The Reality of Sustainable Agricultural Development in the Agricultural Sector and Ways to Develop It

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Abstract

The objectives of the study were to identify the personal and economic characteristics of agricultural researchers in Nineveh Governorate, investigate their opinions regarding the reality and future of sustainable development in the agricultural sector, arrange the four studied dimensions (economic, environmental, extension, and social) according to importance, and identify their proposals for developing the sector. The research targeted the population of agricultural researchers holding Master's and Doctoral degrees across several academic and research institutions in Nineveh Governorate, totaling 440 researchers. A proportional simple random sample of 50% was selected, comprising 205 respondents. The researcher adopted a questionnaire as the data collection tool, which was distributed personally. The questionnaire included a 5-point Likert scale to measure opinions across the four dimensions of reality and the future. Face validity of the tool was verified by experts, and reliability was calculated using Cronbach's Alpha coefficient. The study reached several key findings, most notably: The predominant age group was middle-aged (38–49 years), accounting for 41.5%. Males represented 64% of the sample. Regarding qualifications, 67% of the respondents hold a Master's degree, and 43% hold the scientific title of "Agricultural Researcher". The largest percentage of respondents worked at the Faculty of Agriculture and Forestry / University of Mosul, at 52.5%. The majority of respondents (60%) view the current status of sustainable development in Nineveh as "medium," indicating acceptable efforts that have not yet reached the optimal level. Regarding the **current reality**, the "Economic Dimension" ranked first in importance, followed by the environmental, extension, and finally social dimensions. This was attributed to farmers' immediate focus on material benefits. Regarding the **future**, the "Environmental Dimension" took the lead, followed by the extension, economic, and lastly social dimensions, reflecting an awareness of the necessity to preserve natural resources in the future. The proposal to "use artificial intelligence in agriculture, such as drones for spraying pesticides and monitoring vast agricultural fields" ranked first at 10.196%, followed by the proposal for "managing and rationalizing irrigation water and protecting the soil".

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Introduction

The agricultural sector holds a position of particular importance in Arab economies due to its capacity to absorb massive numbers of the workforce, its contribution to Gross Domestic Product (GDP) and foreign trade, and its fulfillment of a large portion of food consumption needs. Furthermore, it serves as the primary source of livelihood for rural populations, who constitute a significant percentage of the total population in the Arab world (16) . The agricultural sector is considered one of the strategic and sensitive sectors that effectively contributes to achieving development goals. It serves as the primary source for meeting food consumption needs, which helps reduce food imports. This is in addition to the sector's contribution to providing production inputs for other sectors, as well as stimulating and activating other productive sectors and industries directly or indirectly linked to agriculture (15). Hence, focusing efforts on this sector and developing it has become an absolute necessity. In Iraq, there has been and still is an urgent need for the state's role in developing and advancing this vital sector in a manner that aligns with its economic importance to the individual and the overall economic development process (11). This requires establishing a scientific and practical strategy capable of exploiting all available potential in a way that allows food requirements to be met through healthy, safe, and peaceful methods. This must be guided by a government policy based on comprehensive, long-term plans that understand the current and future reality of food production in the country, and how to secure and develop its requirements by relying on the optimal utilization of available resources while considering the needs of future generations (13). Since the human element is the core of development and the means to achieve it, it is essential to advance human resource development to sustain and provide the energy, expertise, skills, capabilities, and competencies required by the development process (14). Achieving sustainable agricultural development and providing food security are two fundamental factors for comprehensive economic and social growth, which requires undertaking numerous measures to overcome the obstacles and problems facing the development and advancement of the agricultural sector and the economy in general (7). Agricultural extension aims to achieve rural and agricultural development in its social and economic dimensions by changing behavior toward positive directions in the knowledge, skills, and attitudes of the target groups of extension work (3). Those responsible for agricultural extension work represent the essential pillar of the extension process within the agricultural

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extension organization. This has placed extension workers under constant pressure and major challenges to elevate performance, including a shortage in the number of agricultural extension workers, limited means of communication, and a lack of technical support (1). Agricultural extension is an educational, persuasive, and executive system that aims to bring about desirable behavioral changes among farmers in their knowledge, skills, and attitudes through conviction using various extension methods (10). The agricultural extension apparatus is considered one of the sustainable development bodies in the agricultural sector, carrying the primary responsibility for confronting the risks of climate change. The agricultural extension worker transfers the results of modern studies that contribute to solving emerging phenomena and problems, after ensuring their suitability to the farmers' conditions, to be subsequently accepted and adopted by the target audience (2). Although Nineveh Governorate is considered one of the important agricultural governorates in Iraq due to its vast agricultural areas and diverse natural resources that contribute to supporting plant and animal agricultural production, the agricultural sector in the governorate faces several challenges that have affected the level of production and its sustainability. Most prominent among these are the scarcity of water resources, soil degradation, weak utilization of modern agricultural technologies, and climate changes that affect agricultural production (8). Despite the importance of this topic, studies examining the opinions of agricultural researchers regarding the reality and future of sustainable development in the agricultural sector in Nineveh Governorate remain limited. This necessitates conducting a scientific study that contributes to identifying their opinions, determining the challenges facing this sector, and envisioning its future in light of sustainable development requirements.

Research Objectives

1. To identify the personal and economic characteristics of the respondents.(gender-age Academic Degree - Specialization- Years of Research Experience).
2. To identify the opinions of agricultural researchers regarding the reality of sustainable development in the agricultural sector in Nineveh Governorate.
3. To arrange the four studied dimensions for both the reality and future of sustainable development in Nineveh Governorate according to importance.
4. To identify proposals toward successful sustainable development in the agricultural sector in Nineveh

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Governorate according to the researchers' opinions.

Materials and Methods

The research population included all agricultural researchers holding Master's and Doctoral degrees in agricultural sciences. The research population comprised all agricultural researchers belonging to: (Faculty of Agriculture and Forestry / University of Mosul, Nineveh Directorate of Agriculture, the Extension Center, the Seed Testing and Certification Center, and the Agricultural Research Department). The total number of active agricultural researchers was 440, distributed as follows: 280 researchers from the Faculty of Agriculture and Forestry, 92 researchers from the Nineveh Directorate of Agriculture and its agricultural branches, 10 researchers from the Extension Center, 28 researchers from the Seed Testing and Certification Center, and 30 researchers from the Agricultural Research Department. A reliability sample of 30 researchers (all from the Faculty of Agriculture and Forestry) was excluded. A proportional simple random sample of 50% was selected and distributed as follows: 125 researchers from the Faculty of Agriculture and Forestry, 15 researchers from the Agricultural Research Department, 14 researchers from the Seed Testing and Certification Center, 46 researchers from the Nineveh Directorate of Agriculture, and 5 researchers from the Extension Center. Thus, the final research sample consisted of 205 respondents. The researcher adopted a questionnaire as the tool for data collection, which was distributed personally by the researcher. The questionnaire consisted of three basic parts:

Part One: Independent Personal Variables

- **Gender:** Measured using a binary nominal scale (Male, Female), assigned values of (1, 2) respectively.
- **Age:** Measured by assigning one unit for each year of the respondent's age up to the year of data collection.
- **Academic Degree:** Measured using a binary ordinal scale (Ph.D., M.Sc.), assigned the numerical values (2, 1) respectively.
- **Specialization:** Measured using a nominal scale consisting of ten levels: (Agricultural Extension and Technology Transfer, Field Crops, Horticulture and Landscape Design, Plant Protection, Animal Production, Agricultural Economics, Forestry Sciences, Food Sciences, Agricultural Machinery and Equipment, Soil Sciences and Water Resources), assigned

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numerical codes (1 to 10) respectively.

- **Years of Research Experience:** Measured by the number of years, assigning one unit for each year of experience; the sum represents the total years of research experience.

Part Two: Dependent Variable Measurement

This part included a scale for the dependent variable: (Opinions of agricultural researchers regarding the reality of sustainable development in the agricultural sector). The dependent variable consisted of two components: (Opinions of agricultural researchers regarding the reality of sustainable development in the agricultural sector in Nineveh Governorate) and (Opinions of agricultural researchers regarding the future of sustainable development in the agricultural sector in Nineveh Governorate). Each dependent variable consisted of four dimensions: (Economic Dimension, Social Dimension, Environmental Dimension, and Extension Dimension). The dependent variable (Reality) consisted of 37 items distributed as follows: 8 items for the economic dimension, 7 items for the social dimension, 12 items for the environmental dimension, and 10 items for the extension dimension. The dependent variable (Future) consisted of 37 items distributed as follows: 10 items for the economic dimension, 9 items for the social dimension, 9 items for the environmental dimension, and 9 items for the extension dimension. Both variables and their dimensions were measured using a 5-point Likert scale: (Strongly Agree, Agree, Neutral, Disagree, Strongly Disagree), assigned numerical values of (5, 4, 3, 2, 1) respectively. The total sum of the scale represents the final score for the dependent variable and its dimensions. To verify face validity and ensure the suitability of the items in their initial form, they were presented to specialists and experts in the fields of agricultural extension. The initial 5-point Likert scale consisted of 126 items. After collecting expert opinions and notes, the percentage of agreement was calculated, and items that received less than 80% expert agreement regarding their suitability were excluded. To determine the reliability coefficient of the scale items, Cronbach's Alpha coefficient was used, as this scale is suitable for estimating the reliability of attitudes and opinion surveys, providing the minimum estimated value for the reliability coefficient (12). The value of Cronbach's Alpha relies on establishing the relationship between the variance of each item and the total variance. A reliability coefficient value of 0.80 or more is considered acceptable (4).

Results and Discussion

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Objective 1: Identify the personal characteristics of the agricultural researchers included in the study: To achieve this objective, the personal characteristics of the respondents were identified through the following results and tables :

Age: The study showed that the age of the respondents ranged between 26 and 62 years, and it was divided into three categories using the range law, as shown in Table (1 :(

Table (1): Distribution of respondents according to age

Mean	**%**	**Frequency**	**Categories**
32	38%	76	Young Age (26–37)
43.18	41.5%	83	Middle-Aged (38–49)
56.42	17.5%	35	Older Age (50–62)
-------	**100%**	**200**	**Total**

Table (1) shows that the largest percentage of respondents fell within the middle-aged category, followed by the young age category. Thus, the respondents can be described as being between young and middle-aged, meaning most researchers were in their youth.

Gender: The gender variable of the respondents was divided into two categories (Male, Female), as shown in Table (2):

Table (2): Distribution of respondents according to gender

%	**Frequency**	**Categories**
64%	128	Male
36%	72	Female
100%	**200**	**Total**

Table (2) demonstrates that the largest percentage of respondents were males, accounting for 64%, while females accounted for 36%. Thus, it can be noted that the

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number of male researchers is double that of female researchers.

Academic Degree : The academic degree variable of the respondents was divided into two categories (Ph.D. and M.Sc.), as shown in Table (3):

Table (3): Distribution of respondents according to academic degree

%	Frequency	Categories
33%	66	Ph.D. Degree
67%	134	M.Sc. Degree
100%	**200**	**Total**

Table (3) shows that 67% of the researchers hold an M.Sc. degree, which is twice the number of researchers holding a Ph.D. degree (33%). This may be attributed to the fact that most researchers had not yet obtained a Ph.D. prior to data collection due to personal reasons, or they gained employment with an M.Sc. degree and their Ph.D. had not yet been processed post-employment.

Scientific Title: The scientific title variable of the respondents was divided into five categories, as shown in Table (4):

Table (4): Distribution of respondents according to scientific title

%	Frequency	Categories
4.5%	9	Professor
14.5%	29	Assistant Professor
19%	38	Lecturer
19%	38	Assistant Lecturer
43%	86	Agricultural Researcher
100%	**200**	**Total**

Table (4) indicates that the highest percentage of researchers held the title of "Agricultural Researcher" (43%), followed by "Lecturer" and "Assistant Lecturer" at 19% each. The title of "Professor" came in last

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place with a low percentage not exceeding 4.5%. This may be attributed to delays in promotions due to unfulfilled requirements for Professor or Assistant Professor titles, or missing eligibility timelines due to a lack of published research in reputable journals.

Scientific Specialization: The scientific specialization variable was divided into ten categories, as shown in Table (5):

Table (5): Distribution of respondents according to scientific specialization

%	Frequency	Categories
7%	14	Agricultural Extension and Technology Transfer
15.5%	31	Field Crops
14.5%	29	Horticulture and Landscape Design
12%	24	Plant Protection
10%	20	Animal Production
13.5%	27	Agricultural Economics
4%	8	Forestry Sciences
2.5%	5	Food Sciences
14.5%	29	Agricultural Machinery and Equipment
6.5%	13	Soil Sciences and Water Resources
100%	**200**	**Total**

Table (5) indicates that the highest percentage of respondents specialized in Field Crops (15.5%), followed by Horticulture and Landscape Design (14.5%). Food Sciences came last with a low percentage of 2.5%. This may be due to Field Crops and Horticulture being older departments with larger numbers of researchers, whereas Food Sciences is a recently established department with fewer researchers.

Current Workplace: The workplace variable was divided into five categories, as shown in Table (6):

Table (6): Distribution of respondents according to current workplace

%	Frequency	Categories
52.5%	105	Faculty of Agriculture and Forestry / University of Mosul
36%	72	Nineveh Directorate of Agriculture
4%	8	Extension Center

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%	Frequency	Categories
6%	12	Seed Testing and Certification Center
1.5%	3	Agricultural Research Department
100%	**200**	**Total**

Table (6) shows that the highest percentage of respondents worked at the Faculty of Agriculture and Forestry / University of Mosul (52.5%), followed by the Nineveh Directorate of Agriculture in second place (36%). The Agricultural Research Department ranked last with a low percentage estimated at 1.5%. This is likely because the Faculty of Agriculture and Forestry is an academic institution requiring large numbers of teaching staff across its ten scientific departments. Other institutions require fewer personnel and suffice with small numbers to fulfill their needs in Nineveh Governorate.

Years of Research Experience: The research experience variable was divided into three categories using the range law, as shown in Table (7):

Table (7): Distribution of respondents according to years of research experience

Mean	%	Frequency	Categories
5.5	60.5%	121	Low (1–10 years)
15.5	30.5%	61	Medium (11–20 years)
25.85	9%	18	High (21–30 years)
-------	**100%**	**200**	**Total**

Table (7) shows that the highest percentage of respondents fell within the low category (60.5%), followed by the medium category (30.5%). Thus, the years of research experience of the respondents can be described as high, which may be attributed to the fact that most researchers possess considerable expertise in agriculture and sustainable development in Nineveh Governorate.

Objective 2: Identify the opinions of agricultural researchers regarding the reality and future of sustainable development in the agricultural sector in Nineveh Governorate in general

The results showed that the actual scores expressing the opinions of agricultural researchers about the reality of sustainable agricultural

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development in the agricultural sector in Nineveh Governorate / Iraq in general ranged between 95 and 180. The arithmetic mean was 144.41 with a standard deviation of 15.036. On the theoretical 5-point Likert scale ranging between 37 and 185, the respondents were divided into three categories using the range, as illustrated in Table (8).

Table (8): Opinions of respondents regarding the reality of sustainable development in Nineveh Governorate in general

Mean	**%**	**Count**	**Categories**
112	5%	10	Low (95–122)
136	60%	120	Medium (123–150)
168	35%	70	High (151–180)
----	**100%**	**200**	**Total**
			Mean = 144.41, SD = 15.036

Table (8) clarifies that the highest percentage of respondents fell within the medium category (60%), followed by the high category (35%). The results indicate that the majority of agricultural researchers view the reality of sustainable development in Nineveh Governorate as being at a medium level, with a clear upward trend. The low category registered a limited percentage (5%), meaning only a few researchers believe the level of sustainable development is weak.

Respondents in the medium category believe that the level of sustainable development in Nineveh Governorate is moderate, while a good portion (the high category) sees the level of development as relatively good. Consequently, we can state that respondents see moderate efforts in applying sustainable development concepts, though they have not yet reached the optimal level. This necessitates strengthening extension programs and modern technologies to achieve a more efficient sustainable agricultural development. This could be due to the fact that the reality of sustainable development is undergoing a developmental stage with acceptable efforts and clear signs of improvement, but still requires further support to elevate it to a higher level worthy of Nineveh Governorate. This result aligns with the findings of (6)and (5), and differs from the study of (9).

Objective 3: Arrange the four studied dimensions for both the reality and future of sustainable development in Nineveh Governorate according to importance

First: Arranging the Dimensions of the Reality of Sustainable Development in Nineveh Governorate

To demonstrate the importance of each dimension and its priority in practical

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application, the dimensions of the reality of sustainable development were arranged using the arithmetic mean for each dimension, as shown in Table (9):

Table (9): Arrangement of reality dimensions according to importance

Rank	Standard Deviation	Arithmetic Mean	Dimensions
1	6.098	40.81	Economic Dimension
4	4.675	36.85	Social Dimension
2	5.152	39.58	Environmental Dimension
3	5.100	38.21	Extension Dimension

Table (9) shows that agricultural researchers in Nineveh Governorate believe that the best and most important dimension regarding the reality of sustainable development is the Economic Dimension, with a mean of 40.81, ranking first. Second is the Environmental Dimension, with a mean of 39.58, followed by the Extension Dimension in third place with an arithmetic mean of 38.21. The last dimension in importance according to the respondents' view is the Social Dimension, with an arithmetic mean of 36.85. This may be attributed to the nature of the immediate needs of farmers according to the researchers' perspectives, which focused directly on economic benefit, followed by the environmental aspect represented by preserving natural resources, soil, and water as a complementary source to the economic side. The extension dimension, represented by the awareness role of transferring technologies, expertise, and information to farmers and shifting their attitudes toward sustainable agriculture, was viewed as less important than economics and environment. Similarly, social factors were seen by respondents as less critical in the current agricultural reality than environmental, economic, and extension factors. Consequently, the results indicate that the reality of development in Nineveh Governorate from an agricultural perspective begins with the economy and finishes with the social aspect. However, differences in opinions were homogenous toward a promising agricultural reality and sustainable development in Nineveh Governorate.

Second: Arranging the Dimensions of the Future of Sustainable Development in Nineveh Governorate According to Importance

To demonstrate the importance of the dimensions for the future of sustainable development in Nineveh Governorate, they were arranged according to importance using the arithmetic mean for each dimension, as shown in Table (10):

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Table (10): Arrangement of future dimensions according to importance

Rank	Standard Deviation	Mean	Dimensions
3	5.125	30.48	Economic Dimension
4	3.973	25.33	Social Dimension
1	5.712	49.96	Environmental Dimension
2	6.409	38.63	Extension Dimension

Table (10) shows that agricultural researchers in Nineveh Governorate believe that the best and most important dimension for the future of sustainable development is the Environmental Dimension, which ranked first with an arithmetic mean of 49.96. This may be attributed to the fact that environmental aspects such as preserving soil, water, biodiversity, and combating pollution receive significant attention regarding the future of sustainable development in Nineveh Governorate.

The Extension Dimension came in second place with an arithmetic mean of 38.63, indicating that planning and the awareness aspect are considered basic requirements for the environment and ensuring its fulfillment. This is followed by the Economic Dimension in third place with an arithmetic mean of 30.48, which may reflect a relative delay in the economic aspects of sustainable development such as improving income and providing job opportunities for the unemployed. Meanwhile, the Social Dimension ranked last with an arithmetic mean of 25.33, being the least realized dimension. This may be attributed to the existence of social challenges such as equity in resource distribution, lack of educational and health services, and low standards of living, which caused this dimension to lag in priority and importance.

Objective 4: Identify proposals toward successful sustainable development in the agricultural sector in Nineveh Governorate according to the researchers' opinions

The study revealed a large number of proposals toward sustainable development according to the researchers' opinions. Similar items were merged, categorized, and sorted according to importance, as shown in Table (11):

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Table (11): Proposals toward successful sustainable development in the agricultural sector in Nineveh Governorate according to researchers' opinions(Dalia, 2026)

Rank	%	Count	Proposal Items According to Respondents' Opinions
1	10.196%	26	Using artificial intelligence in agriculture, such as drones for spraying pesticides and monitoring vast agricultural fields
2	9.412%	24	Managing and rationalizing irrigation water and protecting the soil
3	8.627%	22	Using plastic and glass greenhouses
4	8.235%	21	Improving the quality of education and linking it to market needs
5	7.451%	19	Using good varieties in cultivation
6	6.667%	17	Encouraging organic farming and reducing the use of chemical pesticides
7	5.490%	14	Breeding crop varieties resistant to diseases and environmental stresses
8.5	4.314%	11	Supporting farmers with improved seeds and modern technologies, and enhancing agricultural extension and training
8.5	4.314%	11	Using precision agriculture
10	3.922%	10	Adopting regenerative agriculture systems
11	3.529%	9	Reducing agricultural practices using old machinery that leads to soil degradation and kills micro-organisms
12	3.137%	8	Educating farmers to develop in the field of sustainable development
13.5	2.745%	7	Improving agricultural marketing and supporting value chains
13.5	2.745%	7	Conducting workshops for awareness on sustainable agriculture and planting high-sustainability varieties
16	2.353%	6	Combating desertification
16	2.353%	6	Supporting agricultural extension and training farmers on modern agricultural technologies
16	2.353%	6	Selecting agricultural varieties resistant to drought and diseases
18.5	1.961%	5	Protecting and managing natural resources and applying

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Rank	%	Count	Proposal Items According to Respondents' Opinions
			modern agricultural technologies
18.5	1.961%	5	Studying the problems faced by farmers and crops and finding real solutions for them
20.5	1.569%	4	Training farmers on smart agriculture and traveling to countries that applied it
20.5	1.569%	4	Preventing overhunting and preserving biodiversity
22.5	1.176%	3	Genetic engineering and biological innovation
22.5	1.176%	3	Conducting afforestation operations and protecting forests
25	0.784%	2	Adopting low but healthy yields over abundant but infected or infested yields
25	0.784%	2	Educating the new generation and children on sound agricultural methods to build conscious generations
25	0.784%	2	Reducing the use of plastic materials to eliminate pollutants, recycling waste, and reducing pollution
27	0.392%	1	Using digital management in agriculture
-----	**100%**	**255**	**Total**

Table (11) demonstrates that the proposal item "Using artificial intelligence in agriculture, such as drones for spraying pesticides and monitoring vast agricultural fields" ranked first with a percentage of 10.196%. This may be due to the fact that artificial intelligence has become a modern necessity, coupled with a strong desire to apply it in reality. It is followed by the proposal "Managing and rationalizing irrigation water and protecting the soil" in second place with a percentage of 9.412%. This is because water is the essence of life and indispensable for agriculture and other sectors, and the soil is the cradle of cultivation. Conversely, the proposal "Using digital management in agriculture" ranked last with a percentage of 0.392%, which can be attributed to the fact that digital management is not yet applied except in a few limited trial levels.

Conclusions: Based on the analysis of the previous results, the following is concluded:

- The opinions of agricultural researchers in Nineveh Governorate at present focus on material and profitable aspects, due to the positioning of the Economic Dimension in first place, reflecting the farmers' urgent need to improve their income before thinking about other aspects and future sustainable development.

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- According to researchers' opinions, there is an awareness of the requirements of future sustainable development, with a tendency for the Environmental and Extension dimensions to take the lead despite some failures. This indicates the researchers' awareness that true sustainability cannot be achieved without preserving natural resources and intensifying efforts to transfer modern technologies and digital technical knowledge in the future.
- The majority of agricultural researchers see that the reality of sustainable development in the economic dimension in Nineveh Governorate is within the medium level, noting tangible efforts in applying economic concepts of sustainable development, though it has not yet reached the optimal level.
- A large percentage of researchers believe that the social reality is very good and relatively better than the economic dimension. There are greater efforts than in the economic dimension regarding the application of sustainable development concepts, yet they have not reached the ideal level. This demands greater efforts to utilize extension programs and modern technologies to achieve a more efficient and secure sustainable agricultural development. This may be because the social dimension is passing through a new phase adapted to the target requirements, showing clear intentions for improvement, but remaining in need of more support and development to achieve better levels.
- There are significant differences between the mean scores of respondents' opinions regarding the reality and future of sustainable agricultural development in Nineveh Governorate at a significance level of (0.05) in favor of the reality of development, which may reflect that the reality is more positive toward sustainable agricultural development than the future.
- There are significant differences at the 0.01 level between the economic dimension of reality and future in favor of the future. This means that researchers' assessment of the economic future was higher than their assessment of the current economic reality. This result can be attributed to the respondents having a realistic perception of future economic challenges balanced with relative optimism about shifting toward sustainable agriculture, alongside a conviction in the possibility of

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improving economic performance if modern policies and technologies are applied.

- There are significant differences at the (0.01) significance level between the mean scores of respondents' opinions regarding the reality and future of the social dimension of sustainable agricultural development in Nineveh Governorate, in favor of the future. This means respondents view the future with a higher degree of appreciation compared to the current reality, indicating positive expectations, improvement, and development in favor of the agricultural sector's social dimension in the future.
- There are significant differences at the (0.01) significance level between the mean scores of respondents' opinions regarding the reality and future of sustainable agricultural development for the environmental dimension in Nineveh Governorate, where the mean difference reached 10.38 in favor of the reality. We conclude from this that the environmental dimension according to the respondents' opinions is better in reality than in the future, and there is pessimism among most researchers regarding its application in the future of sustainable agricultural development in Nineveh Governorate.
- There are no significant differences between the mean scores of respondents' opinions between the reality and future of sustainable agricultural development in Nineveh Governorate at a significance level of 0.05. There might be a negative and pessimistic retreat toward improving sustainable agricultural development in the future regarding the extension aspect. This can be attributed to weak awareness of the technical aspect among agriculturalists in Nineveh Governorate, which could be due to old age, a lack of desire to accept modern extension information, and adherence to old traditional knowledge.
- The researchers' opinions converged comprehensively on the definition of sustainable agricultural development across all studied dimensions as: "An integrated system of agricultural activities and policies aimed at achieving efficient, safe, and sustainable agricultural production economically, socially, environmentally, and health-wise, contributing to improving farmers' income and achieving food security while preserving natural resources (soil, water, biodiversity) and

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ensuring their sustainability for future generations through adopting modern agricultural technologies and rational, balanced resource management, in a way that enhances social justice, improves quality of life, and achieves balance between economic, social, and environmental dimensions within a long-term strategic planning framework".

- The most important proposals of the study according to researchers' views were the keenness to use artificial intelligence in the future of agriculture in Nineveh Governorate, particularly drones for spraying pesticides and monitoring vast agricultural fields, as well as managing and rationalizing irrigation water and protecting the soil.

Recommendations

1. The Nineveh Directorate of Agriculture must increase productivity and carry out continuous improvement processes that contribute to increasing agricultural production sustainably to meet society's needs and reduce imports.
2. The Nineveh Directorate of Agriculture and the Environmental Department in Nineveh Governorate should move toward clean agriculture by adopting organic farming and using bio-fertilizers to reduce soil pollution risks and ensure a healthy environment for future generations.
3. The Environmental Department in Nineveh Governorate must work on conserving basic natural resources (land, water, soil, biodiversity), preventing their depletion, and guaranteeing a secure share for future generations.
4. Utilize modern technologies and modern irrigation methods (sprinkling and drip irrigation) and rationalize water consumption to ensure optimal use by current and future agricultural generations.
5. Introduce clean and renewable energy, such as solar energy, into modern agriculture as a sustainable alternative to protect the environment from pollution caused by electrical generator exhausts.
6. Give priority to environmental and extension programs and translate the future aspirations of researchers into reality by intensifying extension programs that educate farmers on the importance of soil conservation, rationalizing water consumption, reducing the use of chemicals to preserve biodiversity, and utilizing agricultural digital management in Nineveh.

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