OPEN ACCESS Int. J. Agr. Ext. 10 (01) 2022. 101-115 DOI: 10.33687/ijae.010.01.3892

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Available Online at EScience Press

International Journal of Agricultural Extension

ISSN: 2311-6110 (Online), 2311-8547 (Print)

https://esciencepress.net/journals/IJAE

TRAINING NEEDS OF AGRICULTURAL EXTENSION AGENTS REGARDING CLIMATE CHANGE IN EGYPT

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ARTICLE INFO

Article History

Received: December 11, 2021

Revised: January 16, 2022

Accepted: March 09, 2022

Keywords

Needs

Training

Climate change-

Agricultural extension

Extension role

Kafr El-Sheikh

ABSTRACT

This study aimed to identify the training needs of agricultural extension agents in the Kafr El-Sheikh governorate regarding climate changes, their sources of knowledge, the role they played, and the challenges that hindered their role coping with climate changes. Data were collected through a questionnaire from 105 respondents from August to September 2021. Findings unveiled that 55.2% of the respondents fell into the age group 48-54 years, 81.9% of respondents had University Education, and 81.9% of respondents were specialized in agricultural extension. Colleagues were the most important sources of information about climate changes for the respondents., Newspapers, magazines, and radio programs came in lagging ranks as an information source. The results further showed that the respondents had good knowledge about climate change. Agricultural extension agents have undertaken many activities to reduce the negative effects of climate change including, raising farmers' awareness about the dangers of burning agricultural waste 67.6%, the importance of preserving and maintaining natural resources 61%, and the importance of planting adapted varieties to climate change 2.55%. The most important obstacles facing the respondents were the difficulty of accessing weather information promptly, lack of training courses, and lack of a clear extension policy to confront this phenomenon.

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INTRODUCTION

Climate change is one of the most prominent contemporary environmental challenges and one of the global phenomena that have far-reaching effects on various sectors, especially the agricultural sector (IPCC, 2014; Rymbai and Sheikh, 2018; Islam and Zhang, 2019). About 2.5 billion people who earn their livelihood partially or completely from agricultural production are affected by climate change (Ali *et al.*, 2017). Therefore, climate change is considered to be the greatest environmental challenge of the current century. In response to the emerging changes related to climate change, the Intergovernmental Panel on Climate Change (IPCC) was established in 1988 (Parry *et al.*, 2001). Climate change, according to IPCC refers to a change in the average weather or a change in its characteristics such as temperature, precipitation, and winds in a particular area for a long period that may extend for decades (IPCC, 2014). This phenomenon is due to several reasons, including those related to natural phenomena or human activities (Islam and Zhang, 2019).

Fahey *et al.* (2017) pointed out some factors that contributed significantly to the fluctuations of the climate system, such as changes in the intensity of sunlight, the expansion of burning fossil fuels, deforestation, greenhouse gas emissions, urbanization, and agricultural activities, and increase the population. Studies indicate that the Earth's temperature has increased at a rate of 0.1 degrees Celsius per decade over the last fifty years in the last century (Jotzo, 2003). The Intergovernmental Panel on Climate Change has predicted that the Earth will rise at a rate of 1.5°C to 5.8°C by the year 2100 (IPCC, 2014). Therefore, concerted efforts must be made to reduce greenhouse gas emissions, which are responsible for global warming through the rationalization of human activities, including agricultural activities and deforestation, as it is believed that they are responsible for about 15% of anthropogenic greenhouse gas emissions today (Ozor and Nnaji, 2011). Climate variability has a serious impact on agricultural production and food security locally and globally (Hatfield *et al.*, 2011). Although developing countries contribute only 10% of carbon dioxide emissions, they are the most affected by these climate changes (IPCC, 2014). Because of the fragility of the economic conditions of the rural people, their limited ability to adapt, and their heavy dependence on natural resources (Ho and Shimada, 2018). Climate changes such as changes in rainfall rates, temperature changes, floods, droughts, and hurricanes have negative impacts on agricultural production (Shakoor *et al.*, 2011). High temperatures, for example, can hinder the ripening of crops. It also harms the pollination process and the ripening of fruits (Schlenker and Roberts, 2006). Also, a decrease in rainfall rates will lead to a decrease in soil moisture and an increase in salt concentrations, especially in rain-dependent regions (van Duinen *et al.*, 2014). These effects pose a serious threat to agriculture and farmers, especially smallholders, leading to reduced productivity and increased costs (Vaghefi *et al.*, 2015). This will certainly have negative social and economic repercussions (Lewis *et al.*, 2018).

Climate change and Egyptian food security

Egypt is located in the northeastern corner of Africa, between latitudes 22° and 32°N, and between longitudes 24° and 37°E. The total area of Egypt is 1,001,450 km^2. (Omran, 2017). Egypt is characterized by a hot, dry climate in summer and moderate winter, with relatively low and erratic rainfall. Egypt ranks 110 globally in terms of the severity of its vulnerability to climate change (it is noted that the order is descending from least affected to most affected) according to the ND-GAIN Country Index rank, a measure that reflects the country's vulnerability to climate change. Egypt is considered one of the countries most affected by climate change, even though it produces less than 1% of global greenhouse gases. (UNFCCC, 2010). At the forefront of the sectors that will be affected by climate change is the agricultural sector, on which 50% of Egyptians depend as a source of income, and it represents 20% of exports (Siam and Fayad, 2009). Scientists expect a sea-level rise of about 70 cm by the end of this century, which will lead to the sinking of a large part of the best fertile agricultural lands in the delta, as Egypt will lose 12%-15% of these lands (Elsharkawy *et al.*, 2009). In addition to harming the neighboring lands with the rise in the water level of the lands and the increase in salinity in the water and soil. As for the expected effects of climatic changes in the event of an increase in temperature, some studies have indicated that an increase in temperature of 3.5 degrees Celsius, for example, will negatively affect the productivity of most crops, as it will lead to a decrease in productivity. Wheat and barley by about 18% and an increase in water consumption by 2.5%, as well as rice, whose productivity will decrease by about 11% and its water consumption will increase by 16%. and its returns (Fawaz and Soliman, 2015).

Hence, climatic changes will have negative effects on the efficiency of the agricultural sector in achieving food security, mainly due to the increase in water consumption of crops, increase in evaporation, and an increase in the spread of insects and agricultural pests, which leads to a decrease in productivity, and livestock will also be negatively affected by these changes, which is represented by reducing the growth rates for cows and poultry and increasing the spread of common diseases such as foot and mouth disease, bird flu, etc. (Abu-Hadid, 2010). In addition to the expected social and economic effects, such as labor migration from coastal areas (Central Administration for Climate Change, 2018). The total value of the negative effects of climate change on agriculture is estimated at $10.7 billion by 2030 (Siam and Fayad, 2009). As part of Egypt's endeavor to achieve the United Nations Sustainable Development Goals 2030, which stipulates the need to take urgent measures to address climate

change and its effects (United Nations, 2015). The Ministry of Agriculture has adopted several axes to reduce the negative effects of climate change, including the expansion of the development of new non-vulnerable varieties for water consumption, the development of field irrigation, the provision of early ripening seeds, and the focus on the role of agricultural extension and its support to confront this phenomenon (Ministry of Agriculture and Land Reclamation, 2009).

Climate Change Strategies

The literature on climate change indicates that there are two main ways to reduce the negative effects of climate change, the first is to try to mitigate greenhouse gas emissions (Mitigation), and the second is to adapt to climate changes (Adaptation) (IISD, 2012). The strategy of mitigating emissions using clean energy sources can be implemented by relying on some innovations such as windmills, solar cell / photovoltaic panels technology, etc (Santos *et al.*, 2020). Adaptation is also an important response to reduce the negative effects of climate change (Ho and Shimada, 2018). The degree of vulnerability of the agricultural sector to climate change depends on the adaptive capacity of farming communities (Gbetibouo, 2009). The adaptation literature has presented various options for adaptation strategies, including options at the farm level such as crop diversification, selection of appropriate cultivars, changing planting dates, and soil and water conservation practices (Kassie *et al.*, 2015) and options related to market responses such as income diversification, credit schemes, and better use of capital, and others related to institutional changes especially government responses such as the development of new crop varieties, subsidies and taxes, use of modern technologies for harvesting and water management (Rymbai and Sheikh, 2018). However, the availability of adaptation tools is limited in developing countries compared to those in developed countries, so the adaptive strategy differs from one country to another. However, farmers need to overcome many barriers that hinder their implementation of these adaptation practices such as lack of financial resources, lack of participation in making decisions, and insufficient information on climate change (Yiran and Stringer, 2017), And perhaps not being convinced at all of the feasibility of these practices, so it must be emphasized that adapting to climate changes requires a change in people's knowledge and skills to help build their ability to meet this challenge. This change falls primarily on the agricultural extension agencies in cooperation with the relevant authorities.

The role of agricultural extension in facing the phenomenon of climate change

Farmers' adoption of adaptation measures depends on various economic, social, and environmental factors. This adaptation requires the participation of actors, especially agricultural extension, which is considered one of the most important official institutions that play a crucial role in supporting agriculture and achieving food security (Rickards *et al.*, 2018). It is the responsibility of this institution to reduce the knowledge gap for farmers and work to increase their awareness of the options and opportunities available to reduce the effects of climate change (Afsar and Idrees, 2019). Agricultural extension represents the link between research institutions and farmers. This role has become more important in light of climate change and its impact on agriculture. Therefore, the agricultural extension must provide farmers with information and new techniques on how to mitigate and adapt to climate changes in the form of technological packages that focus primarily on high-yielding varieties. Resistant to disease and drought (Ndiritu *et al.*, 2014). The role of agricultural extension is to bring together stakeholders from producers, researchers, and extension workers to discuss climate-related issues and provide solutions to the threat of climate change (Oladele and Tekena, 2010). Extension efforts should therefore be directed towards enhancing farmers' capacity to manage such risks and educating them about their adaptation options (IPCC, 2014). This is achieved by enhancing access to information and technologies, enhancing agricultural skills and practices, and providing various rural development solutions in coordination with organizations related to the rural community (Davis and Heemskerk, 2012). Therefore, agricultural extension systems, especially in countries most vulnerable to the risks of climate change, must realize that integrating climate changes into their programs is not a luxury, but rather a necessity imposed by the current situation (Al-Sinawi *et al.*, 2015). For the agricultural extension to play its role in helping smallholders effectively manage and adapt to climate change, it is necessary to first understand the training needs of extension agents concerning climate change (IFPRI FORUM, 2005). It is also important to identify the obstacles to their role in

this field and the solutions they propose to accomplish this task. Hence this paper addresses this important gap.

Objectives of the study

This study mainly aimed to identify the training needs in the field of climate change for agricultural extension workers in Kafr El-Sheikh Governorate, through achieving the following sub-objectives:

- To identify the training needs of agricultural extension workers in terms of the causes of climate change, their manifestations, and the effects.
- To determine the most important sources of respondents' information about the phenomenon of climate change.
- To identify the role of agricultural extension in facing the phenomenon of climate change.
- To identify the most important obstacles for agricultural extension to play its role in facing the phenomenon of climate change.
- To identify the proposals of the respondents to confront climate change.
- To study the relationship between the level of training need of the respondents in the field of climate change and the studied independent variables.

The study hypothesis

There is no correlation relationship between the studied independent variables and the level of training needs for the respondents in the field of climate change.

METHODOLOGY

This study was conducted in Kafr El-Sheikh Governorate, because it is one of the governorates most exposed to the risk of climate changes, especially the risks resulting from rising sea levels and the possibility of its lands being exposed to salinization. The Governorate (Figure 1) is located in the far north of the Arab Republic of Egypt between the two Nile branches along (100 km) on the Mediterranean coast.

It is bordered in the west by the Rashid Branch with a length of (85 km), in the east by the Dakahlia Governorate, and in the south by the Gharbia Governorate. The area of Kafr El-Sheikh Governorate is (3466.7 km^2). Its population is 3,478,753 in 2020, and the governorate is divided administratively into 10 administrative centers.

Figure 1. Delta Governorates, showing Kafr El-Sheikh Governorate.
Source: http://www.kafrelsheikh.gov.eg/SitePages/default.aspx

Study population

The study population represented all agricultural extension workers working in the governorate, who were 105 extension agents distributed over the ten districts in the governorate. It was possible to complete the research data from all of them.

Data collection and analysis method

Data were collected using a structured questionnaire through personal interviews with the respondents during

August and September 2021. The questionnaire included five main sections: The first section: includes a set of questions about some of the personal characteristics of the respondents. The second section also included questions about the sources from which the respondents derive their information about climatic changes. The third section contained questions related to the knowledge needs of the respondents regarding the causes and manifestations of climatic changes and their effects on food security, soil and water, and their environmental, economic, and social impacts. This variable was measured by giving each respondent one score in the case of knowledge and zero in the event of not knowing, and the total scores of each respondent were subtracted from the total score of the scale to express the degree of his knowledge need. The fourth section included questions related to the activities carried out by the surveyed extension workers with the farmers, which express the actual role of agricultural extension in facing the phenomenon of climate change. The fifth section was about the most important obstacles to agricultural extension's role in confronting this phenomenon, while the last section deals with the respondents' proposals to confront this phenomenon. Frequencies, percentages, arithmetic mean, weighted mean, standard deviation. and chi-square, were used to analyze data.

RESULTS AND DISCUSSION

First: The Socio-economic characteristics of the respondents

The results (Table 1) indicated that the majority of the respondents were over 48 years old, as 55.2% of the respondents were in the age group of 48-54 years, and 29.5% of the respondents were in the age group of 54 years and over, which is a crisis facing the Extension organization in Egypt. It must be confronted by appointing new mentors capable of giving and giving and adding to the organization and the farmers. These results are consistent with the findings of Hanan *et al.* (2016) in their study of agricultural extension agents' knowledge about climate changes, which was conducted in the governorates of Kafr El-Sheikh, Sharqiya, and Gharbia, which indicated that 63% of the respondents have over than 46 years. As well as a study by El-Hamouli *et al.* (2019) about the training needs of agricultural extension agents in Kafr El-Sheikh governorate and their impact on fish production, which indicated that 73% of the respondents were in the age group of 50-59 years, which reflects the high age levels and the erosion of the extension organization at the level Republic. The educational levels of agricultural extension agents affect the quality of the extension service provided. In this context, the results indicated that the majority of respondents (81.9%) have a university education, which is a good indicator that can be used to support extension work in the region. These results are in the line with what was mentioned by Fabusoro *et al.* (2008) where the vast majority of the respondents were highly qualified, which they considered as an indication that the extension agents in the region are culturally qualified to perform the roles assigned to them and made them more able to understand and disseminate the concepts of climate-smart agriculture among the farmer. The results also indicated that 81.9% of them were specialized in agricultural extension and that 84.76% of them had a rural upbringing. The majority of the respondents had a great experience in extension work with an average of 19.6 years. This experience is likely to enhance their understanding of agricultural practices related to climate change and thus pass on to the target audience according to Oladele (2011).The results also indicate an increase in the scope of supervision, where the average supervision reaches 2353 Feddan, which is a large area that requires a lot of time and effort to cover, but the shortage of extension agents and the expansion of the scope of supervision will eventually lead to a weakness in the efficiency and effectiveness of any extension efforts over time.

The results also indicate that 25.7% of the respondents were not full-time for the extension work, and this may be due to the low level of salaries in a way that does not suit the nature of the extension work. The results indicated that 84.76% of respondents did not attend any training courses about climate change, and this reflects a shortcoming in the role of agricultural extension in training its affiliates on an urgent issue at present, especially in Kafr El-Sheikh Governorate. Poor training is a problem facing extension systems in developing countries in light of its limited resources and poor budgets, Okwoche *et al.* (2011) stated, for example, that agricultural extension agents in Nigeria did not receive adequate training on climate change and environmental conservation, so the extension organization should focus on retraining the extension staff to acquire professional skills and competencies New to Climate Risk Management (Ozor and Nnaji, 2011).

Table 1. Socio-economic characteristics of the respondents (n = 105).

Variables	N	%	Mean	SD
Age				
under 48 years old	16	15.24		
(48-54 years old)	58	55.24	51.8	4.4
(more than 54)	31	29.52		
Educational level				
Intermediate education	12	11.43		
University degree	86	81.90		
Postgraduate	7	6.67		
Specialization				
Agricultural Extension	86	81.9		
Other	19	18.1		
Growing up	28	26.7		
rural	89	84.76		
urban	16	15.24		
Agricultural experience				
Less than 16 years	16	15.24		
16 – less than 22 years	61	58.09	19.6	4.1
22 years and over	28	26.67		
Supervision area				
Less than 2000 Feddan	32	30.48		
2000 Feddan- Less than 3000	58	55.24	2353	507
3000 Feddan and over	15	14.28		
Dedication to agricultural extension work				
Full time	78	74.3		
Free to work part time	27	25.7		
Attending training courses in the field climate change				
Yes	16	15.24		
No	89	84.76		

Source: field study data

Second: Sources of the respondents' information about climate change

Understanding the sources of information for agricultural extension agents about climate change is critical in helping them to effectively deliver extension activities to farmers to address climate risks (Singh *et al.*, 2017; Hansen *et al.*, 2019). The results in Table 2 indicated the diversity of the agents' information sources. Co-workers came at the forefront of these sources, followed by the Internet, then following up on programs and weather forecasts on television, with weighted averages of 2.03, 1.92, and 1.83 degrees, respectively (Table 2). Despite the importance of cooperation between researchers and specialists in extension, researchers at the Faculty of Agriculture in Kafr El-Sheikh and researchers at the Agricultural Research Center came somewhat late as a source of information for the surveyed extension agents, with a weighted average of 1.82 and 1.8 degrees, respectively. Newspapers, magazines, the Directorate of Agriculture in Kafr El-Sheikh, and radio programs ranked later as sources of the respondents' information on climate changes.

These results may differ from what was mentioned by Ogunlade *et al.* (2014) in their study about the knowledge levels of agricultural extension agents on climate change and their impact on the provision of extension services where radio came first as a source of climate information for extension agents and farmers in rural communities in Ghana.

The study of Hanan *et al.* (2016) about the knowledge of agricultural extension agents related to the phenomenon of climate change in some governorates of Lower Egypt, where the results of scientific research, conferences and

newspapers were at the forefront of these sources. It is worth noting that the arrangement of agricultural information sources for agricultural extension agents differs from one country to another and from one society to another.

It may also differ from one period to another within the same community, and what concerns us in this context is knowing the sources that the extension agents rely on as a source of information and support for these sources, and on the other hand, encouraging the diversity of these sources and making room for new sources, especially those that rely on information and communication technology because of their low cost and ease of access.

Table 2. Distribution of respondents according to their sources of information about climate changes (n = 105).

S	Information sources	Rarely		Sometimes		Always		weighted average	ranking
		N	%	N	%	N	%		
1	TV programs and weather forecasts	47	44.8	29	27.6	29	27.6	1.83	3
2	Radio broadcasting programs	50	47.6	41	39.0	14	13.3	1.66	8
3	newspapers and magazines	46	43.8	38	36.2	21	20.0	1.76	6
4	Agricultural Research Center	41	39.0	44	41.9	20	19.0	1.80	5
5	Internet	35	33.3	43	41.0	27	25.7	1.92	2
6	colleagues at work	30	28.6	41	39.0	34	32.4	2.03	1
7	Directorate of Agriculture	39	37.1	54	51.4	12	11.4	1.74	7
8	Faculty of Agriculture in Kafr El-Sheikh	33	31.4	57	54.3	15	14.3	1.82	4

Source: The field study.

Third: - Determining knowledge training needs levels of agricultural extension agents on climate change

Agricultural extension agent needs continuous training based on the knowledge needs in order to perform the role assigned to them to the fullest (Alibaygi and Zarafshani, 2008) **.**Previous studies agree that the most important factor in the failure of the training process to achieve its objectives is the insufficient information on the training needs of agricultural extension agents)Olatunji *et al.*, 2015; Msuya *et al.*, 2017 (Therefore, the first step in building any training program is to identify the training needs of the target groups, The knowledge training needs of the respondents about climate changes were addressed through three axes, namely the causes of climate changes, their manifestations, and their effects.

Regarding the first axis, the results (Table 3) showed that the respondent's knowledge needs regarding the causes of climate changes ranged between 1 and 9 degrees, with an arithmetic mean of 4.01 degrees and a standard deviation of 3.05 degrees. 41.9% of agents came in the category of low knowledge need, and 30.5 of them were in the moderate category of knowledge need, and 27.6% of them are in the high knowledge need category. These results indicated that the majority of respondents have a good knowledge of the causes of climate change.

At the forefront of the knowledge needs of the respondents related to the causes of climate change were pollution in general 61%, car exhaust in particular, 61%, excessive use of chemical fertilizers 58.1%, excessive use of fuel 55.2%, burning of agricultural waste 51.4% as shown in Figure 2. This is consistent with what was mentioned by Hanan *et al.* (2016) in their study of the agricultural extension agents' knowledge related to the phenomenon of climate change, where the respondents mentioned that the most important causes of this phenomenon are car exhaust, smoke resulting from burning agricultural residues, and the increasing use of coal, petroleum, and gases resulting from factories.

Table 3. Distribution of respondents according to their level of knowledge about climate changes (n = 105).

Axes of knowledge need about climate change	SD	Mean	%	N
knowledge need about causes of climate change				
Low (1-3 degrees)			41.9	44
Medium (4-6 scores)	3.05	4.01	30.5	32
High (7-9 degrees)			27.6	29
knowledge need about causes of climate change				
Low (1-3 degrees)			40.0	42
Medium (4-6 scores)	3.06	4.30	28.6	30
High (7-9 degrees)			31.4	33
knowledge need about causes of climate change				
Low (1-9 degrees)			30.5	32
Medium (10-18 degrees)	6.9	14.9	42.9	45
High (19-28 degrees)			26.7	28

Source: The field study

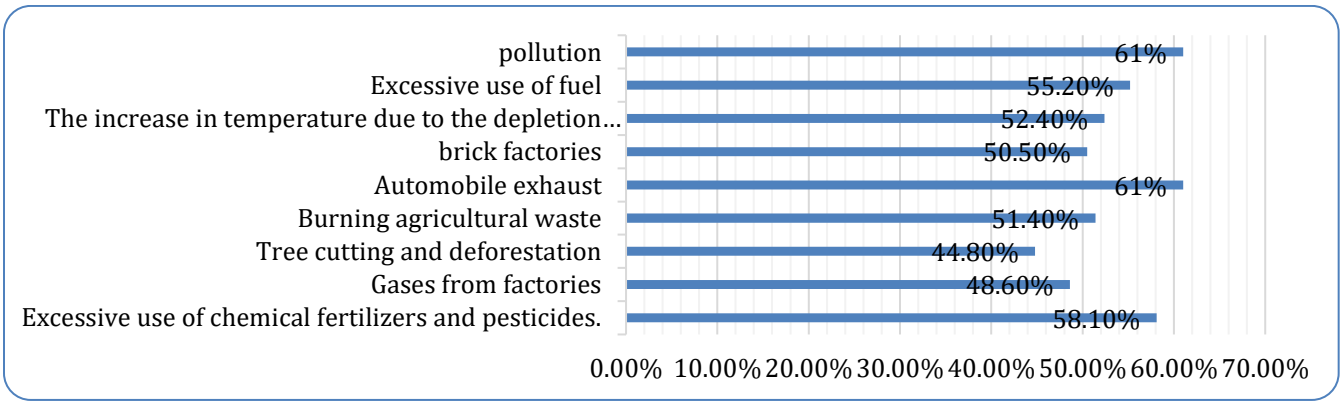

Figure 2. Distribution of the respondents according to their knowledge needs of climate changes causes.

Results indicated that the knowledge training needs of the respondents regarding the manifestations of climate change ranged between 1 and 9 degrees, with a mean of 4.3 degrees and a standard deviation of 3.06 degrees (Figure 3). Around 40% of the respondents fell in the category of low knowledge training need, 28.6% in the category of medium knowledge training need, 31.4% of the respondents in the category of high knowledge training need, At the forefront of the knowledge needs of the respondents related to the manifestations of climate change were the significant rise in temperature 63.8% The occurrence of floods 62.9%, the short duration of winter and the length of summer, irregular rainfall 57.1%, severe drought 56.2%.

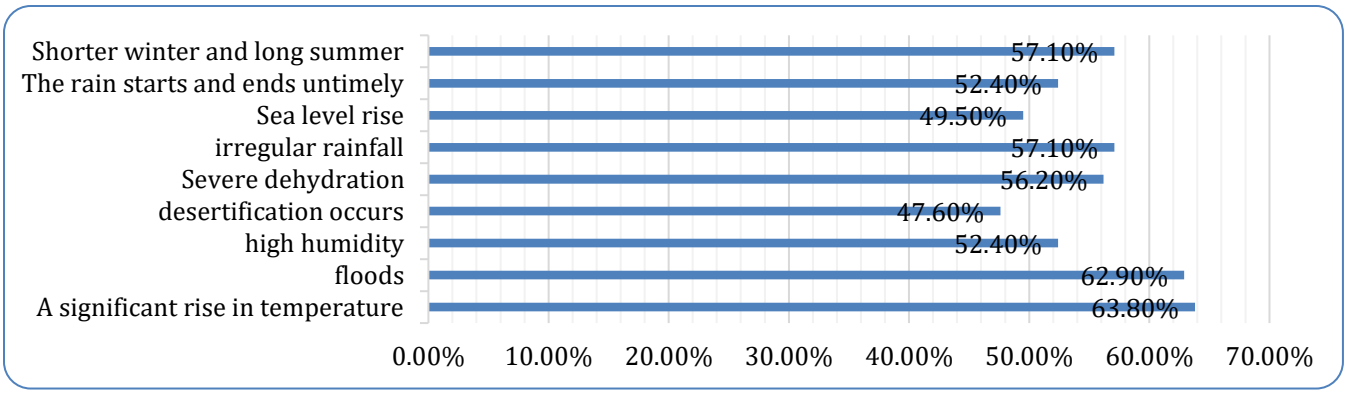

Figure 3. Respondents Distribution according to their knowledge needs for the manifestations of climate change.

Table 4. indicates that the cognitive training needs of the respondents regarding the effects and results of climate change ranged between one and 26 degrees, with an arithmetic mean of 14.9 degrees and a standard deviation of 6.9 degrees. 30.5% of the respondents came in the category of low knowledge need, 42.9% fall in the category of moderate need, and 26.7% were in the category of high knowledge need. at the forefront of the results that the respondents do not realize as the effects of the climate change phenomenon, its impact on food shortage 60%, and the decrease in the average unit area production of crops 45.7%, A large area of the Nile Delta will be flooded, and neighboring lands were affected 43.8 %, and weather extremes occurred, such as a sharp rise or a sharp drop in temperature 45.7% and other reasons.

Table 4. Respondents Distribution according to their knowledge needs about the effects of climate changes (n = 105).

knowledge needs axes about the effects of climate change	Know	%	Don't know	%
Impact on food security				
Climate change affects food shortages.	42	40	63	60.0
Increasing the Egyptian food bill, & increasing pressure on state budget	58	55.2	47	44.8
Rising global food prices	48	45.7	57	54.3
A huge shortage of food, especially cereals	52	49.5	53	50.5
The effect on agricultural production				
A decrease in the average production of agricultural crops	57	54.3	48	45.7
Increase in crop pests and diseases.	52	49.5	53	50.5
Changing planting dates	44	41.9	61	58.1
Increased consumption of irrigation water	53	50.5	52	49.5
Increased crop deterioration after harvest	49	46.7	56	53.3
Changing the geographical distribution of agricultural crops	47	44.8	58	55.2
Increase in animal diseases	52	49.5	53	50.5
Impact on soil and water				
Increased soil salinity	60	57.1	45	42.9
Soil fertility declines	55	52.4	50	47.6
The death of beneficial soil microorganisms	45	42.9	60	57.1
A large area of the delta will be submerged and neighbouring lands will be affected	59	56.2	46	43.8
Environmental effects of biological changes				
Hazards associated with biodiversity loss, such as the extinction of crop species	56	53.3	49	46.7
Increase rates of desertification	54	51.4	51	48.6
Weather extremes occur	57	54.3	48	45.7
The spread of infectious diseases	55	52.4	50	47.6
Economic and social effects of biological changes				
The exodus of farmers from the Egyptian delta	56	53.3	49	46.7
Migration of some people from the village to the city	57	54.3	48	45.7
Conflicts over natural resources	55	52.4	50	47.6
Increase in poverty and unemployment	49	46.7	56	53.3
Weak participation in charitable works in the village.	39	37.1	66	62.9
Low level of interdependence between neighbors	51	48.6	54	51.4
Decreased standard of living for families in general	54	51.4	51	48.6

Source: The field study

These results are consistent with what was mentioned by Hanan *et al.* (2016) where the respondents saw that the most important negative effects of this phenomenon were the lack of water resources, increase in desertification rates, the sinking of Delta, Increasing the water consumption of crops, the spread of diseases, and changing the date of planting.

The total degree of the respondents' training needs about climate change

Agbamu (2006) believes that extension training is one of the basic development paths to facilitate the provision of effective agricultural extension services in the 21st century, but it is first important to identify the knowledge gap for the training target groups to focus on the training skills required to be developed in the trainees (Al-Sinawi *et al.*, 2015). The results showed that the total degree of respondents' knowledge needs regarding climatic changes ranged between 1 and 45 degrees with an arithmetic mean of 21.11 and a standard deviation of 11.04 degrees.

The respondents were divided according to their level of training needs into three categories, where 39.05% of them fall in the category of low knowledge need, 35.24% of them came in the category of medium knowledge need, and 25.71% of them in the category of high knowledge need (Table 5). These results are in agreement with the study Hanan *et al.* (2016), where two-thirds of the respondents had a high overall level of knowledge regarding the phenomenon of climate change, meaning that their knowledge needs were low regarding this topic. These results showed the agricultural extension workers' knowledge of the phenomenon of climate change and its dimensions in terms of causes Appearances, and effects, but this does not preclude the necessity of paying attention to diversifying sources of knowledge and working to provide the respondents with everything new related to this phenomenon to be a safe and effective source of information for the target audience.

Table 5. Respondents' distribution according to the total degree of their knowledge needs about climate changes.

Level of knowledge need about climate change	N	%	Mean	SD
Low (1-15 degrees)	41	05.39		
Moderate (16-30 degrees)	37	35.24	11.21	04.11
High (31-45 degrees)	27	25.71		
Total	105	100		

Source: The field study

Fourth: The role of agricultural extension in facing the climatic phenomenon

One of the agricultural extension responsibilities is to raise awareness of the best available local interventions that can be used to manage climate risks (Afsar and Idrees, 2019) through improving farmers' access to climate-resilient technologies as well as providing sufficient information and knowledge to increase farmers' proactivity.) FAO, 2016(. The respondents mentioned many of the activities they have undertaken to reduce the negative effects of climate change, such as informing farmers about the danger of excessive use of fertilizers and pesticides (69.5%), informing them of the danger of burning agricultural waste such as rice straw (67.6%), informing them of the importance of preserving natural resources (61%), and distributing publications dealing with climate change 61%, informing them about improved irrigation methods 57.1% and informing them about the importance of planting varieties capable of adapting to climate changes 2.55%. These results are endorsed by Hanan *et al.* (2016) where the most important extension activities implemented according to the study were to educate farmers about the danger of burning pasture waste 91% and to educate them about the need to grow alternative varieties capable of adapting to climate changes 84.4% and informing them of the danger of excessive use of pesticides 87.7%.

Fifth: - Obstacles to agricultural extension workers doing their role in facing the climatic phenomenon

Access to accurate and timely climate information is a climate-smart intervention that can be used to manage climate risks by smallholder farmers (Singh *et al.*, 2017; Hansen *et al.*, 2019). In this context, the respondents mentioned some obstacles related to the knowledge gap

that prevents them from playing their role in facing the phenomenon, including the difficulty of accessing weather information promptly 67.6%, the lack of training courses on climate changes 63.8%, and the lack of scientific material related to climate changes 57.1 %, There were issues related to the extension organization such as the absence of a clear indicative policy to confront climate changes 58.1%, and the absence of specific responsibilities and clear authorities for the agricultural extension about this phenomenon 61.9%, and poor coordination between agricultural extension and specialized scientific research bodies 50.5%, and some issues related to farmers, such as farmers not being aware of the effects of climate change 61.9%, the fragmentation of agricultural holdings 61%, and the high cost of improved varieties 59% (Figure 5).

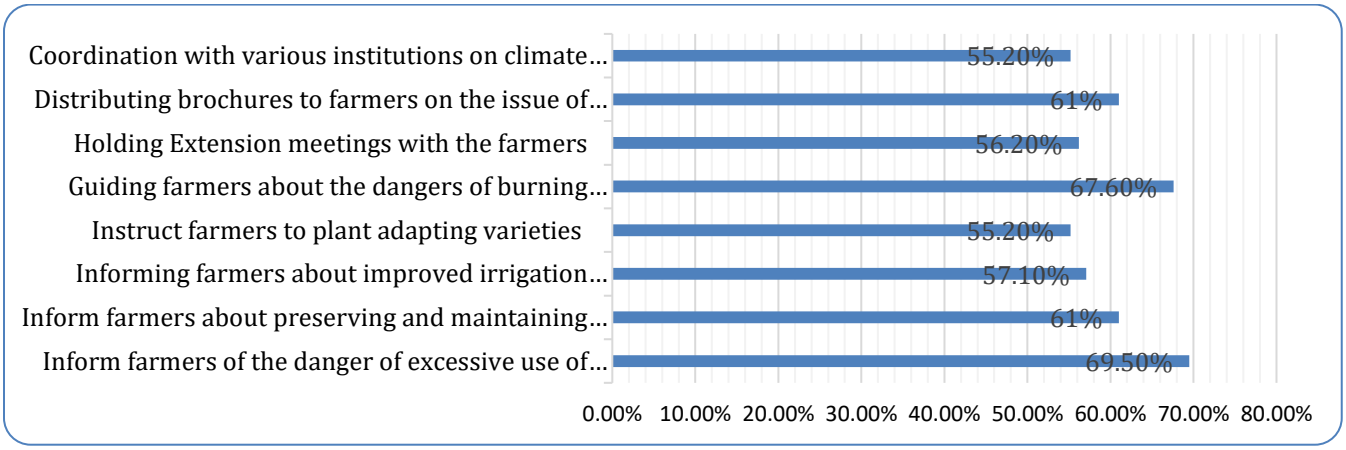

Figure 4. Respondents' distribution according to their activities to confront the phenomenon of climate change.

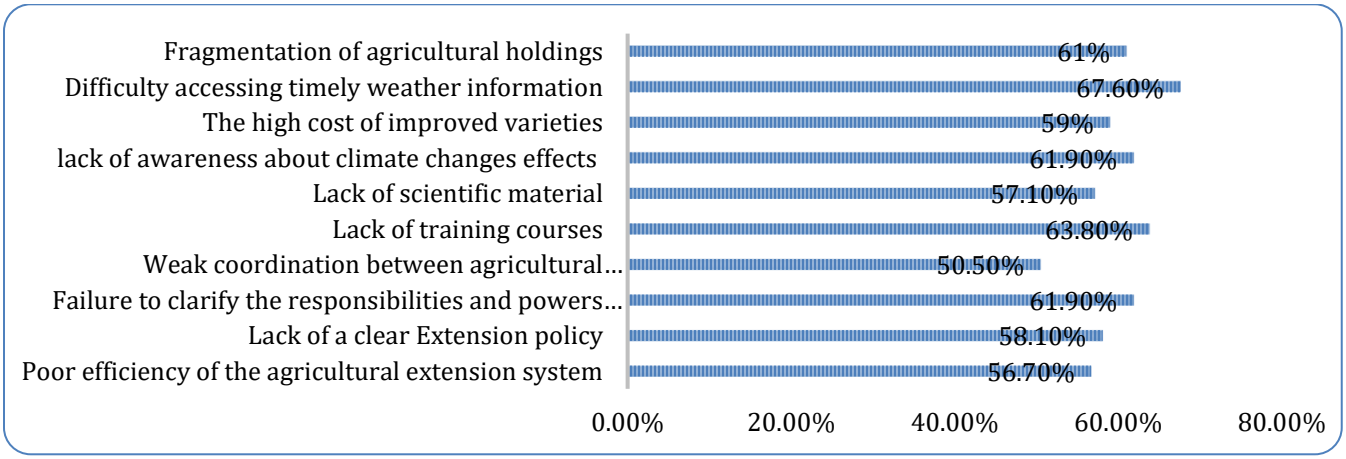

Figure 5. Respondents' distribution according to their opinion about the obstacles that prevent them from performing their role to confront the climate change.

Sixth: Extension agents Suggestions for ways to confront the phenomenon

The respondents mentioned many suggestions that may contribute to limiting the negative effects of climate change. Some of these suggestions were related to public policies, such as the necessity of having a political, legislative, and executive commitment towards climate change at the national level 65.7%, Including climate change issues in school curricula 46.7%, Reducing gas emissions 60%, and providing the necessary infrastructure 56.2%, Some of these suggestions were related to scientific research, such as providing institutional and political support for research related to climate change 64.8%, and developing adapted varieties 54.3%, Some of these suggestions were related to extension organization, such as hiring new agents 60%, holding training courses in the field of climate changes 67.6%, using information and communication

technology to enhance farmers' awareness about this phenomenon 85.1%, and cooperation with all relevant institutions in this regard 56.2%. Some suggestions related to agricultural practices such as using improved irrigation methods 58.1%, planting new varieties 60%, changing the planting date 61 %, encouraging tree planting 55%, and following an agricultural cycle 59% (Figure 6).

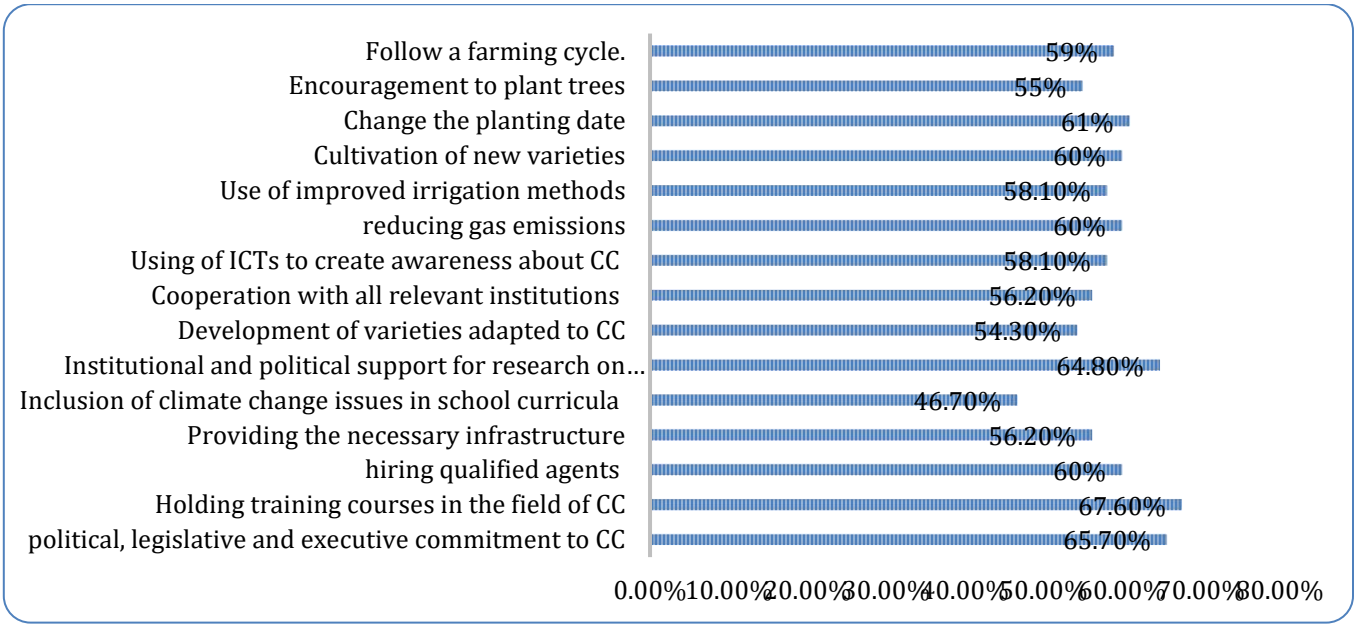

Figure 6. Respondents' distribution according to their suggestions to confront climate change.

Seventh: The relationship between studied variables and the level of respondents training needs in the field of climate change

Table 6 shows that there was a statistically significant relationship between age and the degree of training needs in the field of climatic changes ($P<0.05$). The results also indicated that there was a correlation relationship between the scope of supervision and respondent's training needs, while other variables have no relationship to the level of the respondents' training need in this field. These results can be explained in light of what was confirmed by Mittal and Mehar (2015) in their study about the social and economic factors that affect the adoption of modern information and communication technology in India, where they emphasized that the elderly are an inactive group and respond less to education which increases their training need., the same is true concerning the scope of supervision, as increasing the scope of supervision is linked to increased responsibilities and pressures on the agents, which hinders their pursuit of self-development and ultimately leads to an increase in their training need.

Table 6. The relationship between respondent's variables and their training needs level in the field of climate change.

independent variables	$\chi 2$	DF	P value	Decision
Age	6.9990	4	0.007	S*
Educational level	8.412	4	0.543	NS
Specialization	0.349	2	0.136	NS
Growing up	2.515	2	0.284	NS
Job experience	3.313	4	0.535	NS
Scope of supervision	2.792	4	0.039	S*
full-time work	1.202	2	0.548	NS
Attending training courses	1.704	2	0.246	NS

Significant at 5% level ** Significant at the 1% level.

CONCLUSION AND RECOMMENDATIONS

Climate changes the biggest environmental challenge in the current century are due to several reasons, including those related to natural phenomena or human activities. This phenomenon has serious effects on agricultural production, and Egypt is considered one of the countries most affected by it, especially on the productivity of most crops. Therefore, adaptation is an important response to reduce the negative effects of climate change. This adaptation requires the participation of actors, primarily agricultural extension, and for agricultural extension to play its role in helping smallholders to effectively manage and adapt to climate change, it is necessary to understand the knowledge training needs of agricultural extension agents. and to identify the obstacles facing them in this field. Hence this paper addresses this important gap. The results indicate the high age of the respondents, which is a crisis facing the extension organization in Egypt, and it must be faced by hiring young graduates for extension work. The majority of the respondents were specialists in agricultural extension, and they had a great experience in extension work, and this experience is likely to enhance their understanding of agricultural practices related to climate change. The results indicated the diversity of the respondents' information sources about the phenomenon. The results also showed that the respondents played an effective role in facing climate changes, but this role was hampered by the difficulty of accessing weather information on time, the lack of training courses, and the unavailability of scientific material related to climate changes. Therefore, the study recommends integrating climate changes into agricultural extension programs and holding training courses for extension staff in this field, provided that the planning of training programs is based on the actual respondent's training needs.

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