



## Research Article

# The Knowledge Level of Agricultural Extension Workers in the Climatic Changes Filed and Their Effects on Agriculture in Duhok Governorate, Iraq

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**Abstract** | The current research aimed to estimate the knowledge level of agricultural extension workers in the Domain of climate change in Duhok Governorate Furthermore, the correlation of knowledge degree among the agricultural extension workers was determined based on the following independent variables: (age, gender, upbringing, academic qualification, specialization, duration of service in agricultural extension, training courses, and the use of information sources in the Domain of climate change). The research population included 73 employees of the Directorate of Extension of Duhok. The designed questionnaire was consisted of two parts, first one included the personal, vocational, and communication variables of the respondents, and the second part included a knowledge test to measure the level of knowledge of agricultural extension workers in the Domain of climate changes. The data was analyzed by using the SPSS program to extract arithmetic averages and percentages, the simple correlation coefficient and rank correlation of Spearman. The results showed that the degree knowledge of agricultural extension workers in the Domain of climate change in general is moderate to high while high in the causes of climate change phenomenon. It was followed by the Domain of how to face the negative effects resulting from climate change, and finally the Domain of negative effects resulting from the phenomenon of climate change. The results also showed a significant correlation between the degree of knowledge of the respondents and each of the independent variables, (extension service duration use of information sources in the Domain of climate changes). On the other hand, there was no correlation between the degree of knowledge and each of the (age, gender, upbringing, academic qualification, specialization, training courses in the Domain of climate change). Focusing on the agricultural extension workers experiences.

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## Introduction

Agriculture plays a significant role in the Iraqi economy regarding to food production and animal nutrition. In addition, it contributes to national income and provides the capital for sustainability of agriculture. The demand for agricultural products has increased as a result of population growth, migration and change in consumer patterns of food. Therefore, it is necessary to the search for appropriate policies and mechanisms to advance agricultural production to confront the gap between production and consumption (Hussein, 2011).

High temperature accompanied by rains leads to increased humidity. This result in emergence of diseases and pests, which clearly affect agricultural production (Azooz and Talal, 2015). Climate change in the world. There are expected changes such as high temperatures, less rainfall, spread of diseases and pests, and increased fire risks. Climate change greatly affected by the conditions of implementation of agricultural activities and the intensification of plants, animals and ecosystems in every region of the world with the prevailing climatic conditions (Kirtman *et al.*, 2014).

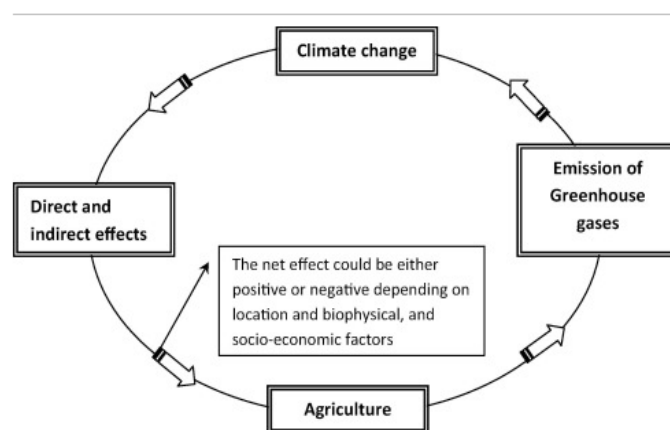
Climate change has become an important issue of concerns to the entire world which leads to effect on the various Domains of life, especially the agricultural sector. This sector is considerably affected and requires high attention due to the direct connection to the food security of any country. Therefore, it requires a direct researches and studies to face the effects of these changes (Issac, 2013: 277).

The World Food Summit of the Food and Agriculture Organization, Fisheries and Forestry confirmed that the land overexploitation and stress belong to several problems such as a desertification, logging, overfishing, loss of biological diversity and insufficient water uses. The climate change and its impacts remain one of the main reasons behind the instability of food production in recent years (Food and Agriculture Organization of the United Nations, 2001).

There is no doubt; the climate change is the main cause of fluctuations in production from year to year in both developed and developing countries. Food and Agriculture Organization (2009) predicted that there will be a sharp decline in cereal production in

developing countries. Additionally, it expected that the decrease average in production in developing countries will be about 10 percent. Similarly, there will be 2-3 percent decline in cereal production in Africa in 2020. Therefore, this is predicted to be sufficient to display about 10 million people to the risk of starvation (Defrance *et al.*, 2020).

Changes in climatic factors (for example, temperature and precipitation) affect agricultural productivity through physiological changes in crops as shown in Figure 1 (Chakraborty and Tiedemann, 2000).

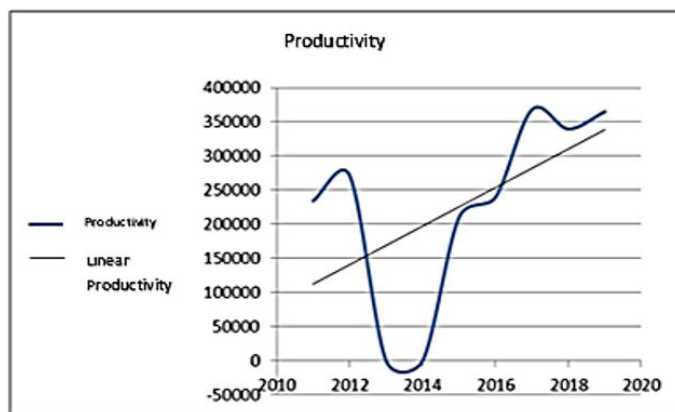


**Figure 1:** Interrelationship between climate change and agriculture (Chakraborty and Tiedemann, 2000).

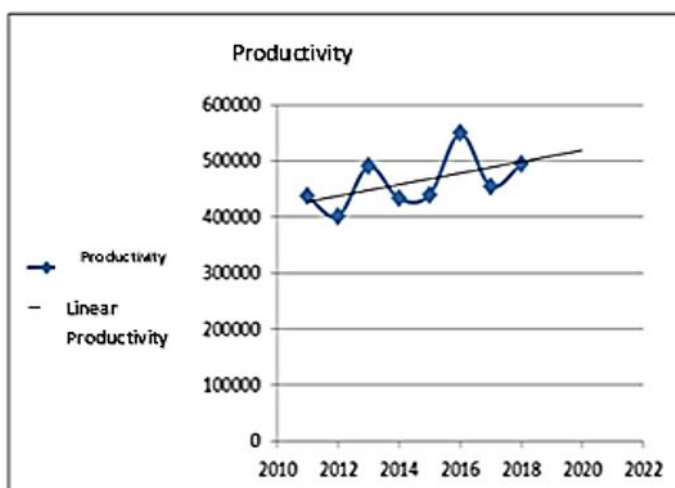
Climate change fluctuations in the region including Iraq have affected many components of the ecosystem related to the cultivation and production of strategic crops and their impact on the food security of the country (Saad *et al.*, 2016).

The population increase, the industrial revolution, and the increase in human activities that need fuel, such as coal and oil, have greatly increased. Consequently, it has led to an increase in the proportion of gases and pollutants in the atmosphere in a manner that exceeds the ability of the ecosystem to absorb and proportion rise of these pollutants in the composition of the atmosphere (Al-Shammari, 2017).

The Duhok Governorate is considered one of the rain-guaranteed Domains, an active and productive agricultural region. However, it was observed the productivity variation of summer and winter vegetable crops as a result of climate changes and their fluctuation nine years ago as a result of climate change, as shown in Figures 2 and 3.



**Figure 2:** Shows the productivity of Sumer crops and vegetables for several years.



**Figure 3:** Shows the productivity of winter crops and vegetables for several years.

Data of Dohuk Agriculture Directorate for the production of winter and summer crops for the period 2010-2019.

Shideed and Mohammad (2006) stated in the report issued by panel on climate change the importance roles of agricultural employees in developing agriculture and achieving sustainable agricultural and rural development. Therefore, is necessary to know the level of their knowledge in climatic changes filed.

Additionally, it should provide food and achieve sustainable development for future generations and find alternative solutions to farmers with every change in agriculture, whether environmental or technical.

#### *Objectives of the study*

The main objectives of this study is to:

- To identify the knowledge level of agricultural extension workers in the Domain of climate changes in general in Duhok Governorate.
- To identify the knowledge level of agricultural

extension workers for each Domain and a clause of climate change Domains according to the degree of their knowledge of them.

#### *Research hypotheses*

In order to achieve the fourth objectives, the alternative research hypothesis was formulated for all variables to ensure their validity or not as follows:

There is no positive correlation between the degree of knowledge of agricultural extension workers in the Domain of climate change and some personal, vocational, and communication characteristics of the agricultural extension workers in Duhok Governorate.

#### *Procedural definitions*

**The knowledge level of agricultural extension workers in the domain of climate change:** It means the degree knowledge of the agricultural extension workers in Duhok in the Domain of climate change which expressed in numerical values.

**Agricultural extension workers:** They are employees working in the directorate of agricultural extension in Duhok and have certificate in agriculture obtained from agricultural schools, agricultural institutes, and agricultural colleges in different specialties and have experience in the Domain of extension work.

**Climate changes:** It means all the changing weather conditions that affect agricultural output positively and negatively.

#### **Materials and Methods**

The research was carried out in Duhok Governorate/ Iraq, where the agricultural employees working in the agricultural extension.

They are in charge of providing extension services to farmers of all their positions and job specializations. The research community consisted of (73) employees, the questionnaire form was distributed to a sample of community members, and to measure the reliability of the questionnaire, 12 employees were selected. For the purpose of collecting data for the research, a questionnaire was prepared that consisted of two parts: First part was prepared to measure the personal, vocational, and communication variables of the employees working in the Directorate of Agricultural Extension of Duhok.

Information sources in the Domain of climate change measured through three-step scales. The second part of the form measured the level of knowledge which included three cognitive axes. The reliability of the test was calculated by applying the Kuder-Richardson equation to the same sample mentioned above. The reliability coefficient of the instrument was 0.88 and the validity coefficient is 0.93. This indicates that the high stability of the test and that the vertebrae are perfect which can be adopted in the measurement.

## Results and Discussion

Prescribing some personal, vocational, and communication characteristics of agricultural extension workers in Duhok Governorate.

**Table 1** represents the distribution of the respondents according to personal, vocational and communicative characteristics: Age. The respondents were distributed into three categories based on the range and length of the category. The table shows an increase in the average ratio of age group (40-52 years) where it reached to (47.54%). Then, the young age group (27-39 years), (37.70%). While the old age group (53-65 years) it reached to 14.75% which is the lowest percentage.

Regarding to the gender, the respondents were divided into two categories, where it appears that the male category formed the higher than the female, which the percentage reached to 67.21%, and 32.79%, respectively.

Considering the education level, the respondents were divided into four categories, namely: Graduates of the College of Agriculture made up the highest percentage of respondents, graduates of an agricultural institute, a high degree and agricultural high school graduates which reached to 73.77%, 11.48%, 8.20% and 3.8%, respectively.

Regarding to upbringing, the respondents were divided into two categories, where it appears that the urban group formed the highest percentage, with a percentage of 59.02%, while the rural category reached the lowest percentage, representing 40.98%.

Related to specialization, the respondents were divided according to their specialization into two categories, other specialties (non-agricultural extension specialists) reached the highest percentage (83.61 %,) while the lowest percentage of agricultural extension specialists was (16.39%).

**Table 1:** *Distribution of respondents according to personal, vocational and communication characteristics.*

No	Variables	Categories	Number	Percentage
1	Age	27-39 years	23	37.7
		40-52 years	29	47.54
		53-65 years	9	14.75
2	Gender	Male	41	67.21
		Female	20	32.79
3	Education Level	Agricultural Secondary	4	6.56
		Agricultural Institute	7	11.48
		College of Agriculture	45	73.77
		Higher diploma	5	8.20
4	Up bringing	Rural	25	40.98
		Urban	36	59.02
5	Specialization	agricultural extension	10	16.39
		non-agricultural extension	51	83.61
6	Duration of service in agricultural extension	1-8 years	30	49.18
		9-16 years	21	34.43
		17-24 years	10	16.39
7	Previous Training	Yes	16	26.23
		No	45	73.77
8	Sources of information in the Domain of climate change	18-29 Source	12	19.67
		30-41 Source	35	57.38
		42 or more	14	22.95



For the duration of service in agricultural extension, the respondents were divided into three categories. The highest percentage reached 49.18% for the category (1-8 years) followed by 34.43% for the category (9-16 years), while the lowest percentage reached to 16.39% for the (17-24 years) category.

Regarding to previous training in the Domain of climate change, the untrained respondents were 73.77%, and that the trained respondents had a percentage of less than that, 26.23%.

Finally, the sources of information in the Domain of climate change, the percentage of respondents whose sources of obtaining information was an average degree for a category (30-41 degrees) amounted to 57.38 which is the highest percentage.

Then the high category was (42 degrees or more) at 22.95%, while the lowest percentage reached 19.67% for the category of less-used sources (18-29 degrees) of the total sample population as shown in [Table 1](#).

To identify the knowledge level of agricultural extension workers in the Domain of climate changes in general in Duhok Governorate.

The respondents were distributed according to their cognitive level, using the method of range and length of the group into three categories. The results showed that (9) respondents represented (14.8%) of the

number of respondents which their level of knowledge was weak. Whereas, (18) respondents represented (29.5%) of the number of respondents which the level of knowledge was average. the highest was respondents (34) represented the highest rate (55.7%) of the number of respondents and therefore their level of knowledge was high as shown in [Table 2](#).

**Table 2:** *Distribution of respondents according to the level of knowledge in the Domain of climate change in general.*

Categories	Number	Percentage	Mean
Low 17-26 degrees	9	14.8	22.7
Moderate 27-36 degrees	18	29.5	33.2
High 37 degrees or more	34	55.7	43.4
Total	61	100%	

The lowest value is 10, the highest value is 47, the mean is 37.377, and the standard deviation is 8.159.

[Table 2](#) illustrates the majority of respondents had a high level of knowledge (55.7%). This may be attributed to the reasons for the cognitive communication of information sources and the use of social media to enrich the cognitive level.

As a result of the work requirements in the extension Domain and they have training courses which includes keeping abreast of everything new solving the crises facing work in the agricultural sector. This has had a positive impact on their high level of knowledge.

**Table 3:** *Distribution of the respondents according to the degree of knowledge in the domain of climate changes in each of its domains.*

	Categories	Number	%	Mean	Mean	Rank
First domain						
Causes of climate change phenomenon	Low 8-11 degrees	10	16.4	9.9	15.72	1
	Moderate12-15 degrees	17	27.9	13.5		
	High 16 degrees or more	34	55.7	18.6		
	Total	61	100			
Second domain						
The negative effects caused by climate change phenomenon	Low 3-5 degrees	5	8.2	4.0	8.98	3
	Moderate 6-8 degrees	17	27.9	7.2		
	High 9-11 degrees	39	63.9	18.6		
	Total	61	100			
Third domain						
How to face the negative effects of climate change	Low 4-7 degrees	9	14.8	5	12.78	2
	Moderate 8-11 degrees	10	16.4	4.7		
	High 12-15 degrees	42	68.9	14.8		
	Total	61	100			

**Third:** Identifying the knowledge level of agricultural extension workers for each Domain and a clause of climate change Domains according to the degree of their knowledge.

**Table 3** indicates that the Domain (the causes of climate change phenomenon) has ranked first among the Domains of climate change with an average score of (15.72). This refers to that the majority of agricultural employees possess high knowledge in this Domain due to internet exploring knowledge. As well as, the climate change has become a phenomenon of the times, there are a large number of media explaining climate change causes on account of the human misuse of the environment and reflects negatively impact on the climate. Consequently, agricultural employees' knowledge has increased in this Domain. Additionally, they search in causes and how to reduce their negative effects because they provide extension services to farmers, and thus so they must follow environmental changes to develop the agricultural sector.

The domain (The negative effects caused by climate change phenomenon) ranked second with a moderate 8.98 arithmetic mean. This shows that most of the respondents possess knowledge in this Domain. Moreover, the employees who work in agricultural extension have increased their awareness to know how to face the effects of climate change and realize the extent of its impact on the agricultural side. Therefore, they resort to developing their knowledge to face the risks that result from climate changes. While the Domain of (How to face the negative effects of climate change) ranked the last grade with an arithmetic mean of (12.78) degrees. This reflects the need of agricultural employees for training and educational programs on the negative effects that result from climate changes and its negative impact on agriculture. In addition to how to address these changes in the use of resistant varieties and other treatments in the agricultural Domain as shown in **Table 3**.

**Table 4** illustrates that the items that are located in the last ranks in the Domains of research are a items (burning fossil fuels) in the Domain of causes of climate changes, a items (the spread of bushes and the growth of wild reeds in some agricultural Domains) in the Domain of negative effects resulting from the phenomenon of climate changes, and a

items (Adding some organic compounds to make plants more tolerant of salinity conditions or high and low temperatures such as humic acid and amino acids) in the Domain of how to counter the negative effects resulting from climate changes. These indicate that the agricultural extension workers have lack of knowledge of these causes and effects and how to counteract the negative effects of climate changes and their impact on agriculture.

**Fourth:** Determining the correlation between the degree knowledge of agricultural extension workers in the Domain of climate changes according to the following independent variables (age, gender, upbringing, education level, specialization, duration of service in agricultural extension, training courses in climate change, and sources of information on changes **Table 5**.

For the purpose of determining the correlation between the degree of knowledge and the following variables, the simple correlation coefficient of Pearson and spearman rank correlation were used: Age gender education level upbringing specialization previous training in the Domain of climate change phenomenon and use information sources in the climate change. Where the results showed that there was no significant correlation between age and degree of knowledge. On the other hand, the results showed that there was a significant correlation between the extension period variable and the use of information sources. This may be due to the cumulative experience resulting from working for many years.

This leads to a significant increase in knowledge that the individual possessing as a result of learning by doing. This generates a high knowledge of how to deal with climate changes, especially problems that may arise during every volatile agricultural season in which the weather conditions. Therefore, it was reflected on the role of employees in their knowledge acquisitions and levels. This is because of their continuous communication with information sources, the internet, and seminars that would increase the cognitive storage of individuals. This leads positively effect on their work.

Spearman rank correlation also used the correlation coefficient between the degree of knowledge and each of the following variables: Gender education level upbringing career specialization previous training in

**Table 4:** Arrangement of test items according to the arithmetic mean of the degree of knowledge of climatic changes for the employees of the Duhok agricultural extension staff.

Nos.	First Domain: Causes of climate change phenomenon	Mean	Rank
1	The risk of logging	0.90	2.5
2	Toxic gas emissions from factories	0.90	2.5
11	Smoke from car exhaust	0.90	2.5
12	Smoke from electric generators	0.90	2.5
5	Risks of excessive use of chemical fertilizers	0.89	5.5
18	Forests subjected to burning and unjust cutting	0.89	5.5
3	Smoke from burning agricultural waste	0.87	7.5
7	Gases from organic pollutants	0.87	7.5
4	Smoke from burning household waste	0.85	9
10	Smoke from agricultural machinery exhausts	0.84	10
6	Risks of excessive use of agricultural pesticides	0.82	11.5
17	Knowledge of natural factors beyond human control	0.82	11.5
14	Increase the number of factories	0.75	13.5
15	Changes in atmosphere components (increased ozone hole)	0.75	13.5
19	The dangers of poaching	0.74	15
16	Frequent floods due to high levels of river water or heavy rain	0.69	16
8	The risks of transportation within villages	0.67	17
9	Agricultural equipment is not regularly maintained	0.64	18
20	Biodiversity loss	0.59	19
13	Burning fossil fuels	0.44	20
<b>Second Domain: The negative effects caused by climate change phenomenon</b>			
1	Agricultural production decreased	0.95	1
4	Prevalence of disease-carrying pests and insects	0.89	2
11	Drought prevalence, less rainfall and lack of drinking water.	0.87	3
2	Decreased soil fertility	0.85	4
5	Lack of water resources	0.82	5.5
9	The spread of desertification and the lack of vegetation	0.82	5.5
3	Soil erosion and erosion exacerbation	0.79	7.5
7	Changing planting dates	0.79	7.5
6	Change the geographical distribution map of agricultural crops	0.77	9
8	Increased water requirement for crops	0.74	10
10	The spread of weeds and the growth of wild reeds in some agricultural Domains	0.70	11
<b>Third Domain: How to face the negative effects of climate change</b>			
10	Planting drought-resistant trees to reduce climatic changes associated with high temperatures	0.87	1
2	Irrigation in the appropriate times and with the appropriate amount of water, depending on the irrigation methods based on the sensors	0.85	2
1	Changing planting dates to suit new weather conditions	0.80	4
3	Attention to finding alternative irrigation sources such as drilling underground wells and relying on a few irrigations with close periods to reduce drought	0.80	4
9	Leave appropriate agricultural distances when planting crops	0.80	4
5	Reducing the cultivation of wasteful crops from water consumption	0.79	6
13	Increase the amount of vegetation	0.77	7
15	Planting windbreaks before you start planting crops	0.75	8
6	Cultivation of drought tolerant varieties	0.74	10

Table continued on next page .....

Nos.	First Domain: Causes of climate change phenomenon	Mean	Rank
7	Devising new varieties that can withstand high temperatures	0.74	10
12	Relying on clean energy (solar, water and wind) to reduce gas emissions from using fuel.	0.74	10
8	Devising new varieties with a short growing season	0.70	12.5
14	Activating environmental conservation laws that govern the consumption of environmental pollutants and maintain the agricultural environment.	0.70	12.5
4	Add some of the chemical compounds that work to break dormancy in the plant that need to be cooler in the winter for the occurrence of flowering.	0.64	14.5
11	The use of modern agricultural methods based on the principle of reducing tillers such as zero tillage to reduce water consumption	0.64	14.5
16	Add some organic compounds to make plants more tolerant of salinity conditions or high and low temperatures such as humic acid and amino acids	0.59	16

**Table 5:** shows the relationship degree of knowledge in the Domain of climate change for the staff of Duhok agriculture and some personal characteristics and vocational.

No	Variables	Person correlation	Spearman rank correlation	Sig value	significant level
1	Age	0.193		0.497	N.S
2	Gender		0.089	0.497	N.S
3	Education level		0.131	0.315	N.S
4	Up bringing		0.154	0.236	N.S
5	Specialization		0.064	0.622	N.S
6	Duration of service in agricultural extension	0.315		0.013	*
7	Previous training		0.230	0.074	N.S
8	Use information sources in the climate change	0.254		0.049	*

Morale at 0.05

the Domain of climate change phenomenon and use information sources in the climate change. The results showed that there was no significant correlation between the degree of knowledge and these variables.

## Conclusions and Recommendations

- The majority of respondents possess high knowledge. This may be attributed to the reasons for the cognitive communication of information sources and the use of social media to enrich the cognitive reservoir.
- The high awareness in the Domain of the causes of climate change phenomenon as a result of the respondents' knowledge of the sources of information because of its association with their business to develop work in the agricultural Domain.
- Lack of information of respondents on the causes of the phenomenon of changes in the Domain of the causes of climate change phenomenon. Also, there is a limit knowledge of the items of burning fossil fuels as a result of their lack of some

scientific concepts related to this phenomenon. In addition, the Domain of negative effects resulting from climate changes, they were in an items (the spread of bushes and the growth of wild reeds in some agricultural Domains). This indicates their knowledge to a small degree of its impact on the spread of bushes, especially wild reeds, being a difficult to remove bush.

- Furthermore, there are lack of their knowledge in the Domain of how to face the negative effects resulting from climate changes with items (adding some organic compounds to make plants more tolerant to salinity conditions or high and low temperatures such as humic acid and amino acids).
- The high level of knowledge of agricultural extension workers as a result of high experience in the Domain of agricultural extension. In addition, the increase use of information sources as a result of the technological revolution, which has had a positive impact by increasing the outcome of their scientific knowledge in this Domain.



- There are factors that have shown their relationship in the Domain of climatic changes, specifically the duration of the extension service and the use of information sources in the Domain of climatic changes, while they did not appear with the rest of the other variables.

Accordingly, the researcher recommends the following:

- Focusing on the agricultural extension workers experiences and adapting them in the Domain of climate changes Crisis.
- Forming extension teams that contribute to providing extension services to farmers because they are the most closely involved category in agriculture by advising them at every stage of the cultivation.
- Agricultural extension workers should participate in training courses in the Domain of climate change to expand scientific horizons.
- Benefiting from the experiences of agricultural extension workers and adapting them to preparing training and educational programs in the Domain of climate change.
- The necessity of taking into consideration the differences between the workers in agricultural extension in terms of their scientific experience in the Domain of climate changes and the diversity of their knowledge.

## Novelty Statement

This manuscript considers one of the first research done in this area to clarifying knowledge level and awareness of agricultural extension workers in the climatic changes effect on agriculture.

## Author's Contribution

**Hashem Saeed Murad:** Prepared questionnaire, assisted in data analysis and wrote the manuscript.

**Salah Jassem Amin:** Helped in questionnaire and writing.

**Rawa'a Muhammad Al-Chalabi:** Analysed and assisted in questionnaire.

**Mahmood Khalaf Wasmi:** Collected the data and helped in writing.

**Sundus Salim:** Collected the data.

## Conflict of interest

The authors have declared no conflict of interest.

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