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Strategies for Sustainable Agricultural Development to Achieve Food Security

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Abstract

The research aimed to identifying the most important problems facing sustainable agricultural development in achieving food security, as well as to preparing a proposed strategy for sustainable agricultural development to achieve food security in Sulaimani Governorate. Research population consist of all the agricultural managers working at general agriculture directorates in Sulaimani Governorate, totaling 57 respondents and all the agricultural extension workers working at agricultural extension departments and sections in Sulaimani Governorate totaling 126 respondents, after excluding 18 respondents to conducting pre-test the research sample consist of 165 respondents. The research results identify the Sulaimani Governorate's top priorities for sustainable agricultural development. The lack of active agricultural organizations is regarded as the least important issue, while inadequate funding for dam construction is identified as the biggest obstacle. Climate is thought to have less of an immediate impact on agricultural productivity than soil. Within the water element, social engagement is prioritized over administration and policies, emphasizing community involvement in resource management. While the impact of political conflicts on agriculture and water security is considered less important, limiting urban expansion over agricultural lands is considered the most important development strategy. Accordingly the researchers recommended Ministry of Agriculture to identify other diverse fields that can help in advancing food security.
Keywords: Water scarcity, Social engagement, environmental factor, soil management

I. INTRODUCTION

In most of the world's countries, developed or developing, the agricultural sector is one of the most significant economic sectors that make up their economic structures **(Hasan *et al.*, 2024),** it is the backbone of human civilization, providing the fundamental resources for food, fiber, and raw materials, it remains a critical driver of socio-economic stability and rural livelihoods, especially in developing regions **FAO (2024).** Beyond its basic role in food production, agriculture contributes significantly to economic growth, employment, and cultural heritage **Bahnasy (2025).**

Despite progress in the agricultural sector, rapid population growth, climate variability, and natural resource degradation have placed unprecedented pressure on agricultural systems. This has made the adoption of more resilient and sustainable agricultural development models imperative **Tai (2025).** In this context, agricultural development is not simply about increasing production levels, but also about enhancing efficiency, ensuring equitable distribution of benefits, and protecting the environment **(Atapattu *et al.*, 2024)**. This requires fostering technological innovation, implementing institutional reforms, and developing human capacities to boost productivity and reduce vulnerability. Overall, agricultural development is a complex and multidimensional process that integrates economic growth, social inclusion, and ecological balance **UNDP (2024).**

This perspective has contributed to shaping the concept of sustainable agricultural practices as a systematic response to the environmental, social, and economic challenges facing traditional agriculture. The sustainable agricultural development model expands on this concept by integrating sustainability principles into long-term agricultural policies and strategies, thereby enhancing the ability to achieve food security goals at the national and regional levels **(Atapattu *et al.*, 2024).**

Despite the available potential, the agricultural sector in many countries faces structural and institutional challenges, most notably land fragmentation, weak infrastructure, inadequate extension services, market volatility, and low awareness of sustainable agricultural practices. These challenges are exacerbated by

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conflict and political instability **Zarqa (2024).** Given this reality, there is a pressing need for strategies that consider local specificities and integrate traditional knowledge with modern technologies. However, this approach faces obstacles related to inequality, knowledge and communication gaps, and resistance to change. Effective management of these challenges is essential for promoting sustainable agricultural development **(Adefila *et al*., 2024)**. In this context, there has been increasing calls for practical policies based on a thorough analysis of existing obstacles and a prioritization of interventions to address the sector's imbalances **(Cao and Solange, 2023)**.

In Iraq, the reality of agricultural development and food security is complex. Despite possessing significant agricultural potential **World Bank (2024)**, the sector suffers from declining cultivated land, water scarcity, high soil salinity, population growth, and low crop productivity, in addition to the effects of climate change. Furthermore, the gap between production and consumption, coupled with a political structure unfavorable to agricultural modernization, hinders its ability to cope with crises **(Al-Zubaidi and Ghazal, 2024)**.

The reality of the agricultural sector in Sulaimani Governorate is no different from the challenges facing the Kurdistan Region in general. This sector has been clearly affected by climate change and fluctuations in production, leading to a decline in its ability to meet local demand and an increased reliance on imported goods to compensate for production shortfalls **(Sakinaa *et al*., 2023; UNDP (2024)**. Recent studies have also indicated that climatic and economic risks weaken decisions related to the production process, whether concerning the quality of agricultural activity, cultivated areas, or the selection of appropriate crop varieties, making farmers more vulnerable to potential losses **(Rashid and Hasan, 2023)**. This is attributed to the accumulation of structural challenges, including limited agricultural investment, weak extension services, and inefficient water management, all of which have contributed to weakening this vital sector in the region **Ahmad (2023).**

Based on the above, due to the lack of reliable sources and scientific studies relating to the subject of this research, regarding the current situation of sustainable agriculture development strategies in Sulaimani Governorate, due to the necessity and seriousness the issue of food security, also to identify the effective sustainable agricultural development strategies in achieving food security, the researchers pose the research question:

1. What are the most important problems facing sustainable agricultural development strategies in achieving food security in Sulaimani Governorate?
2. What are the proposed sustainable agricultural development strategies to achieve food security in Sulaimani Governorate?

Research objectives

1. To identify the most important problems facing sustainable agricultural development in achieving food security in Sulaimani Governorate
2. To prepare a proposed strategy for sustainable agricultural development to achieve food security in Sulaimani Governorate.

Research hypotheses

There is a significant difference between the different groups of respondents regarding their agreement with the proposed areas of the sustainable agricultural development strategy.

II. MATERIAL AND METHODS

Research methodology

The Research adopted a descriptive approach due to its suitability in providing comprehensive and reliable data on social realities, identifying development patterns and traditions, and understanding the attitudes and opinions of individuals and communities **Dovetail (2023)**. Employing this approach enabled the collection of in-depth information on sustainable agricultural development strategies and their role in achieving food security in Sulaimani Governorate.

Research area

Sulaimani Governorate in Kurdistan Region of Iraq is the area of conduction the research. Sulaimani Governorate representing both a vulnerable and strategically important agricultural area that requires comprehensive and adaptive strategies of sustainable agricultural development that integrating agro ecological practices, technological innovations, and supportive governance offer a pathway to enhance productivity while conserving natural resources and strengthening food security in the governorate.

Research population

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Thi-Qar Journal of agricultural research

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Research population consist of all the managers of agriculture directorates totalling (57) manager and all the agriculture extension workers in Sulaimani governorate, totalling (126) workers distributed in all the Districts and Sub-districts, whole members of research population was taken as a sample after excluding (18) of them to conduction pre-test, the research sample consist of (165) agricultural employees.

TABLE (1): DISTRIBUTION OF RESPONDENTS ON THE RESEARCH SAMPLE

Population Categories	Research Population	Pre-test Sample	Research Sample
Agricultural Directors	57	6	51
Agricultural extension Workers	126	12	114
Total	183	18	165

Data collection tool

A questionnaire was used as a proper tool for collecting primary data of the research throw direct interviewing with respondents, which is one of the most fundamental data collection instruments in social research, defined as forms or instruments including a set of questions and secure answers that respondents from a specific population fill to give the researcher information needed for the study **Taherdoost (2021)**.

To achieve the research objectives a questionnaire prepared that consist of two parts:

The first part consists of (30) important problems facing sustainable agricultural development in achieving food security participated on five different fields which are: economic, social, policy and management, environmental, and technological. In which a quadrilateral scale was used (Big problem, moderate problem, small problem, not a problem), they were given weights 4,3,2,1 respectively. The degrees of this scale ranged between 30-120 degrees.

The second part of the research instrument consists of a set of 100 strategies aimed at enhancing food security through the adoption of sustainable agricultural development practices. These strategies were distributed with 20 strategies for each of the five main areas: economic, social, policies & administration , environmental, and technological. Each area addressed one of the five essential elements of sustainable agricultural development: water, soil, climate, food, and human resources, with four items per element.

The study employed a five-point Likert scale to measure respondents' opinions, using the following formats: (Strongly Agree, Agree, Neutral, Disagree, Strongly Disagree), assigning numerical values of 5, 4, 3, 2, and 1 respectively, for the purpose of quantitative and systematic data analysis.

To ensure the questionnaire's face and content validity, it was reviewed by a select group of experts and academics specializing in the research fields to assess its suitability for the study's objectives. Its reliability was also measured through a pretest conducted in December 2024 on a random sample of 18 agricultural extension managers and staff from the Sulaimaniyah Agriculture Directorate, who were subsequently excluded from the study population. The reliability coefficient was calculated using Cronbach's alpha and yielded a value of 0.89 for the Sustainable Agricultural Development Strategies instrument, indicating a high level of internal consistency among its items **(Estremera and Mendoza-Sarmiento, 2024)**. Data collection process conducted from January 27, 2025 to March 20, 2025.

III. RESULTS AND DISCUSSION

1. Identifying the most important problems facing sustainable agricultural development in achieving food security in Sulaimani Governorate.

The research covered (30) of most important problems that facing sustainable agriculture development in achieving food security, the problems were arranged according to weight percentages of agriculture employees perspective, were between (88.24-75.15%) degrees with the average between(3.76-4.41)degrees as showed in table 2.

TABLE (2): ARRANGING THE MOST IMPORTANT PROBLEMS FACING SUSTAINABLE AGRICULTURAL DEVELOPMENT IN ACHIEVING FOOD SECURITY

Fields	Items	Rank	weighted average	Weight %

University of Thi-Qar Journal of agricultural research

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Economic	1. Unreformed agricultural financial and economic systems.	2	3.37	84.25
	2. Urban expansion and increased construction on agricultural lands.	17.5	3.08	77.00
	3. Failure to invest in agricultural research.	4	3.30	82.50
	4. Lack of job opportunities and high unemployment and poverty rates in rural areas.	3	3.23	83.00
	5. Failure to spend the necessary budget for the construction of dams in the region.	1	3.44	86.00
	6. Currency volatility and its negative impact on food security.	16	3.10	77.50
Social	7. The inefficiency of agricultural media regarding the importance of agricultural development and the issue of food security	24	2.96	74.00
	8. Lack of awareness campaigns by the government about the importance of natural resources such as (water, soil) and their proper management.	12.5	3.12	78.00
	9. Many social problems related to land and not resorting to the law to solve them.	14.5	3.11	77.75
	10. Low level of individual awareness about the dangers and harms of food waste and too much food waste.	11	3.13	78.25
	11. Negative consequences of rural migration to cities and reduction of agricultural labour.	5.5	3.27	81.75
	12. Lack of social stability, security and peace as a result of internal and external conflicts.	22	3.02	75.50
Policies & administration	13. Lack of clear mechanisms to reform laws related to agricultural land.	17.5	3.08	77.00
	14. Lack of an effective strategy to protect natural groundwater resources despite random and illegal well drilling.	14.5	3.11	77.75
	15. Lack of a strategy to solve the problems related to the marketing of domestic agricultural products and inflation.	7	3.24	81.00
	16. The negative impact of international relations and domestic government policies on the development of the domestic agricultural sector	19	3.07	76.76
	17. Lack of an integrated plan for importing agricultural inputs.	9.5	3.19	79.75
	18. Lack of a unified national constitution for food health and safety.	12.5	3.12	78.00
Environmental	19. Decrease and destruction of natural pastures due to random grazing and illegal occupation.	21	3.04	76.00
	20. Excessive use of pesticides without following their instructions.	5.5	3.27	81.75
	21. Not taking into account the different geographical nature and important economic dimensions of the regions.	26	2.93	73.25
	22. Mixing of sewage with some sources of drinking water and agricultural irrigation.	9.5	3.19	79.75
	23. Negative impact of climate change on agricultural production.	8	3.21	80.25
	24. Lack of active agricultural organizations and companies in view of the diversity of the environment in the region.	30	2.78	69.50
Technological	25. Lack of use of technology to improve efficient irrigation techniques and save more water.	25	2.95	73.75
	26. Lack of communication and coordination with international organizations and not taking advantage of their advanced experience in the field of agriculture.	29	2.85	71.25
	27. Lack of green area in Sulaimani governorate despite many tree planting campaigns due to poor management.	27	2.92	73.00
	28. Lack of agricultural production due to lack of use of modern technology in this field.	28	2.90	72.5
	29. Following old techniques of fertilizing and adding nutrients without knowing the soil needs.	20	3.07	76.75
	30. Lack of continuous electricity and internet networks to take full advantage of new agricultural technologies.	23	3.01	75.25

Table 2 illustrated that the problem (Failure to spend the necessary budget for the construction of dams in the region) came in the first place over all problems and all five fields according to importance and percentage weight, , rated at an average of 4.41 degrees and 88.24% importance. This challenge directly affects food security, agricultural productivity, and water availability in the Sulaimani governorate. The lack of investment in dams exacerbates water scarcity, climate change, and unpredictable rainfall, making it a pressing concern for agricultural workers and rural livelihoods. While the problem of (Lack of active agricultural organizations and companies in view of the diversity of the environment in the region.) came at

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the last ranking according to importance and percentage weight, as it achieved an average of (3.76) degrees and a percentage weight of (75.15%). Because agricultural employees may prioritize immediate challenges such as water scarcity, land degradation, and unstable weather over long-term sustainable practices, also may be due to the lack of focus on agricultural institutions may stem from their limited impact on sustainable agriculture.

2. Preparing a proposed strategy for sustainable agricultural development to achieve food security in Sulaimani Governorate

2.1 Approval of the elements of sustainable agricultural development strategies to achieve food security in Sulaimani Governorate:

The sustainable agriculture development strategies proposed five elements to achieve food security among agriculture managers and extension workers according to their point of view. The weighted averages percentage weights obtained for these elements ranged from(84.92-86.18) degrees, the maximum degrees that obtained by each of these elements was 100, as shown in table 3.

TABLE (3): RANKING THE ELEMENTS OF SUSTAINABLE AGRICULTURAL DEVELOPMENT STRATEGY TO ACHIEVE FOOD SECURITY ACCORDING TO THEIR PERCENTAGE OF RESPONDENTS' APPROVAL

Elements	Rank	Weighted averages		percentile weight
		Managers	Extension Workers	
Water	2	86.86	84.65	85.75
Soil	1	87.88	84.47	86.18
Climate	5	86.65	83.19	84.92
Food	3	87.22	83.89	85.55
Human Resource	4	86.25	84.59	85.42
Average of weighted averages		86.97	84.16	85.56

Table 3 illustrates that the element of 'Soil' ranked first in terms of importance and weight, as it achieved average weighted average of (86.18) degrees and a percentage weight of (86.18)%. This value is higher than the weighted averages of the other elements. This may be due to that, Soil is the essential foundation for agricultural productivity, directly impacting crop yield, quality, and sustainability by providing nutrients, water, and support for root systems. This result is agree with what found by **Rahim (2024)**. At the same time, the 'Climate' element received the lowest ranking in importance, with a weighted average score of (84.92%). This lower score is likely attributed to the perception that climate issues necessitate long-term global cooperation, leading local agricultural employees to feel they have little influence over climate-related factors. This result is disagree with what found by **Mamshai (2025)**.

The t-test conducted to compare respondent categories' agreement levels on sustainable agricultural development strategies yielded a calculated value of 1.03, which is below the tabulated T value of 1.65 at a 0.05 significance level. This suggests no significant differences between average scores, leading to the rejection of the study hypothesis that states 'there is a significant difference between the categories of respondents in their agreement on the elements of the proposed sustainable agriculture development strategy'.

2.2 Approval of the fields of sustainable agricultural development strategies to achieve food security in Sulaimani governorate.

The sustainable agriculture development strategies proposed 5 different fields for each element to achieve food security among agriculture managers and extension workers according to their point of view. The weighted averages obtained for these fields ranged from (4.09-4.39) degrees, and percentage weights value between (20.45-21.94) ,the maximum degrees that obtained by each of these fields was 20, as shown in table 4.

TABLE (4): RANKING THE FIELDS OF SUSTAINABLE AGRICULTURAL DEVELOPMENT STRATEGY TO ACHIEVE FOOD SECURITY ACCORDING TO THEIR PERCENTAGE OF RESPONDENTS' APPROVAL

El	Fields	Rank	Weighted averages		

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			Managers	Extension Workers	Average weighted averages	% Weight
Water	Economic	6	4.41	4.29	4.35	21.75
	Social	1	4.50	4.28	4.39	21.94
	Policies & administration	25	4.13	4.05	4.09	20.45
	Environmental	14	4.32	4.28	4.30	21.50
	Technology	9	4.37	4.25	4.31	21.55
Respondents' agreement with the fields			4.34	4.23	4.29	21.44
Soil	Economic	4	4.46	4.26	4.36	21.79
	Social	24	4.24	4.08	4.16	20.80
	Policies & administration	11	4.38	4.22	4.30	21.52
	Environmental	7	4.39	4.30	4.34	21.71
	Technology	2	4.50	4.26	4.38	21.91
Respondents' agreement with the fields			4.39	4.22	4.31	21.54
Climate	Economic	18	4.31	4.16	4.24	21.20
	Social	12.5	4.41	4.20	4.30	21.51
	Policies & administration	19	4.28	4.14	4.21	21.06
	Environmental	15	4.45	4.14	4.29	21.46
	Technology	22.5	4.21	4.16	4.19	20.93
Respondents' agreement with the fields			4.33	4.16	4.24	21.23
Food	Economic	10	4.48	4.14	4.31	21.53
	Social	16	4.32	4.22	4.27	21.35
	Policies & administration	12.5	4.38	4.22	4.30	21.51
	Environmental	8	4.44	4.20	4.32	21.59
	Technology	21	4.19	4.20	4.19	20.95
Respondents' agreement with the fields			4.36	4.19	4.28	21.39
Human	Economic	17	4.28	4.23	4.25	21.26
	Social	22.5	4.19	4.18	4.19	20.93
	Policies & administration	20	4.21	4.17	4.19	20.96
	Environmental	3	4.45	4.30	4.37	21.87
	Technology	5	4.44	4.27	4.35	21.77
Respondents' agreement with the fields			4.31	4.23	4.27	21.36

Table 4 illustrates that the field of 'Social' in water element ranked first in terms of importance and weight, as it achieved average weighted average of (4.39) degrees and a percentage weight of (21.94 %). This value is higher than the weighted averages of the other fields. This may be due to that social factors are important to managing water resources sustainably and fairly. Community participation, awareness, and cooperation help ensure efficient water use, reduce waste, and promote equal access for all farmers. This result is agree with what found by **Rahim (2024)**, & **(Sulaiman, and Andrea, 2022)**.

At the same time, the field of 'policies & administration' within the water element is perceived as the least important, with a weighted average of (4.09) and a weight of (20.45%). This is lower than other fields, likely due to agricultural employees favoring immediate, practical solutions like irrigation and water conservation, finding administrative actions to be slow and disconnected from actual field needs. This result is agree with what found by **(Yousuf *et al.*, 2018)**.

The t-test conducted to compare respondent categories' agreement levels on sustainable agricultural development strategies yielded a calculated value of 0.81, which is below the tabulated T value of 1.65 at a 0.05 significance level. This suggests no significant differences between average scores, leading to the rejection of the study hypothesis.

2.3 Approval of the items of sustainable agricultural development strategies to achieve food security in Sulaimani governorate.

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sustainable agricultural development consist of (100) items, which were arranged in descending order according to importance and percentage weight, as shown in Table 5.

TABLE (5): RANKING OF THE SUSTAINABLE AGRICULTURAL DEVELOPMENT TO ACHIEVE FOOD SECURITY ACCORDING TO THEIR PERCENTAGE OF RESPONDENTS' APPROVAL

Fields	Items	Rank	Averages		Average weighted	Weight %
			Managers	Extension Workers		
Economic	Construction of dams and ponds in the area according to local needs and suitability for water collection.	3	4.67	4.38	4.52	90.44
	Providing financial incentives to farmers in areas suitable for fish farming to establish small- or medium-scale projects.	34	4.27	4.40	4.34	86.78
	Maintaining a balance between water supply for agriculture and other sectors, such as industry.	83	4.18	4.12	4.15	82.99
	Establishing projects for sewage recycling and reuse in agricultural irrigation and other fields.	20	4.51	4.27	4.40	87.82
Social	Disseminate awareness messages about water resources through the media, display billboards in public places, and devote part of religious sermons to the same purpose.	28	4.47	4.25	4.36	87.16
	Announce a nationwide campaign to remove plastic and other waste from water sources.	18	4.51	4.30	4.40	88.08
	Organize training courses through agricultural extension centers to raise villagers' awareness and promote the adoption of sustainable irrigation practices.	9	4.55	4.35	4.45	89.00
	Encourage and support farmers who have adopted innovative and sustainable irrigation systems.	31	4.45	4.24	4.34	86.88
Policies & administration	Examine the impact of political conflicts on sustainable agricultural development and water security in affected areas.	100	3.92	3.96	3.94	78.87
	Promote the active use of water through preventive policies.	89	4.16	4.05	4.10	82.09
	Organize workshops and seminars for farmers and policymakers to explain the political aspects of sustainable agricultural development and its relationship to water security.	87	4.24	4.02	4.17	82.53
	Establish coordination among universities, research institutions, and government agencies to formulate appropriate policies for protecting water resources.	75	4.20	4.18	4.19	83.72
Environmental	Protect the area's water resources from pollution caused by factory waste and oil companies.	29	4.33	4.37	4.35	87.02
	Restrict hunting and prevent the use of inappropriate hunting methods.	37	4.35	4.30	4.36	86.51
	Increase fingerling populations by considering the compatibility of species with the area's aquatic environment.	17	4.51	4.32	4.41	88.26
	Promote the conservation of aquatic plant and animal diversity.	88	4.01	4.14	4.11	82.19
Technology	Rely on new scientific methods to monitor the health of aquatic animals, especially rare species.	93	4.04	4.11	4.07	81.45
	Use modern irrigation systems, such as sprinklers, to reduce water wastage.	5	4.63	4.39	4.51	90.22
	Ensure the purity and safety of drinking water sources by conducting regular tests using advanced water-analysis technology.	52	4.39	4.18	4.29	85.76
	Develop a system to prevent the wastage of rainwater in streets and public areas.	26	4.41	4.32	4.37	87.36

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Water element			4.34	4.23	4.29	
Economic	Protect the soil, prevent degradation, and increase its productivity.	14	4.59	4.26	4.43	88.51
	Use organic fertilizers instead of chemical fertilizers, as they provide long-term economic benefits for the soil.	12	4.49	4.38	4.43	88.67
	Provide financial support and micro-loans to farmers with small-scale land for investment.	46.5	4.37	4.23	4.30	86.01
	Plant crops on agricultural lands only after conducting an economic feasibility study.	57	4.37	4.17	4.27	85.39
Social	Achieving fairness among farmers of small and large-scale farms by utilizing all available assistance.	76	4.25	4.11	4.18	83.69
	Preventing the emergence and spread of social problems arising from land ownership.	82	4.25	4.07	4.16	83.25
	Educating farmers and stakeholders about the importance of soil conservation and sustainable management practices.	69	4.27	4.16	4.22	84.41
	Establishing a group of local farmers to share resources, knowledge, and best practices for sustainable soil management.	94	4.18	3.96	4.07	81.41
Policies & administration	Amend laws on agricultural land ownership.	53	4.29	4.28	4.29	85.75
	Implement policies providing incentives and subsidies for farmers who adopt sustainable practices, such as organic farming.	49	4.33	4.26	4.30	85.96
	Formulate policies for the proper use of natural resources.	84	4.25	4.04	4.15	82.98
	Enact laws to penalize agricultural offices that sell illegal or expired pesticides.	7	4.65	4.31	4.48	89.54
Environmental	Protect natural pastures by organizing grazing practices.	65	4.27	4.20	4.24	84.76
	Establish criteria for pesticide use to reduce their negative impacts on the environment and human health.	24	4.41	4.34	4.38	87.54
	Control urban expansion that encroaches on agricultural lands.	1	4.63	4.44	4.53	90.66
	Encourage eco-tourism projects by fully leveraging the natural features of different areas in the region.	68	4.24	4.21 16	4.22	84.46
Technology	Encourage farmers to adopt agricultural techniques that improve soil fertility and increase crop yields.	15	4.61	4.23	4.42	88.36
	Offer regular courses for farmers to train them in sustainable soil management methods.	10	4.55	4.33	4.44	88.82
	Use modern plowing techniques to preserve soil structure.	32	4.43	4.25	4.34	86.86
	Conduct periodic soil composition analyses to determine nutrient requirements.	38	4.43	4.22	4.33	86.50
Soil element			4.39	4.22	4.31	
Economic	Achieving economic balance between agriculture and other sectors.	77.5	4.16	4.21	4.18	83.67
	Encouraging diversification of crop and livestock products to better withstand the impacts of climate change.	73	4.24	4.17	4.21	84.02
	Coping with climate change threats by establishing seed banks to protect local crop varieties.	55	4.4	4.15	4.28	85.61
	Providing compensation to farmers in the event of natural disasters, such as floods or droughts.	51	4.45	4.13	4.29	85.83
Social	Assist farmers in accessing high-quality seeds and seedlings suitable for the local climate.	11	4.59	4.29	4.44	88.78
	Encourage citizens to engage in small-scale agriculture in their gardens to achieve self-sufficiency.	62	4.29	4.20	4.24	84.87
	Raise awareness of the negative impacts of climate change.	58	4.37	4.16	4.27	85.3
	Conduct widespread awareness campaigns to promote a healthy lifestyle among citizens.	60	4.37	4.15	4.26	85.22
Policies &	Follow a policy of wise use of non-renewable natural resources.	74	4.22	4.17	4.19	83.82
	Conduct advance planning to mitigate the damage caused by natural disasters, such as storms and floods.	30	4.45	4.25	4.35	86.97

University of Thi-Qar Journal of agricultural research

Thi-Qar Journal of agricultural research

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https://jam.utq.edu.iq/index.php/main https://doi.org/10.54174/qy8m2q22

	Implement advance plans to protect forests and natural pastures from fires.	85	4.20	4.09	4.14	82.88
	Redirect those who encourage the excessive use of fertilizers, water, or energy in food production.	81	4.27	4.05	4.16	83.28
Environmental	Enact laws and regulations to combat desertification.	71	4.43	3.98	4.21	84.14
	Encourage the use of renewable energy sources, such as solar or wind energy, in agriculture.	39	4.45	4.18	4.32	86.35
	Protect biodiversity to maintain the natural balance and control pests and insects naturally.	63	4.28	4.21	4.2	84.85
	Protect forests and replant areas that have been destroyed for any reason.	19	4.6	4.18	4.40	88.03
Technology	Adopting new agricultural practices, such as conservation agriculture and crop rotations, to reduce greenhouse gas emissions.	90	4.02	4.18	4.10	81.95
	Using precision agriculture techniques, including GPS, GIS, and drones.	43	4.41	4.19	4.30	86.05
	Implementing a vertical farming system.	95	4.02	4.08	4.05	80.99
	Leveraging the experience of developed countries in applying green technologies to reduce the agricultural sector's overall negative impact on climate change.	50	4.39	4.19	4.29	85.85
Climate element			4.33	4.16	4.25	
Economic	Improve the quality of domestic products to enhance their competitiveness.	2	4.67	4.39	4.53	90.61
	Exempt domestic products that have achieved a high level of self-sufficiency from customs duties.	40	4.5	4.09	4.31	86.17
	Conduct detailed assessments of the economic viability of medium and small food production enterprises.	98	4.16	3.85	4.00	80.08
	Advertise and promote local products to strengthen their market presence.	23	4.55	4.22	4.38	87.68
Social	Improve working conditions for farmers and workers in the agricultural, industrial, and food sectors.	25	4.43	4.32	4.37	87.47
	Organize community events such as farmers' markets and food festivals.	61	4.29	4.22	4.26	85.13
	Maintain a balance between population growth patterns and food supply capacity.	70	4.33	4.09	4.21	84.21
	Raise awareness to promote better food consumption behaviors.	64	4.22	4.26	4.24	84.79
Policies & administration	Establish a system to stabilize food prices in the market by maintaining a balance between supply and demand.	35	4.33	4.34	4.34	86.75
	Implement a government policy to develop international relations that support domestic production.	46.5	4.37	4.23	4.30	86.01
	Recognize the role of villages in the food production process to better meet domestic needs.	59	4.33	4.19	4.26	85.26
	Develop an agricultural lending policy aligned with the current state of agricultural development in Sulaimani Governorate.	42	4.49	4.12	4.31	86.13
Environmental	Creating a favorable environment for the preservation of the region's food culture.	79	4.22	4.15	4.18	83.69
	Government monitoring of food storage warehouses to ensure compliance with health and safety regulations.	6	4.63	4.37	4.50	89.96
	Dissemination of environmental guidelines and promotion of reduced plastic use in food storage.	22	4.63	4.15	4.39	87.77
	Offering specialized courses for rural women on managing food waste.	72	4.29	4.11	4.20	84.08
Technology	Designing a database to monitor the health and growth of children in both rural and urban areas to ensure proper nutrition.	91	4.04	4.11	4.08	81.53
	Utilizing modern scientific equipment at different stages of food production to reduce losses.	67	4.20	4.26	4.23	84.59
	Creating a database containing information on individual food needs, imports, domestic production, and population.	77.5	4.16	4.21	4.18	83.67
	Implementing scientific food waste management practices to prevent environmental pollution.	56	4.35	4.19	4.27	85.46

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Food element			4.36	4.19	4.28	
Economic	Establishing a new economic perspective on rural development as the primary driver of agricultural economic growth.	86	4.14	4.12	4.13	82.60
	Providing financial incentives to farmers who achieve high annual crop production in both quantity and quality.	66	4.18	4.30	4.24	84.75
	Creating employment opportunities for low-income populations in both the public and private sectors.	44	4.31	4.29	4.30	86.03
	Taking into account the skill level and capacity of the region's ideal farmers to enhance agricultural economic performance.	33	4.49	4.19	4.34	86.83
Social	Reducing gender discrimination and improving the conditions of rural women by providing them with equal opportunities in agricultural employment.	96	4.06	4.03	4.05	80.94
	Making efforts to maintain the preferred population level in rural areas.	97	4.04	4.03	4.03	80.66
	Emphasizing rural infrastructure development as a strategy to address rural–urban migration.	27	4.39	4.33	4.36	87.26
	Focusing on literacy campaigns in rural areas.	48	4.25	4.34	4.30	85.97
Policies & administration	Equitable distribution of income.	13	4.53	4.33	4.43	88.63
	Encouraging the reverse migration of citizens from cities to villages.	54	4.37	4.19	4.28	85.66
	Reducing the negative effects of religious and political conflicts on farmers and the agricultural sector.	99	3.86	4.09	3.98	79.50
	Developing and demonstrating personal skills in agricultural and non-agricultural activities.	92	4.08	4.07	4.07	81.49
Environmental	Emphasizing the culture of tree planting and expanding green areas within the framework of a national program.	8	4.53	4.41	4.47	89.42
	Encouraging farmers to raise bees to enhance soil fertility and improve the agricultural environment.	4	4.65	4.39	4.51	90.33
	Strengthening environmental organizations to better fulfill their roles.	80	4.24	4.11	4.18	83.49
	Raising individual environmental awareness as an effective factor in protecting the various components of the environment.	36	4.39	4.27	4.33	86.64
Technology	Providing villagers with opportunities to benefit from advances in information and communication technology.	45	4.29	4.31	4.30	86.00
	Enhancing the role of agricultural extension in introducing new agricultural innovations.	16	4.47	4.36	4.42	88.30
	Improving the technical skills of the agricultural workforce in applying modern agricultural technologies.	41	4.41	4.2	4.31	86.14
	Using modern technologies to create and generate new sources of income for citizens.	21	4.57	4.21	4.39	87.79
Human Resource element			4.31	4.23	4.27	

Table 5 illustrates that the item of (Controlling urban expansion at the expense of agricultural lands) came in first place according to importance and percentage weight in improving the role of sustainable agricultural development to achieve food security, with a weighted average of (4.53) and a percentage weight of (90.66%). This highlights the threat that urban growth poses to productive farmland, resulting in decreased crop yields and risks to food security. While the item of (Examine the impact of political conflicts on sustainable agricultural development and water security in affected areas.) ranked lowest, with a weighted average of (3.94) and a percentage weight of (78.87%), as such conflicts are often perceived as external and not directly affecting daily agricultural practices, especially in comparatively stable regions.

The t-test conducted to compare respondent categories agreement levels on the items of sustainable agricultural development strategies yielded a calculated value of 1.380, which is below the tabulated T value of 1.65 at a 0.05 significance level. This suggests no significant differences between average scores, leading to the rejection of the study hypothesis. This result is agree with what found by **(Kule *et al.*, 2025)**.

IV. CONCLUSION

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1. The research highlights the critical role of water infrastructure in sustainable agricultural development, identifying insufficient funding for dam construction as the main obstacle to achieving food security in Sulaimani Governorate. Conversely, the lack of active agricultural organizations and businesses is considered the least pressing issue, providing a framework for future research and policy priorities.
2. The findings indicate that soil is considered the most crucial factor for sustainable agricultural development and food security in Sulaimani Governorate, as per agricultural employees. In contrast, climate is viewed as the least important factor, highlighting that other elements are seen as having more immediate effects on food security in this region.
3. The research indicates that in sustainable agricultural development, the social field is crucial for food security in Sulaimani Governorate, whereas policies and administration are the least important, underscoring the significance of community engagement in water resource management.
4. The research concludes that between hundred items of sustainable agricultural development strategies the item of controlling urban expansion over agricultural lands is the most critical strategy to achieving food security, whereas the impact of political conflicts on agriculture and water security is perceived as the least important strategy in this context.

V. RECOMMENDATIONS AND SUGGESTIONS:

Based on the result findings and conclusions; the following recommendations are made:
1. Ministry of Agriculture should identify other diverse fields that can help in advancing food security.
2. The relevant authorities must providing information and data about the lands, waters, and forests present in the region, and using advanced technologies to monitor data from various areas
3. Using developed methods in agriculture and exploiting the lands and establishing dams and gathering rainwater.
4. Availability of modern irrigation systems in various types, with good support to encourage farmers throw building awareness regarding the use and conservation of water and need for environmental protection, which are factors affecting the quality and quantity of water for irrigation purposes.

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