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Factors Affecting The Adoption of Modern Agricultural Technologies and Their Relationship to Some Variables in Makhmur District or Nineveh Governorate

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Abstract: The main objective of this research is to determine the levels of adoption of modern agricultural technologies by farmers in Nineveh Governorate / Makhmour District and their relationship to some variables, in addition to determining the correlation between the levels of adoption of these technologies and the independent variables represented by: (age, educational attainment, ownership of means and equipment of production, readiness for change, level of exposure to agricultural information sources, and attitude towards the use of modern technologies). The research included all (40) farmers in the Makhmur district who had adopted and implemented modern agricultural technologies. A two-part questionnaire was designed; the first part included personal and economic variables related to the farmers, while the second part included (18) items and indicators to measure the levels of adoption and implementation of these technologies. The results showed that 75% of respondents fell within the middle and lower income brackets, indicating that the levels of adoption of modern agricultural technologies in the study area were moderate to low. The results also revealed a significant correlation between adoption levels and the following variables: age, educational attainment, exposure to information sources, and attitude towards using modern technologies. However, no significant correlation was found between adoption levels and the variables of owning production equipment and willingness to change. Accordingly, the researcher recommended the need to intensify field guidance and demonstration activities and provide financial and logistical support to farmers, as well as the need to establish workshops and demonstration fields to encourage farmers and increase their willingness to adopt modern agricultural technologies in the research area.

Citation: Khalaf, S. A. Factors Affecting The Adoption of Modern Agricultural Technologies and Their Relationship to Some Variables in Makhmur District or Nineveh Governorate. Central Asian Journal of Medical and Natural Science 2026, 7(3), 753-760

Received: 10th Apr 2026

Revised: 21st May 2026

Accepted: 08th June 2026

Published: 01st July 2026



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Keywords: agricultural technologies; workshops; Makhmur District.

1. Introduction

The demand for food is increasing daily due to population growth, leading to food shortages worldwide. With the population projected to reach 10 billion by 2050, this necessitates increased production and productivity [1]. Especially today, the world is suffering from major climate changes, rising temperatures, and water scarcity, which leads to soil degradation and reduced production. Therefore, there are major challenges that require resilience and adaptation in order to feed the population and provide them with food. [2], [3]. It is Wheat is one of the most important strategic crops in Iraq due to its significant role in achieving food security. The agricultural sector is currently witnessing rapid and remarkable developments in modern agricultural technologies; however, the degree of adoption among farmers has varied. [2], [4]. Farmers' adoption of modern agricultural technologies is a crucial indicator of the success of agricultural

extension and technology transfer programs. This adoption process is influenced by a range of personal, economic, social, and extension factors [5], [6]. Makhmur District is a significant agricultural area in Nineveh Governorate, making the study of these factors influencing wheat farmers' adoption of modern agricultural technologies essential for developing extension programs, improving agricultural production, achieving sustainable agricultural development, providing food for the population, improving rural livelihoods, and enhancing farmers' economic income.

Problem Search: The study aimed to identify the technologies available in the study area and the extent of their adoption by farmers, given the significant disparity in the use of modern technologies. Since wheat is a strategic crop in Iraq, it is essential to develop existing technologies and ensure equitable access for all farmers.

Objectives

- 1) Identifying the level of adoption of modern technologies by wheat farmers in Makhmur District / Nineveh Governorate
- 2) Determining the correlation between the level of adoption of agricultural technologies and each of the personal variables of farmers, which are (age, educational level, type of land tenure, main source of family income, and attitude towards the use of modern technologies).

Research Hypotheses: The current study tests the following hypotheses:

- 1) There are no statistically significant differences between those who adopt and those who do not adopt modern agricultural technologies based on age.
- 2) There is no statistically significant relationship between those who adopt and those who do not adopt modern agricultural technologies based on educational attainment.
- 3) There are no statistically significant differences between those who adopt and those who do not adopt modern agricultural technologies based on their exposure to information sources.
- 4) There are no statistically significant differences between those who adopt and those who do not adopt modern agricultural technologies based on their willingness to change.
- 5) There is no statistically significant relationship between those who adopt and those who do not adopt modern agricultural technologies and the tendency to use modern technologies.

Procedural Definitions

Modern agricultural technologies- It is any inputs, whether material or modern, that have entered the agricultural production process for the wheat crop in recent years.

Adoption rate The relative speed at which new ideas are adopted by members of a social system, measured by the length of time required for a certain percentage of members of the social system to adopt the idea.

2. Materials and Methods

- 1) **Research methodology and structure:** The descriptive method was used in this research to achieve its objectives. Through this method, the researcher can study and describe the research correctly and scientifically, expressing accurate results from which we can generalize the research findings. [7]
- 2) **Area and limits of this research:** The district of Makhmur was chosen as a research area belonging to the Nineveh Governorate, located in northern Iraq. The city of Makhmur is famous for cultivating strategic crops, primarily wheat.
- 3) **Research community and sample:** The research community included all wheat farmers in the center of Makhmur district, numbering (311) farmers. A random sample of (13%) was selected, so that the final number of the research sample was (40) farmers, who were included in the research questionnaire.
- 4) **Preparing the questionnaire form:** The questionnaire form was prepared and consisted of two sets:

- a. Group One: This set includes several questions aimed at identifying some of the personal characteristics of the farmer, which include (age, educational attainment, ownership of agricultural production means and equipment, readiness for change, sources of information, and attitude towards these modern technologies).
- b. Group Two: This set consisted of two areas; the first area included a measure of Measuring the factors affecting the adoption of modern wheat crop technologies in the district It consists of (18) items, and in front of those items there was a scale. This scale consists of three levels: (large level, medium level, and small level).
- 5) Research variables and measurement methods: Measurement is defined as the process of converting data obtained from the research population into expressive numbers that give us real results for the purpose of interpreting them scientifically and accurately, as well as arranging and organizing them in the simplest way. Through those numbers, we can clarify the results and give them appropriate recommendations.
- 6) Measuring independent variables:
 - a. Age: This variable was measured by the number of years of age of the subject when that data was collected.
 - b. Academic achievement: The academic achievement of the participants was measured in the following way: following My mother, she reads and writes, elementary, middle, preparatory, institute, bachelor's, higher degree. These levels were given the following weights (1, 2, 3, 4, 5, 6, 7) sequentially and in sequence
 - c. Their possession: of means and equipment for production It was measured using seven items, each presented with the alternatives (I have, I do not have) and assigned numerical values respectively (1, 0) on the sequence, and thus the values expressing ownership of means and equipment of production are limited (0, 7).
 - d. Their readiness for change: The measurement of this variable consisted of five items. These items were presented with alternatives (yes, no) and given numerical values (1, 2) respectively. Thus, the values expressing this variable were limited to (5-10) degrees.
 - e. Exposure to information sources: This variable was measured by identifying (7) sources through which the respondents could obtain the information they needed from the gateway of those sources, especially the research topic, which includes obtaining information about the photovoltaic solar energy system from them, and placing suitable alternatives in front of each of them (always, sometimes, rarely, I do not obtain), and numerical numbers were given to these alternatives, the following numerical values (4, 3, 2, 1) respectively, and thus the level of exposure to information sources is (7-28) degrees.
 - f. Farmers' trend towards using modern technologies: This scale was designed with statements, the total of which was (10) statements, of which (5) were positive and (5) were negative. A graduated scale consisting of levels (agree, neutral, disagree) was set for these statements, and the following values were given to them respectively for the positive statements, and (3, 2, 1) were given respectively for the negative statements, and thus those values expressing this variable were limited to (10-30) degrees.
- 7) Statistical methods: Statistical means program was used (SPSS), the statistical analysis software used in social science analysis, was employed, and several statistical methods were used to analyze this research and arrive at accurate and truthful results. [8]

3. Results and Discussion

1) **First goal:** Identifying the level of adoption of modern technologies by wheat farmers in Makhmur District / Nineveh Governorate: The values expressing the factors affecting the level of adoption of modern technologies by wheat farmers in Makhmur district were limited to (60-110), and the arithmetic mean of those needs was (88.05), with a standard deviation of (10.7). The respondents were divided through a distribution into three categories [2], as shown in Table (1) below:

Table (1) Level of adoption of modern technologies by wheat farmers in Makhmur District / Nineveh Governorate

T	Categories	Number	Average	Percentage	value
1	Low (60-76)	10	68.37	25	10.7
2	Average (77-93)	14	82.58	35	
3	High (94-110)	16	98.61	40	
	Total	3	100%		

This table shows (1) The lowest percentage of respondents fell into the first category, while the highest percentage fell into the third category, according to the averages. The level of adoption average, tending towards high, and the reason for the high may be the high cost of modern technologies is causing crop losses. ([9], [10]).

2) **Second goal:** Determining the correlation between the level of adoption of agricultural technologies and each of the personal variables of farmers, which are (age, educational level, type of land tenure, main source of family income, and attitude towards the use of modern technologies).

1. **Age:** The values representing the ages of the respondents were limited to between (24-62), they were divided into three categories as shown in Table (2)

Table (2) Distribution of respondents according to age groups

T	Categories	number	Percentage	arithmetic mean	Value RS	Statistical significance
1	low24-36)	19	20	2894	**0.956	moral
2	Medium (37-49)	13	45	4241		
3	high (50-62)	8	35	5337		
	Total	40	100%			

**The relationship is significant at the (0.01) level

Table (2) It shows us that the number of respondents in the age group (24-36) The year included (19) participants, representing (20%), and their average training needs amounted to (2894) While the number of individuals in the age group (35-47) years reached (13) respondents, constituting (45%), and the average reached Adoption level (4241). While the number of individuals in the third age group (51-62(35) participants, representing (35%), had an average training need of (4937), which indicates that the elderly category received the highest percentage .Use the ordinal correlation coefficient Pearson Which amounted to (** 0.956)Which tells us that there A significant correlation exists at the 0.1 level, therefore we reject the statistical hypothesis and accept the alternative hypothesis which states (there is a significant correlation between Level of adoption by farmers and factors affecting the agricultural technology process Age, and this may be due to following traditional methods and clinging to the old ways, which has resulted in an increase in their average training and knowledge needs and their need for intensive courses and experiences on the use of Modern technologies to increase productivity [11]

2. **Their academic achievement:** The respondents were divided into three categories according to their educational attainment, as shown in Table (3):

Table (3) the respondents according to their academic achievement categories

T	Categories	Number	Percentage	middle	value RS	Statistical significance
1	Illiterate	2	5	655.		
2	Reads	3	7.5	8.5		
3	Elementary	3	7.5	79,35	**0.474	moral
4	Medium	4	10	81.3		
5	Preparatory	6	15	85.39		
6	institute	8	20	89.50		
7	Bachelor's	12	30	94.20		
8	Higher degree	2	5	105		
Total		40	100%		.	

This table shows that (30%) are holders of a bachelor's degree and the lowest percentage (2%) are graduates of higher degrees, and literacy programs, and to find the correlation between adoption level academic achievement was assessed using the ordinal correlation coefficient. Spearman's value (0.474) is significant at a probability level of 0.01, therefore (the statistical hypothesis is rejected and the alternative hypothesis is accepted). This indicates that those with higher degrees are more receptive to using and building modern technologies [12].

3. **Production Means and Equipment:** The values representing production means and equipment were between (0-7), and the respondents were distributed according to their ownership of production means and equipment into three categories as shown in the table (4)

Table (4) The respondents according to categories of production means and equipment

T	Categories	number	Percentage	Average	value RS	Significance Statistics
1	Low 1-2	5	12.5	1.9		
2	Medium 3-4	16	40	3.57		
3	High 5- or higher	19	47.5	5.70	-143-	immaterial
Total		40	100%			

It becomes clear to us from table (4) that values (-143-) appears that value this is a non-significant relationship, and therefore we reject the alternative hypothesis and accept the statistical hypothesis which states (there is no significant correlation between level of adoption of modern technologies and factors affecting adoption [13].

4. **Readiness for change:** The respondents were divided into three categories according to their readiness levels, as shown in this table (5)

Table (5) Dividing the respondents according to categories of production means and equipment

T	Categories	Number	Percentage	Average	Value RS	Statistical significance
1	Low (1-2)	8	20	1.75		
2	Medium (3-5)	28	70	3.44	0.199	immaterial
3	high 7 or more	4	10	6.5		
Total		40	100%			

It is evident from the table (5) that values (0.199), this is a non-significant relationship, therefore we reject the alternative hypothesis and accept the statistical hypothesis which

states (there is no relationship) Correlation moral between Influencing Factors The level of adoption of modern technologies in the Makhmour district.

5. **Information sources:** The values that express The level of exposure to information sources was limited to what between (12-29). Moreover, the respondents were divided into three categories as shown in the table (6).

Table (6) the respondents according to their level of exposure to information sources

T	Categories	Number	%	average	value RS	Statistical significance
1	Low (12 -18)	12	30	12.69	*0.341-	moral
2	Medium (19-25)	21	52.5	20.77		
3	High (27-29)	7	17.5	26.654		
Total		40	100%			

* The relationship is significant at the (0.05) level.

This table (6) makes it clear that the highest percentage of respondents (52.5%) fell into the middle category. To find the correlation between training and knowledge needs and the level of exposure to resources, the ordinal correlation coefficient was used. Spearman, whose value reached (*0.341-This is a significant relationship at a probability level of 0.05. This indicates a significant correlation, and therefore we reject the statistical hypothesis and accept the alternative hypothesis which states (there is a significant correlation between level of adoption and factors affecting modern technologies and the level of farmers' exposure to resources in Makhmur district. This indicates that the more knowledge and exposure the respondents have to sources, the less training and knowledge they need [14].

6. **The trend towards adoption Modern technologies:** The values expressing the farmers attitude towards training and knowledge needs regarding the use of solar energy systems in Al-Sharqat district were limited to (12-26) as shown in this table (7).

Table (7) Dividing of the respondents, according to the categories of attitude towards Adoption level

T	Categories	Number	Percentage	Average	Value RS	Statistical significance
1	Negative (1 2-16)	14	35	1357	**-0.407-	moral
2	Neutral (17-21)	15	37.5	18		
3	Positive (22-26)	11	27.5	2758		

**The relationship is significant at the (0.01) level

It is clear from the table (7), the highest percentage of respondents (37.5%) were in the middle category, followed by (35%) in the low-trend category. To find the relationship, Pearson's correlation coefficient was used, with a value of (**-0.407-). It indicates a significant negative relationship at a probability level of 0.01. Therefore, we should reject the statistical hypothesis and accept the alternative hypothesis. This means that by increasing trend about adopting modern technologies and the less factors affecting adoption that may be happened because information and skills acquired by the participants are a result of dash the researcher aims to learn experiences and information that will help him to use technology correctly [2], [15], [16], [17], [18], [19].

4. Conclusion

4.1 **The reality of adopting modern agricultural technologies:** The results showed that the levels of adoption of modern agricultural technologies by farmers in Makhmur

district were in the medium category, which tends to be low; it is concluded from this that the phenomenon of adoption in the research area still faces limitations that prevent it from reaching the levels required to develop agricultural production.

- 4.2 **Economic and service-related factors affecting adoption:** The results showed that the most prominent problems that stand in the way of farmers and prevent them from adopting modern technologies are the high prices of these systems and devices and the difficulty of carrying out periodic maintenance operations for them; this conclusion is mainly attributed to the weakness of governmental and institutional support channels for modern production inputs in the research area.
- 4.3 **The role of independent variables in the adoption decision:** It has been shown that there are different correlational and significant relationships between the levels of adoption of modern agricultural technologies and some of the studied independent factors and variables related to farmers. We conclude from this that the decision to adopt is not only influenced by individual desire, but is governed by the characteristics of farmers (such as financial ability, landholding area, or age), which necessitates taking these differences into account when preparing agricultural policies and extension programs in the Makhmour district.
- 4.4 **The respondents' attitudes and stance towards adoption:** The results revealed that the largest group of farmers surveyed fell into the category of (neutral attitude) towards adopting modern technologies; this implies a state of hesitation, anticipation, or uncertainty about the feasibility of these technologies, indicating that farmers need intensive practical and field guidance activities (such as demonstration fields) to modify these attitudes and transform them into a driving force towards actual adoption.

FUNDING: This research received no external funding.

CONFLICT OF INTEREST: The author declares no conflict of interest.

ACKNOWLEDGMENT: The author would like to thanks Nineveh Agricultural directories for providing research data and all facilities to preparing this manuscript.

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