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Application of SEM Analysis for Designing Strategic Model for Agricultural Sustainable Development (ASD) in Iran

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Abstract

The main purpose of this study is identifying strategies for agricultural sustainable development in Iran. This research is a mixed exploratory research and has been carried out in a combination of qualitative and quantitative parts. In the qualitative part, various methods such as semi-structured interviews and focus group techniques were used. In a quantitative part, the population of the study consisted of wheat farmers of Khouzestan province, Iran. The stratified random sampling method was selected as the research sampling method. In order to formulate strategic planning, the model of analysis of Strengths, Weaknesses, Opportunities and Threats (SWOT) was used. Also, in the quantitative part of the research through Structural Equation Model (SEM), the role of the identified strategies was evaluated and the designed model was approved. Based on the results, it can be found that the predictive positive effect of WO1 (β=0.512, t-value=3.453, p<0.001), WO2 (β=0.533, t-value=3.516, p<0.001), WO3 (β=0.581, t-value=4.129, p<0.001), WO4 (β=0.916, t-value=5.821, p<0.001), WO5 (β=0.861, t-value=4.523, p<0.001), WO6 (β=0.823, t-value=5.123, p<0.001), WO7 (β=0.694, t-value=5.212, p<0.001), WO8 (β=0.761, t-value=4.928, p<0.001), WO9 (β=0.832, t-value=5.257, p<0.001) and WO10 (β=0.621, t-value=4.153, p<0.001) on the ASD. Based on the results, the amount of R^2=0.74 was estimated. This indicates that 10 strategies and 34 construct have the ability to explain 74% of the ASD variance. Based on the results obtained, the overall goodness of the fitting statistics showed that the structural model is well consistent with the data. The designed strategic plan can play an effective role in the sustainable development of agriculture.

Keywords:
Strategy, Sustainable Agricultural Development, Iran. SEM

1. Introduction

Rising food demand and depletion of nutrient reserves have led to a large shortfall between food supply and demand and will worsen in the coming years. The introduction of more artificial fertilizers into lands has led to environmental pollution, continuous changes in soil ecology and physicochemical conditions (Mahapatra et al, 2022). Agriculture is a major driver of deforestation and biodiversity loss (Zhang et al., 2021). Also, agricultural activities can have devastating effects on the environment, such as the destruction of water and soil resources, air pollution and reduced ecological diversity (Rani et al., 2021). The agricultural sector uses chemical fertilizers to increase agricultural production to meet the growing food needs of the population (Razeghi et al., 2018). Today, the use of nitrogen fertilizers is widespread in most developed countries. China is the largest producer and consumer of nitrogen fertilizers (Hartmann et al., 2020). Agriculture contributes about 90% of reactive nitrogen (N) and phosphorus (P) inputs (Zhang et al., 2021). Global chemical fertilizer use was estimated at 198.2 Mt of nutrients in year 2020/21, almost 10 Mt (5.2%) higher than in 2019/20. This is the largest increase since 2010/11 (IFA, 2021). The results of research conducted in the Iran indicate that despite the approval of the national plan to reduce the use of pesticides and the optimal use of chemical fertilizers, the use of chemical fertilizers and pesticides has increased. Production and distribution of pesticides by unauthorized sellers and lack of legal action against them, along with the indiscriminate use of pesticides by farmers, in addition to creating the phenomenon of insect resistance and the spread of secondary pests, has increased the cost and pollution of the environment (Maleksaeidi et al., 2021). According to the FAO (2020), more than 698000 tons chemical fertilizers were used in Iran in 2018. The amount of N fertilizer consumption reached to 565000 tons in 2018. The amount of P2O5 fertilizer consumption increased 100 thousand tons. Currently, the average annual consumption of pesticides in Iran is 25,000 to 30,000 tons (Ag News, 2020). Considering that agriculture is one of the most important economic sectors in Iran (Maleksaeidi et al., 2021), but its environmental effects are also significant (Gorji Kheili et al., 2019). This issue is clearly visible in southern provinces such as Khuzestan province (Kaabi et al., 2021).

Various studies conducted in the field of agricultural sustainability in Iran also confirm the unsustainable situation of agriculture (Moridsadat & Roknoddin Eftekhari, 2018). Irregular use of chemical inputs (FAO, 2020), high soil erosion, present soil erosion in Iran is estimated at 6.2 ton/ha/year (Doulabian et al., 2021), failure to implement crop rotation (Ataei et al., 2021), improper management of water resources (Khatibi & Arjjumend, 2019) and low production efficiency (Maleksaeidi et al., 2021), are the most important indicators of agricultural instability in Khuzestan province. At this line, the current situation of agriculture in Khouzestan province, Iran is unsustainable. In terms of water pollution (Ommani, 2019), soil erosion (Amanpour et al., 2021), use of excessive external inputs such as fertilizers and chemical pesticides (Moridsadat & Roknoddin Eftekhari, 2018), failure to use a suitable cultivation pattern (Abdeshahi et al., 2020) and low production efficiency (Hesampour et al., 2021), unsustainability is high. Due to the current situation and unsustainable agricultural situation, in order to improve the food security situation, the need to identify the strategies of sustainable agricultural development in Khuzestan province is of great importance.

Recognizing the major impact of agriculture, along with the environmental crises facing the world, sustainable agricultural strategies must be used as an essential solution. These strategies must be regional and tailored to the conditions of each region. This is also important in the context of the nature-based solutions that have been defined: It simultaneously provides human well-being and the benefits of biodiversity (Cohen-Shacham et al., 2016). Oberc & Arroyo Schnell et al., (2020) examined a number of approaches to sustainable agriculture, as well as supporting activities. The approaches include: agroecology, nature-inclusive agriculture, permaculture, biodynamic agriculture, organic farming, conservation agriculture, regenerative agriculture, carbon farming, climate-smart agriculture, high nature value farming, low external input agriculture, circular agriculture, ecological intensification, and sustainable intensification. NCCMA (2016) concluded that the following strategies should be considered to make major changes in the agricultural sector and move towards sustainability: 1) Adaptation to climate change; 2) Continuous development of agricultural systems and technologies in accordance with local conditions and natural resources; 3) Explore new goods and develop new products and markets; 4) If we want to export successfully, we need to determine how to connect with external food chains and needs; 5) Investment in infrastructure (ie telecommunications, agriculture, road and rail networks); 6) Consider and implement new land management, and corporate and cooperative agricultural structures; 7) Improve soil health and yield; 8) Improve water consumption efficiency; 9) Maintain and increase social capital by investing in individuals and societies; 10) Strengthen stronger relationships with key actors (ie communities, politicians and government agencies).

Also, Branko et al., (2018) described the strategies of sustainable management of natural resources and environmental protection as follows: 1) Environmental situation analysis; 2) Solid wastes management; 3) Management of waste and atmospheric waters; 4) Affirmation of renewable energy programs; 5) Increasing the area under the greenery; 6) Education of local actors and population in the field of environmental protection; 7) Environmental monitoring (continuous measurement of environmental parameters); 8) Networking of all stakeholders related to issues of environmental protection and improvement.

2. Materials and Methods

This research is a mixed exploratory research. This research has been carried out in a combination of qualitative and quantitative parts. In the qualitative part, various methods such as semi-structured interviews and focus group techniques were used. The data were collected by performing in-depth semi-structured interviews with the 30 agricultural experts. In a quantitative part, the population of the study consisted of wheat farmers of Khouzestan province, Iran as the pol of production the country's wheat (N = 10000). The sample size was determined according to Krejcie & Morgan (1970) (n = 370). The stratified random sampling method was selected as the research sampling method. A researcher-made questionnaire was the main instrument to collect data. In order to formulate strategic planning, the model of analysis of Strengths, Weaknesses, Opportunities and Threats (SWOT) and Structural Equation Modeling (SEM) were used. Strengths are the internal capabilities of an organization to achieve goals, weaknesses are the internal shortcomings of the organization to not achieve goals. Opportunities, external perspectives of the organization that confirm the achievement of goals and threats are external adversities that hinder the achievement of organizational goals (Bull et al., 2016). Structural Equation Modeling (SEM) is a powerful multivariate technique that is widely used in scientific research to analyze and evaluate multivariate causal relationships. SEMs are fundamentally different from other modeling approaches because they test for direct and indirect effects on default causal relationships (Kang and Ahn, 2021).

3. Results and Discussion

3.1 Characteristics of respondents

The results of Table 1 in the quantitative phase show that the lowest frequency was 56 people with 15.14% aged between 20 to 30 years. Also, the highest frequency was 105 people and 28.38% were between 41 and 50 years old. The average age of farmers was 43.53 years. The results of Table 1 in the qualitative phase show that the lowest frequency of 2 people, 6.67% were aged 61 to 71 years. Also, the highest frequency was 14 people with 46.6% aged 41 to 50 years. The average age of agricultural experts was 44.5 years. Also, the results of Table (1) in the quantitative phase show that the lowest frequency of 16 people with 4.32% had a master's degree. Also, the highest frequency of 105 people with 28.38% had high school education. The results of Table (1) in the qualitative phase show that the lowest frequency of 13 people, with 43.33% had a master's degree. Also, the highest frequency of 17 people with 56.67% had a bachelor's degree. According to the results, the lowest frequency of 11 people with 9% had an income between 400 to 600 million rials per year and the highest frequency of 109 people and 29.46% had an income between 1210 to 1400 million rials. The average income was equal to 1160 million rials per year. The results of Table 1, in the qualitative phase, show that out of 30 experts surveyed, 11 had incomes between 400 to 600 million Rials and 19 had annual incomes between 610 to 800 million Rials. The average income of agricultural experts is equal to 406 million rials.

Table 1. Characteristics of respondents

Characteristics	quantitative phase		qualitative phase		Total respondents	
	frequency	percent	frequency	percent	frequency	percent
Age						
20-30	56	15.14	0	0	56	14
31-40	65	17.57	3	10	68	17
41-50	105	28.38	12	40	117	29.25
51-60	79	21.35	10	33.33	89	22.25
61-71	65	17.57	5	16.67	70	17.5
Educational level						
illiterate	45	12.16	0	0	45	11.25
Primary	89	24.05	0	0	89	22.25
high school	105	28.38	0	0	105	26.25
Diploma	70	18.92	0	0	70	17.5
BSc	45	12.16	17	56.67	62	15.5
MSc	16	4.32	13	43.33	29	7.25
Income						
400-600	11	2.97	13	43.33	24	6
601-800	35	9.46	17	56.67	52	13
801-1000	63	17.03	0	0	63	15.75
1001-1200	65	17.57	0	0	65	16.25
1201-1400	109	29.46	0	0	109	27.25
1401-1700	87	23.51	0	0	87	21.75

3.2 Explanation External and Internal Factors Evaluation Matrix (EFE/IFE)

This research first started from the qualitative part and examined the strengths, weaknesses, opportunities and threats of Agricultural Sustainable Development (ASD) in social, economic, productive, environmental and policy dimensions. To collect data, 6 focus groups were formed and 3 sessions were held with each group, each session lasting 2 hours. Focus group discussion is frequently used as a qualitative approach to gain an in-depth understanding of social issues (Nyumba et al., 2018).

Initially, 68 phrases were identified in SWOT format. The phrases were then monitored by holding several sessions, and finally 42 phrases were finalized and categorized into strengths, weaknesses, opportunities, and threats. At this phase of the research, external (opportunities and threats) and internal (strengths and weaknesses) factors that identified were evaluated. Based on the experts' idea, each item was evaluated, ranked and the importance ratio coefficient was identified. To conduct the second part of the research, ie evaluation internal and external factors, 5 two-hour sessions were held with experts, and in the sessions, the focus groups technique was used. The EFE and IFE matrix process uses the following five steps (Kiani et al , 2021): 1) Listing internal and external factors: The first step is to list the items of internal and external factors in the form of strengths, weaknesses, opportunities and threats. 2) Assigning weight to each item: Items should be weighed in such a way that the sum of internal factors and external factors to be separately one. 3) Rank of items: The ranking is determined for the items of each factor and is between 1 and 4. Rank indicates the importance of each item. Rank indicates whether the item represents a major threat (rank = 1), a minor threat (rank = 2), a minor opportunity (rank = 3), or a major opportunity (rank = 4). Also, a major weakness (rank = 1), a minor weakness (rank = 2), a minor weakness (rank = 3), or a major strength (rank = 4). 4) Multiply the weight of each item by their rank: Multiply each item weight by its rank to calculate its weight score. 5) Total weight multiplied by rank: To calculate the total weight score, add all the weighted scores of each item.

Based on the results of table 1, the score of the external factors was 2.52 and the score of the internal factors was 2.202.

Table 2. Internal Factors Evaluation (IFE) Matrix.

Factors			Weight	Rating	Weighted score
Internal Factors	Strengths	Existence of young and active workforce, experienced experts and people support for environmental programs	0.055	3.30	0.181
		Existence of necessary real and virtual infrastructures for team and cooperative work in the field of sustainability of production	0.047	3.06	0.145
		Existence of technical infrastructure, diverse ecosystems, fertile lands and desirable water resources for diversification of income generation	0.047	3.30	0.155
		Implementing desirable and effective plans to improve the economic situation of the villagers	0.053	3.50	0.187
		Existence of capitalist farmers in villages and necessary conditions for private sector investment in the region	0.039	3.08	0.119
		Acceptance and compliance with the laws and regulations of sustainability and laws prohibiting land use change by local people	0.037	3.06	0.114
		Existence of favorable and fertile lands and water resources for agricultural production	0.057	3.48	0.200
		Increasing farmers' awareness of the destructive effects of chemical inputs and overuse of tools	0.047	3.10	0.146
	Weaknesses	Low level of knowledge and skills of farmers in the field of sustainable agricultural development	0.048	1.54	0.073
		Inadequacy of educational and extension programs with the sustainability of the production system	0.045	1.92	0.087
		Weaknesses in research and development and dissemination of technology and innovation in the direction of agricultural sustainability	0.051	1.60	0.081
		Lack of institutional development of agricultural sustainability	0.052	1.64	0.085
		Inability to finance high production costs and weak marketing of sustainable agricultural products	0.052	1.62	0.084
		High risk of production and lack of appropriate risk management	0.051	1.62	0.083
		Lack of educational, technical, infrastructure and development credits regarding sustainable agricultural development/ low private investment	0.060	1.38	0.083
		High production waste and lack of conversion and packaging industries in the region to create added value	0.045	1.82	0.081
		Lack of binding, protective and investment facilitation laws	0.046	1.60	0.074
		Lack of proper land management plan and proper cultivation pattern	0.048	1.58	0.077
		Low application of sustainable agricultural methods such as conservation tillage, biofertilizers and livestock, natural control methods	0.058	1.28	0.075
		Increased pollution of water resources and wetlands due to drainage, soil erosion and air pollution due to burning of plant debris	0.061	1.20	0.073
Total weighted score			1		2.202

Table 3. External Factors Evaluation (EFE) Matrix.

Factors			Weight	Rating	Weighted score
External Factors	Opportunities and threats	Possibility of using various agricultural research and higher education centers in the province	0.047	3.22	0.150
		Existence of rich scientific, technical and extension literature at national and international level in sustainable agricultural development	0.044	3.06	0.135
		Develop insights and understanding at the national level in order to produce and consume healthy and clean agricultural products	0.044	3.24	0.141
		Development of information and communication technologies in order to achieve sustainable agricultural development strategies	0.043	3.60	0.155
		Existence of opportunities for proximity to Arab countries and cultural similarity and linguistic compatibility for export	0.053	3.78	0.199
		Possibility of using private sector investors in the construction and development of conversion ancillary industries	0.041	3.20	0.131
		Facility support for the development of modern irrigation and the production of conservation agricultural machinery	0.040	3.32	0.133
		Improving agricultural and livestock and poultry insurance coverage and supporting the banking system for sustainable agricultural development	0.047	3.40	0.159
		Existence of the law on export facilities for agricultural products and providing 85% of modern irrigation costs	0.042	3.44	0.145
		Emphasis of Article 31 of the Sixth Five-Year Plan Law on conservation agriculture and optimal consumption of chemical inputs and healthy cultivation	0.044	3.38	0.148
		National orientation and targeted government support to develop the production of organic and healthy products	0.042	3.45	0.146
		Paying attention to environmental protection in Article 38 of the Sixth Five-Year Development Plan and expanding national vision	0.046	3.44	0.158
	opportunities and threats	Spread of unemployment and lack of job security in rural areas and continuation of rural-urban migration	0.046	1.46	0.067
		Lack of proper health, welfare, cultural, transportation and communication infrastructure and increasing social problems	0.045	1.72	0.078
		Lack of attention to technology development and production sustainability in accordance with regional conditions	0.046	1.74	0.080
		Attracting active labor in non-agricultural sectors due to lack of orientation towards rural economy	0.041	1.72	0.071
		Private sector reluctance to invest due to lack of proper infrastructure and investment security	0.040	1.70	0.068
		Inadequate pricing, export, cultivation and non-sustainability policies	0.048	1.50	0.073
		Existence of various export barriers and excessive increase in the price of production inputs and impact on production	0.050	1.46	0.073
		Existence of numerous floods and droughts and dust and creating problems for production	0.053	1.24	0.066
		Lack of proper conversion and packaging industries and inattention to the design and implementation of desirable educational programs	0.044	1.62	0.072
		Environmental problems due to waste from oil companies, agriculture and industry, climate change and dust	0.054	1.28	0.069
Total weighted score			1		2.520

3.3 SPACE (Strategic Position and Action Evaluation) matrix

The SPACE matrix is a strategic management tool that focuses on strategy formulation especially as related to the competitive position of an organization. The SPACE matrix is broken down to four quadrants where each quadrant suggests a different type or a nature of a strategy: Aggressive, Conservative, Defensive and Competitive (Kiani et al., 2021):

Aggressive Strategies: How strengths are used to take advantage of opportunities.

Conservative Strategies: How weaknesses are reduced by taking advantage of opportunities.

Competitive Strategies: How strengths are used to reduce the impact of threats.

Defensive Strategies: How weaknesses that will make these threats a reality are addressed.

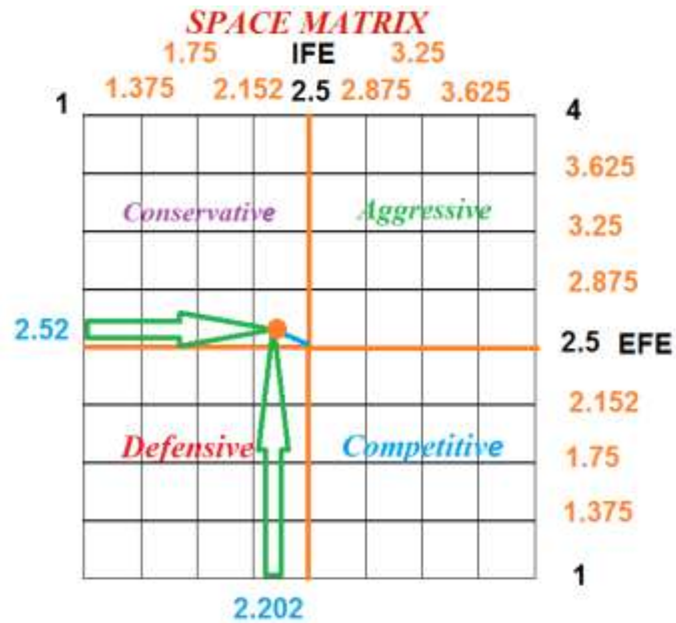

Figure 1. Matrix of internal and external factors of sustainable agricultural development

3.4 Designing strategies

Based on SPACE matrix Conservative Strategies (CS strategies: how weaknesses are reduced by taking advantage of opportunities (WO)) are suggested for ASD. Based on the results and analysis of opportunities and weaknesses, 10 strategies were identified as WO strategies according to analytical opinions and consensus from the point of view of experts:

WO1: Reducing production risk by improving appropriate insurance coverage and supporting the banking system for sustainable agricultural development and utilizing private sector investors in the construction and development of conversion industries (W6, O6, O8)

WO2: Institutional development of agricultural sustainability in the region by utilizing the capabilities of various agricultural research and higher education centers in the province (W4, O1)

WO3: Development of a favorable land management plan and a suitable model for cultivation and sustainable use of water and soil with reference to Articles 31 and 38 of the Sixth 5-year plan in order to pay attention to environmental protection, development of conservation agriculture, optimal use of chemical inputs, application of organic fertilizer healthy culture (W10, W11, W12, O12, O10)

WO4: Approve and allocate favorable funding for educational, technical, infrastructure and development programs for sustainable agricultural development and facilitate private sector investment with regard to national orientation and targeted government support for the development of organic and healthy products (O11, W7)

WO5: Increasing the level of knowledge and skills of farmers in the field of sustainable agricultural development and creating a fit of educational and extension programs with the stability of the production system in the region (W1, W2, O2, O3, O4)

WO6: Development and improvement of physical infrastructure and support policies to promote sustainable production and ensure food security, human health and ecosystems (W9, O7)

WO7: Utilization of facility support for modern irrigation development and conservation farming to reduce production costs (W5, O7, O9)

WO8: Increase value added through the development of conversion industries and optimal packaging of agricultural products and reduction of production waste in the region (W8, O6)

WO9: Creating the necessary bases for research and development and dissemination of technology and innovation in the direction of agricultural sustainability (W3, O1)

WO10: Taking advantage of the proximity to Arab countries and cultural similarity and linguistic compatibility to facilitate exports (W5, O5)

3.5 QSPM (Quantitative strategic planning) Matrix

QSPM is a powerful tool for prioritizing strategies. In QSPM, the effectiveness of each strategy in taking advantage of strengths and opportunities and their ability to reduce weaknesses and threats is evaluated (Ommani, 2011). Attractiveness scores (AS) is the importance of each strategy for the optimal use of strengths and opportunities and the ability of each strategy to eliminate weaknesses and reduce the impact of threats. The range for attractiveness scores is 1=not attractive, 2=somewhat attractive, 3=reasonably attractive and 4=highly attractive. Multiplying Attractiveness Score by Weight (MASW) is multiplying attractiveness scores by the weight of each item. However, the Sum of Multiplying Attractiveness Score by Weight (SMASW) is equals the sum of the MASW scores of each strategy (Ommani, 2011; Kiani et al., 2021). Based on the results of QSPM, the WO strategies are prioritized as follows: WO4, WO5, WO9, WO8, WO7, WO6, WO10, WO3, WO2, WO1(table 4).

Table 4. QSPM (Quantitative strategic planning) Matrix

Factors	Weight	WO1		WO2		WO3		WO4		WO5		WO6		WO7		WO8		WO9		WO10	
		AS	MASW	AS	MASW	AS	MASW	AS	MASW	AS	MASW	AS	MASW	AS	MASW	AS	MASW	AS	MASW	AS	MASW
O1	0.047	2	0.094	4	0.188	3	0.141	4	0.188	4	0.19	4	0.188	4	0.19	4	0.188	4	0.188	2	0.094
O2	0.044	2	0.088	3	0.132	2	0.088	3	0.132	4	0.18	3	0.132	4	0.18	4	0.176	4	0.176	4	0.176
O3	0.044	3	0.132	2	0.088	3	0.132	4	0.176	3	0.13	4	0.176	4	0.18	4	0.176	4	0.176	3	0.132
O4	0.043	3	0.129	2	0.086	3	0.129	3	0.129	3	0.13	3	0.129	2	0.09	3	0.129	3	0.129	4	0.172
O5	0.053	4	0.212	3	0.159	2	0.106	4	0.212	2	0.11	2	0.106	3	0.16	3	0.159	1	0.053	4	0.212
O6	0.041	4	0.164	3	0.123	3	0.123	4	0.164	3	0.12	3	0.123	3	0.12	4	0.164	3	0.123	4	0.164
O7	0.04	3	0.12	3	0.12	4	0.16	4	0.16	3	0.12	3	0.12	4	0.16	4	0.16	2	0.08	3	0.12
O8	0.047	4	0.188	4	0.188	3	0.141	4	0.188	3	0.14	4	0.188	4	0.19	4	0.188	3	0.141	4	0.188
O9	0.042	4	0.168	3	0.126	4	0.168	3	0.126	3	0.13	3	0.126	3	0.13	3	0.126	3	0.126	3	0.126
O10	0.044	1	0.044	2	0.088	4	0.176	2	0.088	4	0.18	2	0.088	2	0.09	4	0.176	4	0.176	2	0.088
O11	0.042	1	0.042	3	0.126	4	0.168	4	0.168	4	0.17	4	0.168	3	0.13	3	0.126	4	0.168	2	0.084
O12	0.046	2	0.092	2	0.092	3	0.138	3	0.138	3	0.14	2	0.092	1	0.05	3	0.138	3	0.138	3	0.138
T1	0.048	3	0.144	3	0.144	3	0.144	3	0.144	4	0.19	4	0.192	3	0.14	3	0.144	3	0.144	4	0.192
T2	0.045	2	0.09	3	0.135	3	0.135	2	0.09	4	0.18	4	0.18	3	0.14	3	0.135	3	0.135	4	0.18
T3	0.051	3	0.153	4	0.204	4	0.204	3	0.153	3	0.15	4	0.204	4	0.2	4	0.204	4	0.204	4	0.204
T4	0.052	4	0.208	4	0.208	3	0.156	4	0.208	4	0.21	3	0.156	4	0.21	3	0.156	4	0.208	4	0.208
T5	0.052	4	0.208	4	0.208	3	0.156	3	0.156	4	0.21	3	0.156	4	0.21	3	0.156	3	0.156	4	0.208
T7	0.051	3	0.153	4	0.204	4	0.204	4	0.204	3	0.15	4	0.204	3	0.15	4	0.204	3	0.153	3	0.153
T8	0.06	3	0.18	3	0.18	3	0.18	4	0.24	4	0.24	3	0.18	2	0.12	3	0.18	4	0.24	3	0.18
T9	0.045	2	0.09	3	0.135	3	0.135	2	0.09	3	0.14	1	0.045	4	0.18	1	0.045	2	0.09	2	0.09
T10	0.046	3	0.138	3	0.138	4	0.184	4	0.184	4	0.18	3	0.138	4	0.18	4	0.184	4	0.184	4	0.184
T11	0.048	2	0.096	3	0.144	2	0.096	3	0.144	3	0.14	4	0.192	4	0.19	3	0.144	4	0.192	3	0.144
S1	0.055	3	0.165	3	0.165	3	0.165	4	0.22	4	0.22	3	0.165	4	0.22	3	0.165	4	0.22	2	0.11
S2	0.047	3	0.141	3	0.141	3	0.141	3	0.141	4	0.19	4	0.188	3	0.14	4	0.188	4	0.188	3	0.141
S3	0.047	3	0.141	4	0.188	4	0.188	3	0.141	3	0.14	4	0.188	3	0.14	4	0.188	4	0.188	3	0.141
S4	0.053	4	0.212	4	0.212	3	0.159	3	0.159	3	0.16	3	0.159	4	0.21	3	0.159	3	0.159	4	0.212
S5	0.039	3	0.117	3	0.117	3	0.117	3	0.117	3	0.12	4	0.156	4	0.16	4	0.156	3	0.117	4	0.156
S6	0.037	2	0.074	3	0.111	3	0.111	4	0.148	4	0.15	3	0.111	2	0.07	3	0.111	3	0.111	2	0.074
S7	0.057	3	0.171	3	0.171	4	0.228	3	0.171	3	0.17	4	0.228	4	0.23	4	0.228	4	0.228	4	0.228
S8	0.047	3	0.141	2	0.094	3	0.141	4	0.188	4	0.19	3	0.141	3	0.14	4	0.188	4	0.188	3	0.141
W1	0.048	2	0.096	3	0.144	3	0.144	4	0.192	4	0.19	3	0.144	3	0.14	3	0.144	3	0.144	2	0.096
W2	0.045	3	0.135	4	0.18	3	0.135	3	0.135	4	0.18	3	0.135	3	0.14	2	0.09	4	0.18	3	0.135
W3	0.051	2	0.102	4	0.204	2	0.102	4	0.204	4	0.2	3	0.153	3	0.15	3	0.153	4	0.204	3	0.153
W4	0.052	3	0.156	3	0.156	3	0.156	4	0.208	3	0.16	4	0.208	4	0.21	3	0.156	4	0.208	3	0.156
W5	0.052	4	0.208	3	0.156	4	0.208	4	0.208	3	0.16	4	0.208	3	0.16	4	0.208	3	0.156	2	0.104
W6	0.051	4	0.204	3	0.153	3	0.153	3	0.153	3	0.15	4	0.204	4	0.2	4	0.204	3	0.153	4	0.204
W7	0.06	3	0.18	3	0.18	3	0.18	4	0.24	3	0.18	3	0.18	3	0.18	4	0.24	3	0.18	3	0.18
W8	0.045	2	0.09	2	0.09	3	0.135	4	0.18	3	0.14	3	0.135	4	0.18	4	0.18	4	0.18	3	0.135
W9	0.046	3	0.138	3	0.138	2	0.092	2	0.092	4	0.18	2	0.092	3	0.14	4	0.184	3	0.138	4	0.184
W10	0.048	3	0.144	4	0.192	4	0.192	4	0.192	3	0.14	3	0.144	3	0.14	3	0.144	4	0.192	4	0.192
W11	0.058	2	0.116	3	0.174	4	0.232	4	0.232	4	0.23	3	0.174	4	0.23	3	0.174	4	0.232	3	0.174
W12	0.061	4	0.244	3	0.183	3	0.183	3	0.183	3	0.18	4	0.244	4	0.24	3	0.183	3	0.183	2	0.122
			5.908		6.365		6.426		6.986		6.95		6.64		6.8		6.901		6.929		6.475

Attractiveness scores(AS) is: 1=not attractive, 2=somewhat attractive, 3=reasonably attractive, and 4=highly attractive, MASW: Multiplying Attractiveness Score by Weight

3.6 Action plan (Strategic way)

In order to implement the strategies, an action plan must be developed for each strategy. For this purpose, several meetings were organized with six focus groups (Kiani et al., 20021). Action plans or strategic way for each strategy were identified as follows:

Action plans of WO1

WO1-1: Accelerating the time of visit, reviewing and estimating the amount of damage, timely payment of compensation to the damaged farmers and realizing the amount of damage with the amount of compensation

WO1-2: Providing low-utility facilities by the banking system to farmers in order to implement sustainable agricultural strategies

WO1-3: Providing the necessary funds to support private sector investors in the construction and development of conversion industries in the region

WO1-4: Carrying out necessary measures in the field of generalization and expansion of rural insurance and covering it 100% by strengthening the social insurance fund of farmers, villagers and nomads.

Action plans of WO2

WO2-1: Utilizing the ability of committed and expert specialists and faculty members of academic and research centers in order to implement agricultural sustainability indicators in the region

WO2-2: Creating an information network for the users of the region to access accurate and up-to-date information in accordance with the climatic conditions of the region in the field of sustainable development.

WO2-3: Interaction and cooperation between different institutions related to sustainable agricultural development in the regionSO3-1: Providing space and time for testing and reflection as well as grants for failure.

Action plans of WO3

WO3-1: Planning and accurate implementation of appropriate cultivation pattern annually in the region with regard to the protection of soil and water resources and sustainable agricultural indicators

WO3-2: Implementation of desertification, erosion, soil and water erosion and green management projects in the lands near the Karkheh River

WO3-3: Implementation of support, technical and educational programs for integrated control of pests and diseases, use of livestock and biological fertilizers, minimum tillage, crop rotation and appropriate cultivation pattern

Action plans of WO4

WO4-1: Pursuing the representatives of the city and the province in the legislature to approve and allocate the desired funds for educational, technical, infrastructure and development programs for sustainable agricultural development in the region.

WO4-2: Providing government grants to develop the production of organic and healthy products

WO4-3: Facilitate private sector investment in the production of organic and healthy products by reducing administrative bureaucracy in obtaining exploitation, production and processing licenses

Action plans of WO5

WO5-1: Modification of extension methods and use of new methods, creating a better relationship between extension agents and villagers

WO5-2: Plan and implement at least 2 practical and applied training programs per month for farmers

WO5-3: Continuous assessment of educational needs through participatory methods on a quarterly basis

WO5-4: Assessing the level of stability of the production system and designing appropriate educational and extension programs

Action plans of WO6

WO6-1: Implement quality control programs and identify potential hazards in the production process to food consumption and adopt appropriate methods of production, warehousing, storage, transportation, processing and distribution

WO6-2: Subsidized support and facilities for the implementers of healthy food production programs and quality food processing industries and the development of new technologies to ensure food security

WO6-3: Implementing environmental considerations and protection of water and soil resources in the region and preventing the entry of unhealthy water resources and waste of oil companies, drains with chemical toxins in the production process and human and animal use

Action plans of WO7

WO7-1: Holding training courses to inform about the facilities support of modern irrigation development and conservation agriculture

WO7-2: Allocation of special funds for the implementation of educational projects and Demonstration farms with the participation of grassroots organizations and cooperatives and leading farmers

WO7-3: Facilitate the use of technical, skill, financial and credit support for the development of modern irrigation and conservation agriculture in order to reduce production costs

Action plans of WO8

WO8-1: Development of conversion and complementary industries in the agricultural sector and increase of 30% of annual production فرآ Processed products compared to the current situation and annual reduction of waste by 50% of the current situation

WO8-2: Implementation of operational measures of all relevant departments and organizations for post-harvest intensive care, such as new packaging, proper and managed storage, and transportation and export of products

WO8-3: Allocation of credits and low-utility facilities to support the processing and packaging industries to reduce waste and waste of agricultural products

WO8-4: Implementing awareness and promotion programs for producers and consumers to control and reduce food and agricultural waste

Action plans of WO9

WO9-1: Diversification of research programs and use of indigenous knowledge along with scientific innovations and technologies with the participation of people and rural organizations

WO9-2: Legal, financial and administrative support for the presence of the private sector in research and development of innovation and sustainable agricultural technology

WO9-3: Utilizing and strengthening local and indigenous capacities in research and development of sustainable agriculture

WO9-4: Organizing farmers and farmers and strengthening agricultural cooperatives and organizations to play a role in the field of agricultural research

Action plans of WO10

WO10-1: Laying the ground and creating small border markets due to the existence of a common border and transportation communication roads and facilitating the export and import of agricultural products

WO10-2: Elimination of administrative barriers to exports and granting facilities to farmers in border areas to improve the quality of markets between the two countries in the region

WO10-3: Providing the necessary credit and administrative facilities for the export of farmers in the region, which are adjacent to Arab countries and have cultural and linguistic similarities.

3.7 Structural equation modeling (SEM)

In this research, SEM has been used to identify the direct and indirect effects of the identified strategies on sustainable agricultural development. The results of confirmatory factor analysis showed the initial measurement model to provide an acceptable fit for the data (X^2=659.059; GFI=0.95; TLI=0.96; CFI =0.95; IFI=0.94; RMSEA=0.065). Therefore, the measurement model provided a reasonable fit (Table 5). Thus, the hypothesized model was judged suitable for the SEM.

Table 5. Summary of Goodness of Fit Indices for the Measurement Model

Fit indices	X^2	P	GFI	CFI	TLI	IFI	RMSEA
Value in study	659.059	0.000	0.95	0.95	0.96	0.94	0.065
Suggest value	-	>0.05	>0.80	>0.90	>0.90	>0.90	<0.08

Goodness of Fit Index (GFI), Tucker-Lewis Index (TLI), Comparative Fit Index (CFI), Incremental Fit Index (IFI), Root Mean Square Error of Approximation(RMSEA).

3.7.1 Convergent validity:

The convergent validity of the measurement model implies that the observed variables defining the same latent variable should have a relatively high correlation, which is evaluated by the factor loadings. There are several empirical views on the standardized estimate of the factor loadings. Generally, values of at least 0.3 and greater than 0.5 are interpreted as good, while values greater than 0.7 are interpreted as very good (Kang and Ahn, 2021). The results in Table 6 show the t-value for the factor loadings to all exceed 4.29 ($p < 0.01$) and the standardized factor loading to all have values greater than 0.508. This shows good convergent validity for the constructs of this study.

Table 6. Results of Confirmatory Factor Analysis for the Measurement Model

Constructs	Indictors	Standardized factor loading	t- value	CR	AVE
WO_1	WO_{1-1}	0.577	5.84	0.852	0.85
	WO_{1-2}	0.675	6.97		
	WO_{1-3}	0.772	4.29		
	WO_{1-4}	0.698	4.63		
WO_2	WO_{2-1}	0.672	4.46	0.713	0.81
	WO_{2-2}	0.764	4.78		
	WO_{2-3}	0.672	5.99		
WO_3	WO_{3-1}	0.677	5.42	0.837	0.86
	WO_{3-2}	0.871	4.49		
	WO_{3-2}	0.771	5.57		
WO_4	WO_{4-1}	0.654	5.37	0.844	0.89
	WO_{4-2}	0.679	5.65		
	WO_{4-3}	0.678	5.89		
WO_5	WO_{5-1}	0.789	4.84	0.758	0.81
	WO_{5-2}	0.798	6.75		
	WO_{5-3}	0.799	5.88		
	WO_{5-4}	0.714	4.89		
WO_6	WO_{6-1}	0.566	5.84	0.812	0.88
	WO_{6-2}	0.655	6.89		
	WO_{6-3}	0.739	4.58		
WO_7	WO_{7-1}	0.592	4.66	0.791	0.89
	WO_{7-2}	0.508	4.44		
	WO_{7-3}	0.672	5.46		
WO_8	WO_{8-1}	0.662	5.42	0.857	0.94
	WO_{8-2}	0.671	4.59		
	WO_{8-3}	0.725	6.52		
	WO_{8-4}	0.676	4.96		
WO_9	WO_{9-1}	0.656	6.89	0.865	0.96
	WO_{9-2}	0.764	6.65		
	WO_{9-3}	0.565	6.99		
	WO_{9-4}	0.659	4.66		
WO_{10}	WO_{10-1}	0.709	4.74	0.758	0.88
	WO_{10-2}	0.722	5.75		
	WO_{10-3}	0.559	5.65		

3.7.2 Construct Reliability (CR):

Construct reliability measures how well variables underlying constructs served in structural equation modelling. In SEM construct reliability is depicted using confirmatory factor analysis (CFA). Composite reliability is estimated based on the factor loading analysis (Lerdpornkulrat et al., 2017). It is allowed to have a build reliability coefficient greater than 0.70. A value of CR ≥ 0.7 is required to achieve construct reliability (Tentama & Anindita, 2020). As shown in Table 6, all of the constructs had CR which were greater than the recommended 0.70. The result is a good composite or CR for the constructs measured in this study.

3.7.3 Discriminant validity:

For discriminant validity to be achieved in research, the square root of the AVE estimate for each construct must be greater than the correlation between it and all other construct in the model (Arcolin et al., 2021). Based on the results in table 7, the square root of the AVE estimate for each construct is greater than the correlation between it and all other construct in the model. This means that the indicators have more in common with the construct that they are associated with the other constructs. Thus, discriminant validity has been showed for the constructs in the measurement model.

Table 7. Means, SD and Correlations with Square Roots of the AVE

Constructs	Mean	SD	WO_1	WO_2	WO_3	WO_4	WO_5	WO_6	WO_7	WO_8	WO_9	WO_{10}
WO_1	4.14	0.89	0.85 [a]									
WO_2	3.38	0.98	0.81**	0.84 [a]								
WO_3	4.83	0.82	0.73**	0.79**	0.86 [a]							
WO_4	4.85	0.82	0.69**	0.64**	0.85**	0.89 [a]						
WO_5	4.87	0.89	0.75**	0.73**	0.80**	0.73**	0.88 [a]					
WO_6	4.57	0.92	0.73**	0.74**	0.76**	0.79**	0.71**	0.88 [a]				
WO_7	4.69	0.87	0.81**	0.75**	0.72**	0.76**	0.79**	0.73**	0.89 [a]			
WO_8	4.58	0.81	0.79**	0.79**	0.76**	0.79**	0.86**	0.81**	0.80**	0.94 [a]		
WO_9	4.55	0.83	0.69**	0.64**	0.85**	0.78**	0.76**	0.71**	0.77**	0.70**	0.96 [a]	
WO_{10}	4.49	0.81	0.78**	0.73**	0.80**	0.73**	0.73**	0.76**	0.75**	0.72**	0.76**	0.88 [a]

**Correlation is significant at the <0.01 level

[a] :The square roots of AVE estimates, AVE: Average Variance Extracted

3.7.4 Assessment of the structural model:

The first step was to develop a satisfactory measurement model that was implemented in the previous section. The second step, involving SEM, involves evaluating the structural model. The structural model includes hypothetical relationships between structures in the research model (Kiani et al., 2021). From table 8 and figure 2, it can be found that the predictive positive effect of WO_1 (β=0.512, t-value=3.453, p<0.001), WO_2 (β=0.533, t-value=3.516, p<0.001), WO_3 (β=0.581, t-value=4.129, p<0.001), WO_4 (β=0.916, t-value=5.821, p<0.001), WO_5 (β=0.861, t-value=4.523, p<0.001), WO_6 (β=0.823, t-value=5.123, p<0.001), WO_7 (β=0.694, t-value=5.212, p<0.001), WO_8 (β=0.761, t-value=4.928, p<0.001), WO_9 (β=0.832, t-value=5.257, p<0.001) and WO_{10} (β=0.621, t-value=4.153, p<0.001) on the ASD. Based on the research results presented in Table 8, the amount of R^2=0.74 was estimated. This indicates that 10 strategies and 34 construct have the ability to explain 74% of the ASD variance. Based on the results obtained, the overall goodness of the fitting statistics showed that the structural model is well consistent with the data.

Table 8. The effects of constructs on ASD

Construct	$Outcome_1$	Path $coefficient_1$	t-value	$Outcome_2$	Path $coefficient_2$	t-value	R^2
WO_{1-1}	WO_1	0.798	5.65	ASD	0.512	3.453	0.74
WO_{1-2}		0.724	6.59				
WO_{1-3}		0.712	4.98				
WO_{1-4}		0.659	4.76				
WO_{2-1}	WO_2	0.816	4.98		0.533	3.516	
WO_{2-2}		0.812	4.81				
WO_{2-3}		0.816	5.64				
WO_{3-1}	WO_3	0.837	5.69		0.581	4.129	
WO_{3-2}		0.824	4.85				
WO_{3-2}		0.716	5.94				
WO_{4-1}	WO_4	0.712	5.59		0.916	5.821	
WO_{4-2}		0.695	5.91				
WO_{4-3}		0.589	5.46				
WO_{5-1}	WO_5	0.829	4.95		0.861	4.523	
WO_{5-2}		0.812	6.81				
WO_{5-3}		0.724	5.63				
WO_{5-4}		0.665	4.92				
WO_{6-1}	WO_6	0.864	5.36		0.832	5.123	
WO_{6-2}		0.813	6.89				
WO_{6-3}		0.715	4.85				
WO_{7-1}	WO_7	0.758	4.95		0.694	5.212	
WO_{7-2}		0.713	4.65				
WO_{7-3}		0.711	5.85				
WO_{8-1}	WO_8	0.826	5.65				
WO_{8-2}		0.813	4.69				

WO_{8-3}		0.719	6.95	0.761	4.928
WO_{8-4}		0.682	4.66		
WO_{9-1}	WO_9	0.738	6.81	0.832	5.257
WO_{9-2}		0.712	6.82		
WO_{9-3}		0.698	6.31		
WO_{9-4}		0.671	4.28		
WO_{10-1}	WO_{10}	0.912	4.54	0.621	4.153
WO_{10-2}		0.824	5.62		
WO_{10-3}		0.627	5.89		

$p<0.01$

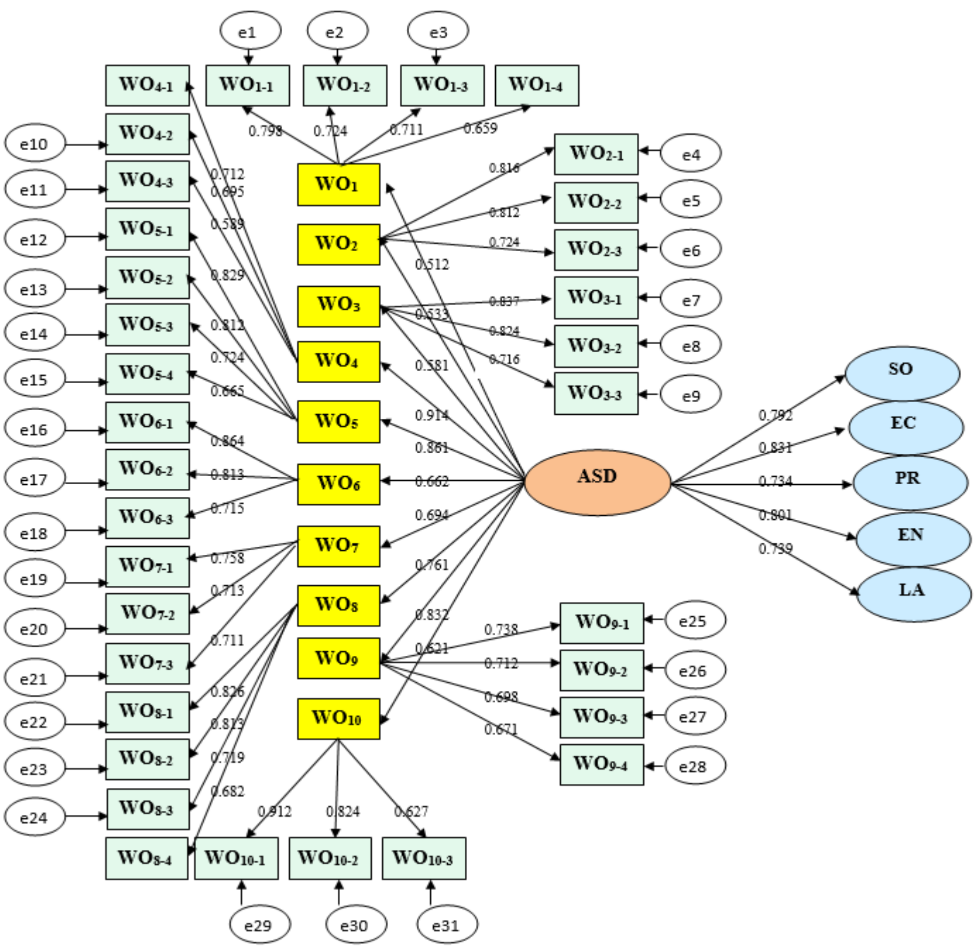

Figure 2. Path Model with Standardized Factor Loadings
ASD: Agricultural Sustainable Development
LW: Learning at Work, OL: Organizational Learning, CL: Climate for Learning, LS: Learning Structure

3.8 Discussion

Based on the results of the research, it was determined that WO1 had a significant and positive effect on the ASD. This result was in line with Alam et al (2020), Gaurav and Chaudhary (2021) research. They point to the role of reducing production risk by improving appropriate insurance coverage and financial support system. Similarly, Trémolet et al (2021) argued that science-based decision tools are required to catalyze investment in sustainable food systems. Also, the results of this study showed that WO2 had a significant and positive effect on the ASD. This finding is consistent with the results of Žalėnienė & Pereira (2021) argued higher education institutions have an essential role in sustainability. They are key agents in the education of future leaders that will contribute to the successful Sustainable Development Goals (SDGs) implementation. In addition, based on the results WO3 had a significant and positive effect on the ASD. This finding is consistent with the results of Nhamo & Lungu (2017) that explained conservation agriculture (CA) practices combine the use of soil cover, crop combinations, and reduced tillage. They argued CA has the potential to improve crop yields, soil organic matter content, soil infiltration rates, and microsites for proliferation of beneficial soil organisms. Also, WO4 had a significant and positive effect on the ASD. This finding is consistent with the results of Grivins et al (2021) that explained most farmers do not have resources to make the investments needed to ensure the competitiveness of their farm and banks play an important role in facilitating a shift towards more sustainable models of farming. In addition, WO5 had a significant and positive effect on the ASD. This finding is consistent with the results of Aare et al (2021). They explained transitions towards sustainable farming practices through participatory research and knowledge development. Findings indicated WO6 play an important role in realization of ASD. This finding is in line with the results of Łuczka et al (2021) research. They provide new aspects of knowledge on sustainable agriculture support policy and on the effect it has on the sustainability of development processes experienced in this type of farming. They present some aspects of the support policy, which do not exhaust the complex problem of how it affects the development of organic farming. Another finding showed that WO7 had a significant and positive effect on the ASD. In this regard, Zou et al (2013) and Sidhu et al (2021) concluded water resources could be used more efficiently and sustainably in agricultural production to save global water resources and achieve food security, as crop yields are obviously largely influenced by water availability. Also, WO8 had a significant and positive effect on the ASD. Bani Assadi et al (2021) argued that conversion and complementary industries are one of the best ways to develop agricultural waste prevention. Based on the results WO9 had a significant and positive effect on the ASD. Berthet et al (2018) identified an urgent need to renew agriculture's traditional design organization and foster more open, decentralized, contextualized and participatory approaches to design and innovation. In addition, WO10 had a significant and positive effect on the ASD. Based on the Pishbahar et al (2021), the role of the agricultural sector in ensuring food security, employment, self-sufficiency, non-oil exports and currency has led to the prediction of this sector to become one of the basic goals of policymakers.

4. Conclusion and Recommendation

At the first step this research started from the qualitative part and examined the strengths, weaknesses, opportunities and threats of Agricultural Sustainable Development (ASD) in social, economic, productive, environmental and policy dimensions. To collect data, 6 focus groups were formed and 3 sessions were held with each group, each session lasting 2 hours. Initially, 68 phrases were identified in SWOT format. The phrases were then monitored by holding several sessions, and finally 42 phrases were finalized and categorized into strengths, weaknesses, opportunities, and threats. At this phase of the research, external (opportunities and threats) and internal (strengths and weaknesses) factors that identified were evaluated. Based on the experts' idea, each item was evaluated, ranked and the importance ratio coefficient was identified. To conduct the second part of the research, ie evaluation internal and external factors, 5 two-hour sessions were held with experts, and in the sessions, the focus groups technique was used. Based on the results of table 1, the score of the external factors was 2.52 and the score of the internal factors was 2.202. Then, based on SPACE matrix, group 2 strategies (Conservative Strategies) are the suggested strategies for realization of ASD. Finally, with the consensus of experts, 10 strategies as conservative strategies were identified. Then, the identified strategies were ranked using the QSPM matrix. The strategies were as follows:

WO1: Reducing production risk by improving appropriate insurance coverage and supporting the banking system for sustainable agricultural development and utilizing private sector investors in the construction and development of conversion industries.

WO2: Institutional development of agricultural sustainability in the region by utilizing the capabilities of various agricultural research and higher education centers in the province.

WO3: Development of a favorable land management plan and a suitable model for cultivation and sustainable use of water and soil with reference to Articles 31 and 38 of the Sixth 5-year plan in order to pay attention to environmental protection, development of conservation agriculture, optimal use of chemical inputs, application of organic fertilizer healthy culture.

WO4: Approve and allocate favorable funding for educational, technical, infrastructure and development programs for sustainable agricultural development and facilitate private sector investment with regard to national orientation and targeted government support for the development of organic and healthy products.

WO5: Increasing the level of knowledge and skills of farmers in the field of sustainable agricultural development and creating a fit of educational and extension programs with the stability of the production system in the region.

WO6: Development and improvement of physical infrastructure and support policies to promote sustainable production and ensure food security, human health and ecosystems.

WO7: Utilization of facility support for modern irrigation development and conservation farming to reduce production costs.

WO8: Increase value added through the development of conversion industries and optimal packaging of agricultural products and reduction of production waste in the region.

WO9: Creating the necessary bases for research and development and dissemination of technology and innovation in the direction of agricultural sustainability.

WO10: Taking advantage of the proximity to Arab countries and cultural similarity and linguistic compatibility to facilitate exports.

Afterwards, SEM was used to test for the direct, indirect and mediating effects of the identified strategies in the prediction for ASD. Based on the results, the measurement model provided a reasonable fit and the hypothesized model was judged suitable for the SEM. The first step was to develop a satisfactory measurement model that was implemented in the previous section. The second step, involving SEM, involves evaluating the structural model. From the results, it can be found that the predictive positive effect of WO1 to WO10 on the ASD. Based on the research results, the amount of R^2=0.74 was estimated. This indicates that 10 strategies and 34 construct have the ability to explain 74% of the ASD variance. Based on the results obtained, the overall goodness of the fitting statistics showed that the structural model is well consistent with the data.

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