fakari *et al*., 2020). Due to the ever-increasing changes and transformations, relying on traditional planning methods is no longer the answer, and the heavy shadow of uncertainties and the emergence of discontinuous and surprising events change the situation in such a way that planning seems difficult. The lack of ability to predict the future as well as the complications caused by the changes have caused the emerging knowledge of foresight to enter the activities of planning and predicting developments (Zali & Atriyan, 2016). During this period, planners have adopted various approaches to address future challenges, depending on the time and location conditions, typically based on the analysis of past trends and the continuation of the current situation. However, today, the science of futurology has transformed scattered and fragmented studies on future planning into a well-established field with solid principles and foundations. Its role, in addition to analyzing past trends, is to explore, invent, and evaluate possible, probable, and desirable futures (Zali & Atriyan, 2016).

In agriculture, considering the future is essential for ensuring the strengthening and stability of the sector. A key and fundamental aspect of foresight studies in agriculture is the stability and growth of agricultural production, which should be accompanied by improvements in product quality. Additionally, serious attention must be given to creating a suitable platform for fostering sustainable agriculture in the country. Undoubtedly, planners and policy makers in the agricultural sector can use foresight to draw future prospects for the sustainable development of the agricultural sector and in this way, realize the capacity of directiveness expected from strategic policies in advancing the agricultural sector in accordance with situational considerations, national priorities and global developments. Accordingly, various researchers and international organizations, such as the FAO, have utilized foresight to shape future perspectives for the agricultural sector and related areas, including food security (Sharifzadeh & Hosseini, 2009). Futurism has a long history, with the United States and Japan being among the pioneers in using this tool. However, in the last decade, nearly all countries worldwide have adopted it (Karamatzadeh, 2006). In Iran, some researchers have analyzed the future and designed scenarios in different fields. In other countries, studies have been done in the field of agricultural future research or agricultural research (Akrami *et al.*, 2021). An analysis of scientific sources reveals a strong need for extensive research in the field of future studies within the agricultural sector of the country. Below, some of the limited studies that have been conducted in this area are highlighted.

Jashari & Morad (2018) in research entitled "Development of macro-strategies for the development of the agricultural sector of Sistan and Baluchistan province", investigated the agricultural situation of this province with a future research approach. The authors identified the driving forces affecting the development and progress of agriculture and animal husbandry in the province and then they introduced five main drivers in the agricultural sector and five drivers in the livestock sector and tried to analyze the scenarios using the scenario method and then, in the form of each scenario, according to the upstream documents and previous studies, for the agricultural development of the province, they have expressed strategies such as the promotion of specialized and applied knowledge and the empowerment of human resources, the continuation of government investment, etc.

Fakari *et al.* (2020), in their research titled "Future Research of Iran's Wheat," examined the status of wheat up to the year 1420. Using the GBN scenario writing method with Scenario Wizard and Mic Mac software, and consulting a group of experts from universities, research centers, and managers of the country's wheat project in 2019, they explored the future of wheat research in the country. From eighteen possible scenarios, three were selected: "Forward to the Future" (the first scenario), "Never Changing" (the second scenario), and "Going Back to History" (the third scenario). These evaluations provided different future scenarios to help policymakers develop better planning strategies for the future of wheat production. Bagheri *et al.* (2020), in their article on the future research of the Agricultural Engineering and Technical Research Institute in 1404, focused on examining alternative futures for the institute as an active, knowledge-based research organization in agricultural technology. The GBN method was used to design the scenarios. Initially, the trends influencing the institute's research activities were identified, followed by the key uncertainties. After developing the scenario matrix, three scenarios were created: the "Traditional Future," the "Difficult Future," and the "Desirable Future." Asadi *et al.* (2021), in their research titled "Forecasting the Future of Australia's Digital Agriculture: Using Innovative Thinking to Predict the Impact of Research and Development Under Different Scenarios," explored the future of agriculture in Australia, focusing on the role of digital technology and its social and ethical implications. The study developed four scenarios to predict the future of agriculture in Australia. The findings indicate that these scenarios highlight potential changes in farm business models, decision-making processes, stakeholder involvement, and the inequalities introduced by new technologies, as well as other components of the food value chain. Gutzler *et al.* (2015), in their study of agricultural land use changes, assessed the sustainable and integrated effects of agricultural intensification scenarios in the federal state of Brandenburg, Germany, for the year 2025. The results of the research indicate that, in the comprehensive evaluation, agricultural intensification scenarios have a sustainable effect at the regional level. However, this intensification is accompanied by negative environmental and socio-economic impacts. Ajilore *et al.* (2018) explored the future of agricultural research and innovation in Africa. Using collaborative methods and examining the current and past agricultural situation, they proposed four possible future scenarios for agricultural research. The results of the scenario analysis indicated that African agriculture is evolving due to innovations. The purpose of examining these scenarios with the involvement of stakeholders was to help the new generation of scientists, researchers, promoters, and innovators in the agricultural sector develop the necessary capacity for dialogue and strategic thinking regarding the future. Makal *et al*. (2017), in their study titled "Problems and Challenges of Agricultural Development (Case Study: Farmers of West Bengal)," highlighted several issues faced by agriculture in West Bengal, including problems with agricultural and rural infrastructure such as irrigation, soil, land, capital, labor, product storage, modern agricultural inputs, the environment, production, production costs, and price fluctuations. Similarly, a study by Nsikak & Kesit (2015) in Nigeria found that the challenges in the country's agricultural sector include climate change, outdated farming methods, weak infrastructure, and insufficient government support for research and development in agricultural technologies, which hinder production growth. Additionally, Nematollahi *et al.* (2016) analyzed the necessary measures for the environmental development of the agricultural sector in Jianshan using the SWOT method, concluding that the development of agriculture in the region is progressing well and that an aggressive strategy is the dominant development approach. Among the study's recommendations were eliminating the need for animal husbandry development, creating the necessary infrastructure for large-scale agriculture, and establishing new farms.

Bradfield *et al*. (2016), in their analysis of Pakistan's agricultural sector using the SWOT method, concluded that despite the sector's importance due to its significant share in the country's gross domestic product (GDP) and the available capabilities, agricultural development in Pakistan faces serious weaknesses and threats. The research suggests government intervention to increase productivity, provide farmer training, and offer loans to small farmers. Goldstein *et al.* (2012) published a report on the project "Investment Scenarios for the US Hawaii Region," aimed at assisting in the design of a land use map for the northern Ohio coastal region, with a focus on the agricultural sector. The project identified key development variables and, using the Delphi method and consultative workshops with regional stakeholders, formulated possible scenarios for the Hawaii region. Their research found that the key influential variables for the future use of the area were the land irrigation system and the future land sales strategy. Gavetti & Menon (2016) conducted a major project on the future of food and agriculture, using scenario writing methods. They identified the sector's most important challenges, including regulating demand and supply for agricultural products, addressing food system instability, ending hunger, and preserving biodiversity and ecosystem stability while feeding the global population. After identifying these challenges, they pinpointed the key factors to address them and suggested tools for better policymaking for the future. Abdollahi *et al.* (2020), in their research titled "Analysis of the Key Drivers of the Development of the Poultry Industry Using a Forward-Looking Approach," identified three key drivers for the development of the poultry industry. These include macroeconomic and commercial policies aligned with the development and formation of a market based on innovation, an educational system focused on fostering a culture of innovation, and access to loans and financial resources. Takallo *et al.* (2020) discussed the future development of human resources in the agricultural sector in the rural areas of the central part of Malair city. The research identified 24 key factors in human resource development. Among these, the most significant drivers for future development were integrated management of rural development, sustainable employment, advanced technology, the elimination of discrimination between urban and rural areas, and the expansion of production cooperatives. Based on these factors, the study proposed three groups of scenarios for the future of human resources in the agricultural sector of rural areas. Bagheri *et al*. (2020) investigated the future research of the Agricultural Engineering and Technical Research Institute for the horizon of 1404. The results showed that self-sufficiency in the production of basic products, the impact of product quality and health indicators on pricing, the contribution of the research budget to national gross production, and the adoption of new technologies by users were the most influential drivers. Additionally, the study identified 9 economic drivers, 10 policy and planning-related factors, 7 science and technology drivers, 6 environmental factors, 3 cultural-social factors, and 5 human resource leadership factors. The political and planning agents, along with the economic agent, were identified as having the most significant influence on the future of the institution. In their research, Beheshti et al. (2020) studied and investigated water resource management scenarios using a future-research approach in Tabriz city. According to the results, 15 key factors were identified as influencing the state of water resources in Tabriz. Among the most important and influential factors in water resource management were climate change, water quality, the economic productivity of water, investment in the supply sector, consumption and water infrastructure, as well as changes in precipitation and cropping patterns. Ghoochani *et al*. (2019) conducted research entitled "Macro-Inspection of Drivers of Water Resources Management in the Agricultural Sector of Iran." The study identified four main drivers that are highly effective and important in the field of agricultural water management. These drivers include: 1) institution building in the field of agricultural water management, 2) the establishment of an integrated management system for water resources in catchment areas, 3) the management of the country's water resource conflicts, and 4) the volume delivery capacity of agricultural water.

Jashari & Moradi (2019) developed a scenario and strategy for the agricultural sector's development by identifying key drivers in the rural areas of Sistan and Baluchistan province. Among these drivers, the most influential include: improving agricultural knowledge, managing water resources effectively, financing agricultural projects, developing transformation industries in agriculture, and enhancing marketing knowledge for agricultural products. Nikanfar & Naseri (2019), in their research titled "Future Study of Energy Efficiency in Wheat Production on the Eastern Margin of Lake Urmia," concluded that from an energy perspective, the conservation tillage system is preferred over conventional tillage for wheat production. However, in many cases, the statistical difference in energy parameters between the two systems was not significant. The study suggests that proper implementation of conservation tillage with the right tools and equipment can improve energy parameters in wheat production. The Research Center of Majlis (2018) also examined the future of agriculture in Iran, finding that agricultural production is unlikely to meet the growing demand in the future. Over the past decade, the average annual growth rate of agricultural production has been 2.63%, while demand for agricultural products has grown at an average rate of 4.13% annually. Sadeghi & Khanzadeh (2019) analyzed the strategic development of agriculture in the Urmia Lake catchment area using the SWOT method and the QSPM matrix. The research showed that the primary strategy for the region's agricultural development is a defensive strategy, with the top priorities for implementing sustainable development programs being: managing water consumption in agriculture, developing agricultural mechanization, integrating agricultural lands, and improving the literacy and awareness of human resources working in agriculture. Sustainable agriculture is seen as the key solution to the crisis. Ahmad & Enayatollah (2013) in their study titled "Challenges of Agricultural Development in Iran" identified several key challenges facing agriculture in the country, including: limited access to water, declining water levels in the Caspian Sea, the conversion of agricultural land for non-agricultural purposes, land shortages, insufficient government support, organizational inefficiencies, increasing water salinity, the influence of political issues on decision-making, unplanned land use systems, lack of advanced technological infrastructure, and unfavorable social and economic conditions.

Eghbali (2020) examined the water governance system in the Zayandeh River basin to promote sustainability of water resources. The research highlighted that the most influential factors in the water governance system included the Supreme Water Council and the subordinate organizations of the Ministry of Energy. Key legal challenges identified were unclear ownership rights, the non-participation of stakeholders in water legislation and management, and weaknesses in existing laws. Enteshari & Safavi (2019) investigated the administrative-institutional system of water management in the Zayandeh-Rood watershed using a qualitative grounded theory method. They identified factors such as incomplete and inaccurate information, differing understandings of issues, ineffective meetings, conflicts of interest, lack of coordination between organizations, potential corruption, and weak supervision as contributing to the ineffectiveness of the current administrative structure. Hatami & Noorbakhsh (2019) focused on the semantic reconstruction of the water crisis in the eastern region of Isfahan based on contextual theory. They extracted the core category of "mismanagement of water" and found that, according to farmers, the current water crisis was directly related to mismanagement. This mismanagement has manifested itself in governance practices that exclude social stakeholders. Mahmoodi & Karimi (2015) conducted a case study of agricultural land use changes in the Zayandeh River basin in Isfahan province. Their research showed an increasing trend in the conversion of agricultural land to residential land, with the area of residential land growing from 14,000 hectares to 39,000 hectares over the study period. This change has had significant effects on the components of sustainable development, which can be categorized into environmental, economic, social, and agricultural impacts.

Given the limited research in the field of agriculture with a future research approach, the studies emphasize the potential benefits of future research in identifying key factors and guiding planning for agriculture. With proper planning and a focus on the future, these studies can significantly contribute to sustainable agricultural development. The present research aims to identify scenarios for sustainable agricultural development in the Zayandeh River catchment area in Isfahan province.

Research Method

The current research is applied in nature and employs a descriptive-survey methodology, as it describes and interprets existing conditions, relationships, common ideas, and ongoing processes. In terms of data type, this research is both quantitative and qualitative. The statistical population for this study includes: 1) managers and entrepreneurs in the agricultural sector within the Zayandeh River watershed in Isfahan province, 2) academic researchers and professors involved in the agricultural sector in the same region, and 3) policymakers and managers engaged in the planning and policymaking process for agricultural development in the Zayandeh River watershed. Participants were selected using a non-probability snowball sampling method. Data were collected using a combination of library resources, researcher-developed questionnaires, and interviews. Qualitative data were gathered through open-ended questionnaires and interviews with experts, as well as document analysis. Quantitative data were compiled numerically and obtained through the weighting of Delphi questionnaires. To identify the factors affecting agricultural development, five experts were interviewed. To validate these factors, the identified variables were then presented to 25 experts in the form of a researcher-made questionnaire to assess the importance of each factor. To ensure the validity of the research instruments, form-content validity was employed. The questionnaire, along with the research questions, was shared with several experts, including the supervisor, who were asked to evaluate its suitability for measuring the research variables.

Reliability was assessed using Cronbach's alpha and the composite reliability coefficient to check the internal consistency of the questionnaire. Given that the Cronbach's alpha value for the variables was 0.944, the reliability of the instrument was confirmed. A matrix with dimensions of 8x8 was used for the scenario planning part of sustainable agricultural development using the results of interviews with experts and a Delphi questionnaire and was given to the experts of the agricultural sector. In the following, in order to enter these elements into the Scenario Wizard software environment, the related subcategories of each were defined with their own unique statuses in the software environment. Then, by expressing the possible states for each of these factors, the matrix of cross-effect analysis was formed and the statistical sample was asked to rate them according to the effect of one factor on other related factors from -3 to +3 in the framework of the formed matrix. (-3: Strongly negative effect; -2: Relatively negative effect; -1: Limited and weak negative effect; 0: Neutral effect; +1: Weak positive effect; +2: Moderate positive effect; +3: Strong positive effect).

The scenario wizard software does not emphasize that the scenarios are selected from different ranges and they are designed only based on negative and positive relationships. Scenario planning is still a more or less new method that has been developed in various ways. Diversity of thought in the field of scenario planning is a kind of capital because it has led to a diverse set of interpretations in scenario programming. In fact, scenarios, Jammayeh and Shah Bayt are futuristic activities that draw alternative images of believable futures in the field in question. A scenario is a narrative with possible outcomes and effective links that connect the future state with the present; while also describing key decisions, events and consequences throughout her narrative (Nematollahi, et al, 2016). In fact, the scenario describes a situation in the future and a path that takes us from the present to this future; therefore, the process of planning with the help of scenario or scenario planning helps us to understand the bigger space of the future.

It should be noted that Zayandeh Rood catchment is the second catchment of the Central Plateau, which is coded with number 42. This basin is located in the middle part of the central plateau, its area is 41550 square kilometers. There are 21 study areas in this watershed, 17 of which are (Kupa Segzi, Barkhar Isfahan, Morche Khort, Alavijah and Dehgh, Mimeh, Najaf Abad, Karon, Mehyar Shamli, Lanjan, Chadegan, Boyin-Miandasht, Chehlkhaneh, Daran- Domain, Shahreza, South Mehyar, Esfandaran, Gavkhoni Lagoon) under the management of Isfahan Regional Water Company and three units (Chalgerd - Qala Shahrokh, Yanchashme and Ben - Saman) under the coverage and supervision of the Regional Water Company of Chahar Mahal and Bakhtiari Province and another unit (Izdkhas) is under the supervision of Fars Regional Water Company. About 87.7% of the catchment area of Zayandeh River is located in Isfahan province, which is of considerable importance for consumption in the agricultural and drinking sectors of Isfahan province, in such a way that between the years 2015-2015, water from the Zayandeh Rood basin was used to irrigate 331,220 hectares of agricultural land. And the amount of exploitation of underground water resources for consumption in the agricultural sector between 1399-1400 has been reported as 3200 million cubic meters. Also, the amount of exploitation of surface water resources for consumption in the agricultural sector between 2018-2019 was reported to be 1.544 million cubic meters. Therefore, careful planning to manage water consumption in Zayandeh Rood basin is inevitable.

Findings and Discussion

Descriptive findings showed that in terms of education, the majority of them (12 people) had a master's degree and in terms of gender, 100% of them were men, and in terms of history of participation in policy-making activities, the majority of the respondents did not participate. Also, the majority of the respondents did not have teaching experience at the university (Table 1).

Table 1- Demographic characteristics of experts

History of participation in policy activities		University lecturer		Gender		Education			Total number of respondents people
No	Yes	No	Yes	Woman	Man	Ph.D	senior expert	expert	
14	11	16	9	0	25	8	12	5	25

As stated earlier in the research method section, an 8x8 matrix was extracted through interviews with experts and was given to the experts of the agricultural sector. The results of the expertise index show that the experts have more than 50% expertise in all the questions raised and they have high knowledge about the subject. Also, the desirability index shows that there is a lot of desirability regarding one of the two situations raised in the questionnaire questions and in this regard, agriculture in a controlled environment with -0.68% has the highest percentage and changing the country's education system with -0.43% has the lowest level of favorability. The consensus index also indicates the level of uncertainty associated with each option. It shows that the development of new programs in the entrepreneurship sector, changes to the country's education system, and strengthening land use laws exhibit the highest levels of uncertainty. Among the issues raised, changing the cultivation pattern and focusing on the production of low-water-demanding crops emerges as the most crucial factor for the sustainable development of the agricultural sector in the future (Table 2).

In order to enter these elements into the Scenario Wizard software environment, these 8 factors were defined with their unique status in the software environment. Then, by expressing the possible states for each of these factors, the matrix of cross-effect analysis was formed and the statistical sample was asked to rate them according to the effect of one factor on other related factors from -3 to +3 in the framework of the formed matrix. In Table 3, drivers and possible influencing modes of sustainable agricultural development in Zayandeh River watershed of Isfahan province are presented.

Table 2- The results of experts' answers to Delphi questionnaire questions

Row	Question	Expertise index	Desirability index	Consensus index	Significance index
1	Farming in open space or controlled	73.61	-0.68	-0.44	84.25
2	Strengthening the current cultivation pattern or changing the cultivation pattern and production of low water-demanding crops	68.85	-0.65	-0.68	85.61
3	Direct government rule or popular participation	69.69	0.51	0.49	73.32
4	Traditional agriculture or smart agriculture	65.6	-0.61	0.68	77.84
5	Strengthening current consumption management or modifying consumption pattern	62.7	-0.59	-0.58	78.82
6	Development of current actions in the entrepreneurship sector or development of new programs in the entrepreneurship sector	70.13	-0.65	-0.28	74.75
7	Strengthening the education system of the country or changing the education system	65.15	-0.43	0.18	71.98
8	Removing agricultural land use rules or strengthening the rules	75.31	-0.53	-0.13	76.62

Table 3- The main factors and possible situations facing the sustainable development of agriculture in the catchment area of Zayandeh River in Isfahan province

Acronym	Possible situation	Degree of desirability	The main influencing factors
A1	Elimination and reduction of government support	Critical	Government support and financial facilities in the agricultural entrepreneurship sector
A2	Maintaining and continuing the current trend	Static	
A3	Increasing government support	Desirable	
F1	Lack of development of low water-demanding products such as medicinal plants, saffron and saffron	Critical	Development of low water-demanding products such as medicinal plants, saffron and saffron
F2	Maintaining the current situation of using low water-demanding products such as medicinal plants, saffron and saffron	Static	
F3	Development of low water-demanding products such as medicinal plants, saffron and saffron	Desirable	
B1	Lack of agricultural development in controlled environments such as greenhouses	Critical	Development of agriculture in controlled environments such as greenhouses
B2	Continuing the current trend of farming in controlled environments such as greenhouses	Static	
B3	Increasing the development of agriculture in controlled environments such as greenhouses	Desirable	
U1	Reducing the economic productivity of water	Critical	Increasing the economic productivity of water
U2	Continuation of the current trend of economic water efficiency	Static	
U3	Increasing the economic productivity of water	Desirable	
S			
S1	Deterioration of water management between industry and agriculture sectors	Critical	Proper management of water consumption between industry and agriculture sectors
S2	Continuation of the current process of water consumption management between industry and agriculture sector	Static	
S3	Improving water consumption management between industry and agriculture sectors	Desirable	
L			
L1	Reduction of employment in the agricultural sector	Critical	Development of employment fields in the agricultural sector
L2	Continuing the current trend of employment in the agricultural sector	Static	
L3	Increasing employment in the agricultural sector	Desirable	
H			
H1	Reduction in the production of export products	Critical	Development of export products
H2	Continuing the current trend of producing export products	Static	
H3	Increasing the production of export products	Desirable	
G			
G1	Worsening management of cropping pattern	Critical	Proper management of cropping pattern
G2	Continuing the current trend of cropping pattern management	Static	
G3	Improving the management of the cultivation pattern	Desirable	

Finally, according to the effect of one factor on other related factors, 5 believable scenarios were identified by considering possible situations resulting from key factors and their commonalities or differences in the categories of favorable, static and critical scenarios (Table 4).

The percentages and number of scenarios in Table 5 show the distribution of different situations. Specifically, critical situations account for 20 scenarios, static situations (maintaining the current state and continuing the existing trend) for 12 scenarios, and favorable situations for 8 scenarios, representing the highest to lowest amounts, respectively. In other words, 50% of the scenarios are related to critical situations, 30% to static situations, and nearly 20% to favorable situations, as explained below.

Table 4- The status of each of the factors according to optimal to critical status

The fifth scenario	The fourth scenario	The third scenario	The second scenario	The first scenario	scenarios/ Agents
Desirable	Static/Continuation of current trend	Undesirable	Static/Continuation of current trend	Undesirable	Government financial support and facilities in the field of agricultural entrepreneurship
Desirable	Static/Continuation of current trend	Undesirable	Static/Continuation of current trend	Undesirable	Development of areas to increase employment in the agricultural sector
Desirable	Static/Continuation of current trend	Static/Continuation of current trend	Static/Continuation of current trend	Static/Continuation of current trend	Development of low water-demanding products
Desirable	Static/Continuation of current trend	Static/Continuation of current trend	Undesirable	Undesirable	Agricultural development in controlled environment such as greenhouses
Desirable	Undesirable	Undesirable	Undesirable	Undesirable	Correct management of water consumption between industry and agriculture sectors
Desirable	Static/Continuation of current trend	Static/Continuation of current trend	Undesirable	Undesirable	Increasing the economic productivity of water
Desirable	Undesirable	Undesirable	Undesirable	Undesirable	Development of export products
Desirable	Undesirable	Undesirable	Undesirable	Undesirable	Correct management of the cultivation pattern

Table 5- Number and percentage of situations

Percentage	Number	Status
20	8	Desirable
30	12	Static
50	20	Critical
100	**40**	Total

Favorable scenarios

According to favorable, static and critical situations; Scenario number 5 is a favorable scenario. In this scenario, all states of agents are favorable. In total, these scenarios have 8 favorable situations, which are shown in Table 6.

Static scenarios

According to favorable, static and critical situations; Scenario number 4 is a static scenario. In this scenario, there are 5 static states, 3 unfavorable states, which are shown in Table 7.

Table 6- Characteristics of desirable scenarios

General features	Number of scenarios	Category
Increasing government support The trend of increasing employment in the agricultural sector The process of increasing agriculture in a controlled environment Improving water consumption management between industry and agriculture sectors The increasing trend of producing low water-demanding products Increasing the economic productivity of water Increasing the production of export products Improvement of cultivation pattern management	**Fifth**	Desirable

Table 7- Characteristics of static scenarios

General features	Number of scenarios	Category
Maintaining and continuing the current process of government support and financial facilities in the agricultural entrepreneurship Continuing the current trend of employment in the agricultural sector Maintaining and continuing the current trend of cultivating low water-demanding crops such as saffron Maintaining and continuing the current trend of agriculture in controlled environments Deterioration of water consumption management between industry and agriculture sectors Maintaining and continuing the current trend of economic water efficiency Reducing the cultivation of export products Worsening of proper management of cropping pattern	**Fourth**	Static

Critical Scenarios

According to favorable, static and critical situations; Scenarios number 1 to 3 are critical scenarios. From the total of 24 situations in these scenarios; 17 critical situations 7 situations have a static situation and maintain the existing situation, which is shown in Table 8.

Based on the results of Table 9, the fifth scenario with 8 favorable assumptions (100 percent) is the most favorable situation and the first scenario with 7 critical assumptions (87.5 percent) is the most unfavorable situation for the catchment area.

Table 8- Characteristics of critical scenarios

General features	Number of scenarios	Category
Removal and reduction of government support Deterioration of water supply and consumption Continuing the current trend of government support and facilities in the agricultural entrepreneurship sector Continuing the current trend of employment in the agricultural sector Continuation of the current trend of cultivation of low water-demanding crops The decreasing trend of growing crops in a controlled environment Deterioration of proper management of water use between agriculture and industry Continuation of the process of economic efficiency of water The trend of reducing the cultivation of export crops Worsening of proper management of cropping pattern	**First to third**	Critical (unfavorable(

Table 9- Coefficients, number and percentage of each situation separately for each scenario based on the triple spectrum

Critical situations									Adverse situations	Status coefficients	The number of statuses separately	scenario
Percentage of critical conditions	Maximum critical conditions	The extent of critical conditions	Percentage of desirability	Ideal score	The desired amount	3-	1	3	critical	static	Desirable	
87/5	-24	-21	0	24	0	21-	1	0	7	1	0	1
62/5	-24	-15	0	24	0	15-	3	0	5	3	0	2
62/5	-24	-15	0	24	0	15-	3	0	5	3	0	3
37/5	-24	-9	0	24	0	-9	5	0	3	5	0	4
0	-24	0	100	24	24	0	0	24	0	0	8	5

Table 10- Possible scenarios of sustainable agricultural development

The fifth scenario	The first scenario	scenarios/ Agents
Increasing government support	Removal and reduction of government support	Government financial support and facilities in the field of agricultural entrepreneurship
Increasing employment in the agricultural sector	Reduction of employment in the agricultural sector	Development of employment fields in the agricultural sector
Increasing the cultivation of low water-demanding crops	Continuation of the current trend of growing low water-demanding crops	Development of cultivation of low water-demanding crops
Increasing cultivation in controlled environments	Reduction of cultivation in controlled environments	Agricultural development in a controlled environment
Improving water consumption management between industry and agriculture sectors	Deterioration of water consumption management between industry and agriculture sectors	Correct management of water consumption between industry and agriculture sectors
Increasing the economic productivity of water	Reducing the economic productivity of water	Increasing the economic productivity of water
Increasing the production of export products	Reducing the production of export products	Development of export products
Improvement of cultivation pattern management	Deterioration of management of cultivation pattern	Correct management of the cultivation pattern

Identify Possible Scenarios

Among the 5 believable scenarios and software outputs and according to their total impact score, which are between 85 and 109; 2 scenarios are the most likely scenarios. These scenarios have a total effect score of 87 to 109, of which 1 is favorable and 1 is critical. Which is shown in Table 10.

Conclusions and Suggestions

The complexity of human changes and variables, coupled with the unpredictable nature of environmental and global economic factors affecting agricultural activities, presents significant challenges for sustainable agricultural development. On one hand, the strategic importance of food security and combating poverty is critical, while on the other, the continuous and rapid changes make traditional planning methods inadequate. The increasing uncertainties and the emergence of unexpected events have created a situation where planning has become increasingly difficult. Therefore, it is necessary that the developed strategies to face these issues are based on comprehensive and optimal analysis which examines the main dimensions of agriculture and food sector in an integrated way. Therefore, this research was conducted with the aim of developing possible scenarios of sustainable agricultural development in the Zayandeh River watershed in Isfahan province. The results of Delphi analysis showed that experts in agriculture in controlled environment have the highest percentage of favorability with -0.68%. Since sustainable production is the most important task in agriculture Therefore, in sustainable production, agricultural products needed by the society should be produced to the extent that the relative advantage of each province allows and the biggest obstacle in this path is the water problem. Given that agriculture faces numerous challenges such as climate change, fluctuating agricultural product markets, and political decisions, it is crucial to develop a strategic plan to stabilize some of these variables while optimizing production based on others. One approach to achieving this is through farming in controlled environments, such as greenhouses, which allow for better control of factors like water consumption, ultimately increasing production. Additionally, among the various issues raised, changing cultivation patterns to focus on low-water-demanding crops is considered the most important for the sustainable development of the agricultural sector in the future. Since agriculture is the largest consumer of water, improving water consumption management and enhancing efficiency in this sector can significantly reduce water usage. One of the methods that improves the management of water consumption and ultimately increases the efficiency of water consumption, drought risk management of agriculture in dry areas and determining the optimal pattern of low water intensive cultivation. Research was conducted by Joolaei (2004) in the field of investigating cultivation patterns, the results indicate that the implementation and design of the optimal cultivation model in the form of a specific program has been used in many countries of the world and with its help, many problems of crop and garden production have been solved and to determine the optimal pattern of cultivation in each region, micro and macro goals should be considered.

The findings of the scenario wizard analysis showed that there are 5 believable scenarios based on the effect of one factor on other related factors. Finally, among the 5 believable scenarios and the outputs of the software and according to the total score of their effects, 2 scenarios are the most probable scenarios that among them, 1 favorable scenario and 1 critical scenario. Therefore, according to these results, supporting the agricultural sector for various reasons, including creating employment and booming production in the former and latter industries, establishing food security, the essentiality of some agricultural products in the community's food basket, rural development and maintaining the structure of the rural population and preventing migration to cities, preservation and sustainability of the environment, contribution to national security and independence of the country, creation of added value and increase of national income through non-oil exports, the requirements of relative and structural advantage of production and self-sufficiency and raising the income of farmers are accepted. Therefore, in all developed and developing countries, producers support the agricultural sector in various ways. Hatberg (2000) who studied the effects of Sweden's support policies in agricultural development concluded that due to the effectiveness of these policies, political reforms should also be carried out and in order to meet the needs of farmers, financial resources should be available to them.

There are various tools to support the agricultural sector, the use of each of which has different effects on the agricultural sector and other economic sectors. In general, agricultural policy in Iran can be divided into three categories: pricing policy, institutional support, and other support. One of the important policies in the economy that is carried out in most countries is to support the producer or consumer through the payment of subsidies. Statistics also show that only 12% of Iran's area is under cultivation, more than 90% of the consumed water is allocated to the agricultural sector, and part of it is wasted. Meanwhile, the average efficiency of water consumption in the agricultural sector in Iran is 40% lower than the average of the world standard. Therefore, due to the limited and fixed amount of renewable water, the competition between drinking, agricultural and industrial water users on the one hand and the competition at the catchment level on the other hand can intensify in the future or cause new challenges. On the other hand, water pollution has spread and during periods of drought and uneven distribution of rainfall on the ground and destructive works, flowing water caused by floods has created conditions that if water resources are not managed and their quality and quantity should not be considered it may cause unpredictable tensions for countries. Therefore, in order to prevent this crisis, the first step is to create a correct and rational culture of water consumption and improve it through the formulation of optimal water consumption, planning and implementation of water consumption management plans in agriculture and modification of tariffs for high consumption subscribers and implementation of incentive plans such as correct subsidies in the direction of developing modern irrigation plans. New technology and applying new methods can help us in this goal of providing enough water but it will not be able to be together forever. The best solutions to promote the culture of correct and optimal water consumption in the agricultural sector require a correct and reliable cultural infrastructure and culture building in the agricultural society. In this context, both government and non-government sectors, which include farmers and specialists in this sector, must be aware of their duties and act and have continuous communication and coordination in the development of agriculture and especially water and just like in the field of crop cultivation, land preparation plans are made in this section, the national study of water resources and the balance of the region should be compiled and implemented that this is not possible without promoting and educating and informing farmers by the government and the relevant ministry of research and education and creating a culture to save agricultural water consumption is not possible only by a ministry or government body and there is a need for national and coherent determination on the part of all governmental and non-governmental institutions. Due to the large consumption of water in the agricultural sector, water demand management, especially the management of exploitation and improvement of the economic efficiency of water and considering the water input as an economic and valuable commodity, is of special importance in the country. Economists to solve the problem of food production from limited water resources and prevent excessive import of agricultural products, they recommend increasing the physical productivity and economic productivity of water (Heydari, 2013). In developing countries, improving agricultural water productivity is considered one of the most important basic solutions. Finally, according to the results obtained from the research, the following suggestions can be made.

- Changing the traditional irrigation pattern and developing the cultivation of low water-demanding plants such as saffron, saffron and medicinal plants using modern scientific methods of irrigation.

- Reducing the amount of water consumption in the agricultural sector by changing the cultivation pattern and increasing the economic efficiency of water.

- Implementing a model for crop cultivation, based on the country's macro policies, market structure, farmers' knowledge and regional and climatic potentials in order to preserve the environment and achieve sustainable economic advantages.

- Introduction of potential fields by relevant organizations such as agricultural jihad, where ideas in those fields have the ability to be commercialized and successful in order to guide and organize talents and innovations in the agricultural sector.

- Applying appropriate policies from the government in the field of obtaining facilities, exporting agricultural products, security for investment in the agricultural sector, product insurance, strengthening the production sectors, making the market of agricultural products competitive and paying attention to fostering the spirit of creativity and innovation among students.

- Cultivation and promotion of correct and optimal use of water, implementation of incentive schemes by government agencies such as paying correct subsidies to new and established irrigation schemes and modifying tariffs for high-consumption subscribers.

- Using modern and smart agricultural methods, including remote sensing methods, information technology, nano technology and agricultural applications to increase the economic efficiency of water in the agricultural sector.

References

1. Ahmad, U., & Inayatullah, M. (2013). Challenges to the agricultural development in Iran. *International Journal of Innovative Research & Development*, *2*(10), 85-91.
2. Ajilore, O., & Fatunbi, O.A. (2018). Exploring the futures of agricultural research and innovations (ARI) systems in Africa. *Journal of Futures Studies, September, 23*(1), 23–36. https://doi.org/10.6531/JFS.201809_23(1).0003
3. Akrami, M., Mahdavi, R., Rezaie, M., Vagharfard, H., & Barkhordari, J. (2021). Calculating the water requirement and providing a pattern of horticultural cultivation with low water demand

and compatible with dry areas, in order to reduce the vulnerability of agricultural drought) Case study: Pishkoh watershed, Yazd province. *Scientific Research Journal of Irrigation and Water Engineering*, *12*(46), 314-337.

4. Asadi, H., Mahmoodi, M., & Zare, SH. (2021). Determining the profitability and economi efficiency of agricultural water in the production of crops. *Iran Irrigation and Drainage Journal*, *6*(15), 1404-1411.
5. Bagheri, N., Keshavarz, M., Abbasi, F., Abbasi, N., & Bordbar, M. (2020). Future research of the agricultural engineering and technical research institute in the horizon of 1404. *Journal of Strategic Research in Agricultural Sciences and Natural Resources*, *5*(1), 1-18. https://doi.org/10.22047/SRJASNR.2020.113048
6. Bahrami, M., Asadi, M., & Khaliliyan, S. (2020). Evaluation of water efficiency indicators with an emphasis on modern and traditional irrigation in crops of Shahryar city. *Environment and Water Engineering*, *6*(3), 284-292.
7. Beheshti, M., Behboodi, D., Zali, N., & Ahmadzadeh, F. (2019). Scenarios of water resources management based on future research approach (case study: Tabriz city). *Two Quarterly Journals of Iranian Future Studies*, 5(2), 203-228. https://doi.org/10.30479/JFS.2020.12446.1150
8. Bradfield, R., Derbyshire, J., & Wright, G. (2016). The critical role of history in scenario thinking: augmenting causal analysis within the intuitive logics scenario development methodology. *Futures*, *77*, 56-66. https://doi.org/10.1016/j.futures.2016.02.002
9. Eghbali, J. (2020). Analysis of water governance system in Zayandeh Rood catchment area in the direction of stabilization of agricultural water resources. Department of Agricultural Development, Faculty of Agriculture and Natural Resources, University of Tehran .
10. Enteshari, C., & Safavi, H. (2019). Investigating the administrative-institutional system of water management in the Zayandeh River basin using the qualitative method of grounded theory. *Water and Wastewater Journal*, *30*(6), 1-17. https://doi.org/10.22093/WWJ.2019.149029.2749
11. Fakai Sordeie, B., Shahnooshi, N., & Mohammadi, H. (2020). The future research of Iranian wheat. *Journal of Agricultural Economy*, *14*(1), 27-49. https://doi.org/10.22034/IAES.2020.124268.1761
12. Gavetti, G., & Menon, A. (2016). Evolution cum agency: Toward a model of strategic foresight. *Strategy Science*, *1*(3), 207-233. https://doi.org/10.1287/stsc.2016.0018
13. Ghoochani, A., Dabiry, D., & Ghaniyan, M. (2019). Macro survey of drivers of water resources management in Iran's agricultural sector. *Scientific Research Quarterly of Public Policy*, *5*(2), 59-78. https://doi.org/10.22059/PPOLICY.2019.72272
14. Goldstein, J., Caldarone, G., Duarte, K., Hannahs, N., & Mckenzie, E. (2012). Invest Scenarios case study: Hawaii, USA. WWF, Morges.
15. Gutzler, C., Helming, K., Balla, D., Dannowski, R., & Paol, C. (2015). Agricultural land use changes–a scenario-based sustainability impactassessment for Brandenburg, Germany. *Ecological Indicators*, *6*(48), 505-517.
16. Hatami, A., & Noorbakhsh, S. (2018). Reconstructing the meaning of the water crisis in the east of Isfahan based on grounded theory. *Journal of Applied Sociology*, *30*(73), 122-143. https://doi.org/10.22108/JAS.2018.109357.1299
17. Heidari, N. (2014). Determining and evaluating the efficiency of water consumption of some major crops under the management of farmers in Iran. *Journal of Water and Irrigation Management*, *1*(2), 43-57.
18. Holtsberg, C. (2000). Swedish Support to Agricultural Development. Natural Resources Managemen Division, SIDA.
19. Jashari, S., & Moradi, A. (2018). Developing strategies for the development of agricultural economy in the rural areas of Sistan and Baluchistan province with a future research approach.

Space Economy and Rural Development Quarterly, *8*(29), 51-66.

20. Jashari, S., & Moradi, A. (2017). An analysis of the development drivers of the agricultural sector of Sistan and Baluchistan province with the principles of future research. National conference of economy, development management and entrepreneurship with the approach of supporting Iranian goods. May 11, Zahdan. EDME01_108
21. Joolaei, R. (2004) Management of crop pattern in 3central counties of Fars province in a multi-region.
22. Keramatzadeh, A. (2006). Comparative study of characteristics and methodologies of social sciences and natural sciences from Popper's point of view. *Field and University Magazine*, *12*(48), 28-48.
23. Mahmoodi, A., & Karimi, H. (2015). Economic valuation of water for large and small wheat farms: a case study of Tabas city. *Journal of Agricultural Economics and Development*, *25*(100), 1-19.
24. Majlis Research Center. (2018). Foresight of the agricultural sector: environmental survey, supply and demand. Vice President of Infrastructure Research and Production Affairs, Infrastructure Studies Office.
25. Makal, A., Banerjee, A., Roy, A., Hazra, S., & Polley, K. (2017). Issues and problems in agricultural development: A study on the farmers of West Bengal. Bhui, S., Das, M. S. and Coomar, P. C. Development among the Tribal and Minority Societies. Publisher: Gyan Publishing House, New Delhi, 179-182.
26. Nematollahi, Z., Fakoori, N., Shahpoori, A., & Ashktorap, N. (2016). Are government support policies effective on Iran's agricultural growth? 10th Biennial Conference on Agricultural Economics of Iran, Scientific Association of Agricultural Economics of Iran, Shahid Bahonar University of Kerman, 237-245.
27. Nikanfar, R., & Naseri, A. (2019). Future research of energy efficiency in water wheat production in the eastern margin of Lake Urmia. *Environmental Science Quarterly*, *17*(2), 80- https://doi.org/101. 10.29252/ENVS.17.2.81
28. Nsikak- Abasi, A.E., & Kesit, K.N. (2015). Barriers to increasing agricultural production in Nigeria. *American Journal of Agricultural Science*, *2*(4), 138-143.
29. Sadeghi, H., & Khanzadeh, M. (2019). Strategic analysis of agricultural sector development using swot method and Qspm matrix: a case study of Urmia Lake catchment area. *Agricultural Economics and Development*, *27*(108), 87-118. https://doi.org/10.30490/AEAD.2020.252675.0
30. Sharifzadeh, A., & Hosseini, M. (2009). Necessity and fields of application of future research in the promotion and sustainable development of agriculture. The 3rd Congress of Science and Promotion of Agricultural Education, March 10, Mashhad.
31. Takallo, A., SHamsoddini, A., Rahmani, B., & Valishariatpanahi, M. (2019). Future research of human resources development in the agricultural sector in rural areas (Case: Central part of Malair city). *Scientific and Research Quarterly of the Iranian Geographical Society, 18*(67), 103-88.
32. Zali, N., & Atriyan, F. (2016). Development of regional tourism development scenarios based on the principles of future research (case study of Hamadan province). *Amish Sarmeen*, *8*(1), 107-131. https://doi.org/10.22059/JTCP.2016.59147

Journal of Agricultural Economics & Development

https://jead.um.ac.ir

مقاله پژوهشی

جلد ۳۸، شماره ۴، زمستان، ۱۴۰۳، ص. ۴۲۹-۴۱۳

تدوین سناریوهای توسعه پایدار کشاورزی در حوضه آبریز زاینده رود استان اصفهان

زهرا زارعی دستگردی[۱]- خلیل کلانتری[۲*]- علی اسدی[۲]

تاریخ دریافت: ۱۴۰۳/۰۷/۰۲

تاریخ پذیرش: ۱۴۰۳/۰۸/۲۷

چکیده

بخش کشاورزی در کشورهای در حال توسعه نقش مهمی را در پیشبرد توسعه ملی ایفا می‌نماید و سیاستگذاری عقلایی و برنامه‌ریزی راهبردی جهت پیشبرد توسعه پایدار این بخش یکی از دغدغه‌های اصلی کنشگران نهادی ذیربط به شمار می‌رود. در این راستا پژوهش حاضر با هدف شناسایی سناریوهای توسعه پایدار کشاورزی در حوضه آبریز زاینده رود استان اصفهان انجام گرفت. پژوهش حاضر کاربردی، از نوع توصیفی-پیمایشی بود. جامعه آماری خبرگان مرتبط با توسعه کشاورزی در استان بودند. جهت جمع‌آوری داده‌ها از منابع کتابخانه ای، پرسشنامه و مصاحبه استفاده گردید. برای شناسایی مؤلفه‌ها و پیشران‌های اولیه مؤثر بر توسعه پایدار کشاورزی در حوضه آبریز زاینده رود استان اصفهان از روش دلفی و مصاحبه با نخبگان و مسئولین اجرایی استفاده شد و برای انتخاب خبرگان نیز تکنیک گلوله برفی به کار رفت. در نهایت تعداد ۸ پیشران کلیدی در راستای تبیین متغیرهای پژوهش در قالبی استراتژیک مورد شناسایی و تفکیک قرار گرفتند. بر این اساس در قسمت مربوط به بیان اولویت‌های پژوهش در دو حالت مستقیم و غیرمستقیم، این ۸ عامل کلیدی در اولویت‌های مختلف تکرار شده اند. پرسشنامه‌ها بین ۲۵ نفر از خبرگان توزیع گردید. در این پژوهش برای آینده نگاری توسعه پایدار کشاورزی ۵ سناریوی باورکردنی با درنظر گرفتن وضعیت‌های حاصل از عوامل کلیدی و وجه اشتراک و یا تفاوت‌های آنها در دسته‌های سناریوهای مطلوب، ایستا و بحرانی شناسایی و با توجه به نمره کل اثر آنها که بین ۸۵ تا ۱۰۹ هستند؛ تعداد ۲ سناریو محتمل‌ترین سناریوها تشخیص داده شد که یک سناریو مطلوب و یک سناریو بحرانی هستند.

واژه‌های کلیدی: آینده‌نگاری، توسعه کشاورزی، حوضه آبریز زاینده رود، سناریو نگاری

۱- مربی گروه کشاورزی، دانشگاه پیام نور، تهران، ایران

۲- استاد گروه مدیریت و توسعه کشاورزی، دانشکده کشاورزی، دانشگاه تهران، کرج، ایران

(*- نویسنده مسئول: Email: khkalan@ut.ac.ir)

https://doi.org/10.22067/jead.2024.89627.1292