Scientific Journal of Agricultural Sciences 3 (2): 317-326, 2021
Print (ISSN 2535-1796) / Online (ISSN 2535-180X) DOI:10.21608/sjas.2021.107138.1168

Wheat Growers' (WGs) practices to adapt with climate change in the Nile Delta (ND) of Egypt.

Radwa .M. Ata and Ahmed .A. Fahmy

Department of Rural Sociology & Agricultural Extension, Faculty of Agriculture, Cairo University, Cairo
*Corresponding author: Email: Ahmed.abdelhamid@agr.cu.edu.eg

Received on: 21-11-2021 **Accepted on: 1-12-2021**

ABSTRACT

Wheat growers in the ND of Egypt, are vulnerable to climate change, specifically hydro-climatic severe fluctuations and variability. Phenomena such as heavy rain, drought and salt intrusion increasingly and negatively affect their crop production and productivity, with far-reaching socio-economic and environmental impacts. Reliable hydro-climatic information service received in a timely manner could help farmers improve their responses to hydro-climatic variability, thus improving their agricultural decision-making.

This study aims to answer the following questions: What is the currently available technical package of Best-Fit Practices (BFPs)? What are the levels of application/ adoption of these BFPs among WGs in ND of Egypt? What are the relationships between the WGs' levels of application/ adoption and their characteristics? Study was conducted in 3 villages in Kafr El-Sheikh Governorate. A sample of 278 WGs was personally interviewed, by using a questionnaire designed for data collection.

The most important results could be summarized as follows:

- Farmers perceived hydro-climatic variability as high and the quality of available hydro-climatic information as poor. They indicated a need for more accurate, time-specific, trusted and applicable information for improving agricultural decision-making. It was conclude that there is high potential and need for hydro-climatic information services tailored for farmers in the study area.
- The results of factorial analysis showed that there were three main factors namely: a) Efficient Agricultural Production, b) Innovative and Trustworthy Information, and c) experience-based personal influence. These three factors, together explain 52.34% of the total variance.

KEYWORDS: hydro-climatic information; agricultural decisions; Nile Delta; Egypt

1. INTRODUCTION

The agricultural sector faces a main challenge to increase production in order to feed a growing and increasingly prosperous population specially in the view of decreasing availability of natural resources. Factors of particular concern are water shortages, declining soil fertility, effects of climate change and rapid decrease of fertile soil due to urbanization. (Abhay Kumar and K. M. Singh, 2019).

Agriculture in Egypt faces many difficulties, such as scarcity of land and water resources, land fragmentation, and increasing demand for food, When need a sustainably expand agricultural production to meet escalating domestic demand for food and serve as a pathway out of poverty, particularly in rural areas. (Abdelaal, 2021)

Egypt's food security is facing three critical challenges, which are ever-increasing population, shortage of natural resources and climate change, (Kheir. et al, 2019). As reported by (FAO, 2012), the rapidly growing as population and a stagnation in wheat yields over the last decade will lead to increased wheat shortages.

Egypt is considered as the largest importer of wheat since one-third of its people's food consumption, in terms of calorie intake, depend on wheat products. This leads Egypt to be one of the countries that were hurt most by the turbulence of global food markets in recent years. (Tetsuii, 2018)

Egypt has a population of around 100 million (with an increasing grown at a rate of 1.9% per year) mostly (around 97%) concentrated in the basin of the Nile river and the Nile Delta and a significant percentage (around 29%) of the total work force is the agricultural sector.(Ahmed et al,2020)

Therefore, wheat production and storage has become one of the most important issues facing Egypt at the present and in the future due to the limited number of countries that can export wheat, Homegrown wheat accounts for only half the wheat consumption in the nation, making the domestic markets susceptible to the volatility of foreign supply (Asmaa. et al, 2020).

Besides the mitigation of climate change, there is a growing need to adapt with these changes (Soha, 2021) According to the recent Global Adaptation Commission report, the most powerful

way to adapt is to invest in early awareness services and pay special attention to impact-based forecasts. (Kheir. *et al*, 2019). Food security is generally negatively impacted by increasing wheat demand and input prices, soil degradation, greenhouse emissions and competition between land and the main impact of increasing temperature on wheat crop productivity is mainly due to a reduced time from crop emergence to maturity.

Climate Change (CC) impacts include increased frequency of flash flood events, droughts, or periods of water deficiencies and rising temperatures. As well, sea level rise is also an important issue (Heba Elbasiouny and Fathy Elbehiry, 2018). The models that describe global climate are mathematical representations of physical and dynamical processes to simulate the interaction within and in between the atmosphere, land surface, oceans and sea ice (Samih et al, 2020)

A Report of the Intergovernmental Panel on Climate Change (IPCC,2014) indicated that risks arising from climate change could be made worse by the interactions between hazards, vulnerability, and exposure (people, assets, or ecosystems). also suggested that Egypt's precipitation may decrease due to climate change which in Egypt would decrease crop yields for most crops, with wheat yields expected to be reduced by up to 9% in 2030 and by close to 20% in 2060. Although the limited availability of supply resources is the main challenge facing the water resources system in Egypt. In the demand side, many challenges are found (Omar. *et al*,2021).

The CC negative effects could seriously threaten the Nile Delta, as reported by (Alkhawaga. *et al*, 2022), the Sea Level Rise (SLR) will affect coastal areas and its inhabitants, especially the Nile Delta coast. About 12% of agricultural land areas in the Nile Delta would be affected by 1.0 m SLR and salinization problems. Estimated that about 8.35% of the agricultural area in Kafr El-Sheikh governorate would be inundated under the impact of global SLR of 43 cm and the land subsidence.

The effect of environmental stress on crop plants depends on the growth stage، growth habit, crop species and cultivar (Hassan, 2022). The wheat crop is characterized by the seasonality of harvest and the consumption is continuous during the year, where the Egyptian food behavior depends on wheat as the main food. (Asmaa. et al, 2020) Heat stress throughout the late sown condition reduced total chlorophyll content, leaf area, grain filling duration, plant height, and grain yield. (Akter and Islam 2017). As reported by (McCarl et al, 2015) Agricultural adaptation In Egypt is Vera important, especially in Nile Delta, to achieve food security and sustainable water management. (Hazem et al, 2019) has presented different adaptation strategy options, including minimizing tillage, changing planting dates, the development and produce of new crop varieties, increased use of water and soil conservation techniques, crop diversification, use of subsidies and taxes, improvement in agricultural markets, changed use of capital and labor, shading and sheltering/tree planting, mixed crop–livestock farming systems, and diversification from farm to nonfarm activities

Few research has been conducted on about the currently available technical package of the BFPs, related to wheat crop management, specifically as responses to water and weather-related stresses. It has therefore been considered important to clearly understand both the WGs' current situation, when preparing them to face the challenges of CC related to wheat crop, and the advisory services in this situation. The problem of this study was to measure the levels of application or adoption of these BFPs among WGs and to identify the relationships between the WGs' levels and their characteristics.

Objectives of the current study were to:

1. Identify the currently available technical package of the BFPs, related to wheat management, specifically as responses to water and weather-related stresses.
2. Measure the levels of application/ adoption of these BFPs among WGs in the ND of Egypt.
3. Identify the relationships between the WGs' levels of application/ adoption and their characteristics.

2. MATERIALS AND METHODS

2.1. Study Area and Sample Selection

This study was conducted in Kafr El-Sheikh, which is considered one of the main areas in wheat production, as it occupies the third place of wheat production, among Egyptian Governorates. Most of the farms in the Kafr El-Sheikh are small, with an average size of 3–4 feddan (~1.5 hectares). Wheat is a cold season crop and is sensitive to thermal and wet stress during the reproductive phase, Furthermore, high terminal temperature through flowering increased canopy temperature and leaf and stem rust susceptibility Chlorophyll content weakened significantly under the late sown condition, due to high temperature damage on chloroplast (Hassan, 2022). As shown in table (1), the distribution of the area planted with the wheat crop on the five largest districts in Kafr El-Sheikh Governorate, and also the number of wheat growers in each districts. Sidi Salem has been shoes one of the largest districts in terms of wheat, Therefore, this three largest villages were selected from this districts in terms and number of wheat growers.

Table 1. Distribution of wheat area and wheat grower Kafr El Sheikh districts Governorate during agricultural season 2020/2021

Districts	Wheat area in acres	Number of Growers
Kafr El Sheikh	34930	36825
Desouq	40513	41615
Sidi Salem	36828	32959
Bella	26522	27656
Al Hamoul	21343	21968

Source: the Agriculture Directorate in Kafr El-Sheikh, public Administration of Agricultural Affairs, Statistics Department, 2021

The study population was represented in the total number of wheat growers in the selected villages, which amounted to (3335) growers. To determine the sample size, the Krijicie and Morgan equation was applied. Applying a simple random selection, the total sample size reached 278, distributed over the selected villages as follows: 100 growers from village Damro, 77 from village Kom al-Dahab, and 101 from village Manshaet Abbas (table 2).

Table 2. Distribution of the study sample in the selected villages of Sidi Salem Districts

Village	Number of Growers	Number of Growers in the sample	%
Damro	1206	100	36.16
Kom al-Dahab	915	77	27.44
Manshaet Abbas	1214	101	36.40
Total	3335	278	100

Source: Agricultural tenure records in agricultural cooperative and associations in selected districtss and villages, 2021

2.2.Data Collection

The personal interviews, by using a questionnaire, designed and pretested for the study objectives, was used as a data collection tool, The questionnaire included a part related to the independent variables, and the other part related to the implementation practices of the technical recommendations to adapt with climate changes on the wheat management. The SPSS was used for data processing and analysis.

3. RESULTS

3.1.Respondents Characteristics:

Table data (3) shows the distribution of respondents according to their personal, social and economic characteristics (age, marital status, educational status, their informal social participation, agricultural and livestock holding capacity, mechanism, attitude towards new ideas, cosmopoliteness, contact with change agent, opinion leadership Their average productivity of wheat per acre, exposure to new means of information sources, availability of local facilities, duration of their experience in wheat cultivation, area cultivated with wheat, exposure to sources of information on which they depend, source of income, access to weather information, frequency of climate changes, and severity of changes climatic conditions, and access to extension services). It was found:

- The majority of respondents (65.8%) fall into the middle-age category (41-63),
- Nearly half of the respondents (47.8%) have a secondary school certificate,
- The highest percentage of informal social participation is in the middle group (57.6%),
- The majority of them (82%) reported that their access to extension services is medium,
- The majority of the respondents (90.3%), have small and medium land (Less than 42 karat-89 Karat), medium animal wealth (80.6), and 70.1 % of them have medium machinery capacity,
- The majority (76.3%) confirmed that climate changes were repeated at least twice and the severity of these changes was medium (78.8%).

3.2. The currently available technical package of the BFPs, related to wheat management, specifically as responses to water and weather-related stresses

Based on the latest research articles, and technical scientific references, on how farmers can cope with the negative effects of CCs with regard to wheat cultivation, the following 28 practice represent the most important BFPs:

(i) Practices to reduce the impact of increasing or decreasing temperatures, wind and rain on the crop: It is to stop spraying pesticides when the wind blows, and add potassium sulfate in the event that less rain is expected or irrigation shifts will be delayed (50 kg /F). not plowing the soil to depths that lose its moisture before planting, avoiding irrigation at afternoon when the temperature increases and planting a fence of trees around the farm to protect crops from wind and wheat from dormancy, preventing irrigation of plants 15 days before harvest, and increasing

Table 3. Distribution of the respondents of according to their studied characteristics (n = 278)

Characteristics	N	%	Characteristics	N	%
Age:			**Size land holding:**		
Younger age. (under 41 years old)	43	15.5	Small (less than 42 Karats)	116	41.7
Middle age (41-63 years old)	183	65.8	Medium (42 - 89 Karats)	135	48.6
Old age (more than 63 years)	52	18.7	large (more than 89)	27	9.7
			Educational status:		
Marital status:			illiterate	18	6.5
Single	7	2.5	Reads and writes	36	12.9
Married	255	91.7	primary	5	1.8
Divorced	3	1.1	preparatory	6	2.2
Widower	13	4.7	secondary	133	47.8
			university	80	28.8
Animal holding capacity:			**Automatic holding capacity**:		
Small (zero - less than 1) animal unit	21	7.6	small (0 - less than 1)	32	11.5
Average (1-3) animal unit	244	80.6	Average (1-3)	195	70.1
Large (more than 3) animal unit	33	11.9	large (more than 3)	51	18.3
opinion leadership:			**Availability of local facilities:**		
Low (zero - less than 1 degree)	103	37.1	Low (less than 4) degree	115	41.4
Average (1-3 degrees)	96	34.5	Average (4-6) grade	151	54.3
High (more than 3 degrees)	79	28.4	High (more than 6) degree	12	3.4
Exposure to new means of information:			**Access to extension services:**		
Low (less than 2 degrees)	50	18	Low (under 3) degrees	40	14.4
Average (2-6) degrees	179	64.4	Average (3-10) degrees	228	82
High (more than 6) degrees	49	17.6	High (above 10) degrees	10	3.6
Informal social participation:			**Attitude towards new ideas:**		
Low (less than 22 degrees)	58	20.9	Low (less than 15) degrees	25	9
Average (22 -28) degrees	160	57.6	Average (15 -17) degree	211	75.9
High (more than 28) degrees	60	21.6	High (more than 17) degrees	42	15.1
Exposure to information sources:			**cosmopoliteness:**		
Low (less than 15) degrees	56	20.1	Low (less than 6 degrees)	73	26.3
Average (15 -25) degrees	173	62.2	Average (6-10) degrees	153	55
High (more than 25) degrees	49	17.6	High (more than 10)	52	18.7
Contact of change agent:			**Frequency of climatic changes**:		
Low (less than 7) degrees	55	19.8	repeated once	20	7.2
Average (7-13) degree	162	58.3	repeated two times	212	76.3
High (more than 13) degrees	61	21.9	repeated three times	46	16.5
Continuing to wheat cultivation:			**Source of income:**		
It continues every year.	69	24.8	Income from agriculture only	138	49.6
Not Continuous	209	75.2	Income from other activity	140	50.4
Get weather information:			**Experience in wheat cultivation:**		
Rarely.	67	24.1	Few (under 12) years of age	51	18.3
Sometimes.	209	75.2	Average (112 - 18):	192	69.1
Always.	2	0.7	Large (older than 18)	35	12.6
Average amount of production : ardeb/p			**Intensity of climate change:**		
low (less than 12)	34	12.2	Weak	56	20.1
Average (12 -16)	184	66.2	Average	219	78.8
high (more than 16)	60	21.6	severe	3	1.1

(ii) The number of irrigation times on the protector when the temperature rises Heat or little rain.

(iii) The practices of planting dates, which are arranging with the neighboring farmers to plant wheat at the same time and following the recommended agricultural cycle (wheat and then a legume crop), and planting wheat in the second half of November The practices of preparing the land for cultivation and irrigation are the good leveling of agricultural lands before cultivation, adding agricultural sulfur when planting wheat, adding superphosphate (150 kg), ammonium nitrate (300 kg) or ammonium sulfate (480 kg).

The use of a plow under the soil, the addition of urea in case of salinity of the soil, the addition of agricultural soil conditioners (municipal fertilizer - chick compost fertilizer), the addition of biological fertilizers (microbial - phosphorous), taking into account irrigation at the appropriate dates and in the appropriate quantity in each irrigation, and avoiding the drowning of the wheat crop when Irrigation with the necessity of draining the excess water, adding folic acid and humic acid to the soil, adding manufactured organic fertilizers at a rate of 20 cubic meters per feddan, spraying microelements of iron, zinc and manganese compounds, and planting on lines or terraces.

(iv) The appropriate selection practices for these changes are the cultivation of drought and heat-bearing varieties (Giza 168 - Egypt 1 - Seds 1), and the loading of some crops on the wheat crop.

(v) The practices to reduce the prevalence of pests and diseases are earlier in the time of agriculture to resist the yellow rust, increase the number of pest resistance and purify the grass.

3.3. Respondents' levels of implementing the technical recommendations to adapt with the negative effects of CC:

As shown in table (4). Degrees of implementing the technical recommendations to adapt with the negative effects of CC, ranged from (6 to 22) degrees with an average of 13.2 and a standard deviation of 3.35. The majority of the respondents (85.2%) fall in the medium a high levels categories (11 scores and above), compared with 14.8% in the low level category (less than 11 scores).

The results of Table (4) show that the majority of the respondents farmers with a percentage of (70.1%) have a medium executive level, while (14.8%) have a low level of implementation, and this indicates that the majority of them do not implement agricultural operations related to achieving their agricultural adaptation to the wheat crop in light of the current climatic changes, despite That these practices, if implemented, could achieve a tangible increase in the productivity of the wheat crop and avoid it for some production problems resulting from climate changes, as well as the lack of recommendations made by agricultural guidance in this field, and to identify the most important of those practices that the surveyed farmers do not implement and related to technical recommendations of avoiding the effects of climatic changes on the productivity of the wheat crop, as they were arranged in descending order according to the average degree of each practice.

Table 4. Distribution of the respondents according to the levels of implementing the technical recommendations to adapt with the negative effects of CC on the productivity of the wheat crop (n = 278)

Executive Level Categories (Applied) Degree	Frequency	%
Low executive level (6 - 10)	41	14.8
Average Executive Level (11-17)	195	70.1
High executive level (18-22)	42	15.1
Total	278	100

The results in Table (5) show the variation in the rates of application of some agricultural operations associated with avoiding the effects of climate changes on the productivity of the wheat crop, and that this variation in application may negatively affect the productivity of the crop, while we find that there is a high implementation of some practices such as: cultivation on lines or terraces, and cultivation Varieties tolerant of drought and heat (Giza 168 - Egypt 1 - Seds 1) with a medium score of 0.73, followed by the arrangement with neighboring farmers to grow wheat at the same time with a medium score of 0.69.

Some essential practices demonstrated low levels of implementation. Among the most important of which are: spraying the micro-elements of iron, zinc and manganese compounds at an average score of 0.29, followed by the cultivation of wheat in the second half of November with a medium score of 0.27. In the last order came the increase in the number of times of pest resistance and weed control, with an average score of 0.22.

3.4. Factor analysis of the studied variables.

It is showed from the results of Table (6) according to the " Kaiser Meyer Olkin Measure (KMO) to judge the adequacy of the sample, and "Bartlett's Test of Sphericity" that the value of Olkin is equal to (0.696), which is greater than (0.5), which indicates an increase in reliability. For the factors that we get from the factor analysis, we also judge the adequacy of the sample size. It also shows that the P-Value of the Bartlett test is equal to (0.000) which is less than (0.05), and this means that the correlation matrix is not equal to the unity matrix, and that there is a correlation between some variables in the matrix, so a factorial analysis of the data can be performed.

Table 5. Implementation of some practices of the farmers surveyed related to the technical recommendations for avoiding degrees the effects of climate changes on the productivity of the wheat crop in descending order according to the average degree of each practice (n = 278)

M	Wheat farming practices to adapt to climate change	Implemented		Not Implemented		Average degree
		N	%	N	%	
1	Farming on lines or terraces	202	72.7	76	27.3	0.73
2	Cultivation of drought- and heat-tolerant varieties (Giza 168 - Egypt 1 - Seds 1)	202	72.7	76	27.3	0.73
3	Arranging with neighboring farmers to grow wheat at the same time	191	68.7	87	31.3	0.69
4	Follow the recommended agricultural cycle (wheat then legume crops)	186	66.9	92	33.1	0.67
5	Stop spraying pesticides when the wind blows	178	64	100	36	0.64
6	Add potassium sulfate if less rain is expected or irrigation shifts will be delayed (50 kg/feddan).	172	61.9	106	38.1	0.62
7	Not plowing the soil to depths that lose moisture before Cultivation	171	61.5	107	38.5	0.62
8	Good settlement of agricultural land before Cultivation	171	61.5	107	38.5	0.62
9	Early Cultivation time to resist aphids and yellow rust	166	59.9	112	40.3	0.60
10	Add agricultural sulfur when growing wheat	161	57.9	117	42.1	0.58
11	Loading some crops on wheat crop	159	57.2	119	42.8	0.57
12	Avoid afternoon irrigation when temperature increases	155	55.8	123	44.2	0.56
13	Planting a fence of trees around the farm to protect crops from the wind and wheat from the dormancy	153	55	125	45	0.55
14	Adding superphosphate (150 kg), ammonium nitrate (300 kg) or ammonium sulfate (480 kg).	144	51.8	134	48.2	0.52
15	Prevention of plant irrigation 15 days before harvest	145	52.2	133	47.8	0.52
16	Use a plow under the soil	143	51.4	135	48.6	0.51
17	Addition of urea in case of salinity of the Land	140	50.4	138	49.6	0.50
18	Addition of conditioners to agricultural soil (municipal fertilizer - chick fertilizer - compost)	140	50.4	138	49.6	0.50
19	Adding bio-fertilizers (microbial - phosphorous)	127	45..7	151	54.3	0.46
20	Increasing the number of irrigation times on the protector when the temperature is high or rainfall is low	116	41.7	162	58.3	0.42
21	Taking into account irrigation at the appropriate times and in the appropriate amount in each irrigation	106	38.1	172	61.9	0.38
22	Adding folic acid and humic acid to the soil	96	34.5	182	65.5	0.35
23	Avoid drowning the wheat crop when irrigating with the need to drain the excess water	91	32.7	187	67.3	0.33
24	Adding manufactured organic fertilizers at a rate of 20 cubic meters per feddan	84	30.2	194	69.8	0.30
25	Spraying microelements of iron, zinc and manganese compounds	82	29.5	196	70.5	0.29
26	Wheat cultivation in the second half of November	76	27.3	202	72.7	0.27
27	Increase the frequency of pest resistance and weed control	60	21.6	218	78.4	0.22
28	Change to activity other than agriculture	21	7.6	257	92.4	0.08

Source: collected and calculated from field research data in Kafr El-Sheikh Governorate in 2021

Table 6. Kaiser Meyer Olkin Measure (KMO)

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.696
Bartlett's Test of Sphericity	Approx. Chi-Square	887.573
	Df	120
	Sig.	.000

Factor analysis of the thirteen research variables was conducted using Hottelling's Principal Components method as the most accurate and commonly used method. It was also relied on the method of determining the variables with significant values for each factor in the light of Loading that saturates the major (more than 0.40), and on the values of the latent root Eigen value (the eigenvalue) of the factors so that they are not less than one correct according to the Kaiser test (Feloor. et al, 2011) In order to identify the extracted factors with functional ramifications, the factors were rotated by Varimax method to avoid randomness in determining the factors and logical interpretation of them.

According to the results, the studied variables were combined into six factors, where the value of the Latent root of each of them was greater than the correct one. Together, these six factors contributed to explaining 62.583% of the total variance in the practices of the respondents farmers related to technical recommendations for avoiding the effects of climate changes on the productivity wheat crop.

And taking into account what most of the scientific literature related to factor analysis indicated that the factor must be saturated with at least three significant variables in order to be interpreted (Faraj and Khalil, 2014), (Faraj, 1980), and (Khattab et al., 2016), the It was sufficient to present the results related to the first, second and third factors, and they explain approximately 52.34% of the total variance in the degree of practices of the respondents farmers related to technical recommendations for avoiding the effects of climatic changes on the productivity of the wheat crop, as follows:

The first factor: **Efficient Agricultural Production**:

The results presented in Table (7) show that the first factor has saturated three variables with great saturation values, which are, in order, the agricultural tenure in Kirrats (.888), the area planted with wheat (.884), the amount of production (.403).

Based on the components of this factor, the agricultural productive efficiency (the ability to make the most of agricultural resources), the greater the cultivated area, which is accompanied by an increase in production, the more productive the farmer will be, which makes him more eager to follow and learn the information related to the farmers' practices to adapt to climate changes. And the larger the cultivated area, the more interested the producer is in searching for information and practices related to climate change adaptation practices, which leads to increased productivity.

Factor Two**: Innovative and Trustworthy Information**

The results in Table (7) show that the second factor has been saturated with four variables with great saturation values, which are, respectively: the use of new information means (.781), sources of information for farmers (.685), openness to the outside world (.667), Informal social participation (.508)

Based on the components of this factor, it refers to the search for new means of information, as the phenomena, including sudden & severe changes, are also included, so the farmer resorts to using new means of information and obtains information from a reliable source of high credible, by expanding the circle of his information and the degree of exposure to non-information sources. Traditional and non-local as they are quick to respond to climate change

The third factor**: experience-based personal influence**:

The results shown in Table (7) show that the third factor has been saturated with three variables with great saturation values, which are, in order: opinion leadership (.695), source of income (.652), continuing to grow wheat (.590) based on the components of this factor indicating To the fact that continuity in agriculture raises the capabilities of the farmer or his experiences and thus improves his information and qualifies him to become an opinion leader and increases his confidence in himself and his trends, which leads to his ability to help other farmers

From the above, it is showed the link and interaction of the basic factors, as it becomes clear that the use of highly credible information leads to an increase in productivity after increasing the sources of information.

4. REFERENCES

Abdalmonem Al, Bakenaz Z, Mohamed El (2022). Climate change impacts on water security elements of Kafr El-Sheikh governorate, Egypt, Agricultural Water Management, Volume 259, 2022.

Table 7. the saturation values of the variables on the factors after the process of axes rotation

Rotated Component Matrix

	Component					
	1	2	3	4	5	6
Size of land holding by karat	.888					
Cultivated area	.884					
Quantity of Production	.403					
Using New Means of Information		.781				
Sources of Information		.685				
Cosmopoleteness		.667				
Informal social participation		.508				
Opinion leadership			.695			
Source of Income			.652			
Continuing to wheat cultivation			.590			
Age				.865		
Experience in wheat cultivation				.804		
Get weather information					.695	
Intensity of climate changes					.662	
Attitude towards new ideas						.768
Getting Water						-.725-

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.a
a. Rotation converged in 6 iterations.

Abdelaal HSA (2021). " Food Security Concerns and Sustainable Agricultural Production in Egypt", J. of Agricultural Economics and Social Sciences, Mansoura Univ., 12 (6): 529 - 534, 2021

Abhay K, Singh KM (2019). " ICT for Agricultural Development under Changing Climate", , New Delhi, ISBN: 978-93-80428-45-1, 2019

Abhay K, Singh KM (2019). " ROLE OF ICTs IN RURAL DEVELOPMENT WITH REFERENCE TO CHANGING CLIMATIC CONDITION", New Delhi, 2019 ICT for Agricultural Development under Changing Climate, Pages 83-88

Ahmed AEl, Abdelraouf MA, Elsayed SM, Farahat SM, Mohamed SS, Igor S, Anton P, Zheli D. Ahmed MSK, Ali AA. Abdelaziz El. Peter D, Rosa L (2020). "Modeling Land Suitability for Rice Crop Using Remote Sensing and Soil Quality Indicators The Case Study of the Nile Delta" Published: 19 November 2020

Akter N, Rafiqul IM (2017). Heat stress effects and management in wheat. A review. Agron. Sustain. Dev. 37, 37 (2017). https://doi.org/10.1007/s13593-017-0443-9

Asmaa MEl, Mohamed OAF (2020). An analytical study of wheat storage allocation in Egypt between current situation and desired outcomes, Middle East Journal of Agriculture Research,Volume 9, 2020, https://www.curresweb.com/mejar/mejar/2020/mejar.2020.9.1.3.pdf

Damià B, Andrey G (2013). Kostianoy,springer, Climate Change and Water Resources Handbook of Environmental Chemistry, Volume 25, 2013

FAO (2012). Developing a Climate-Smart Agriculture Strategy at the Country Level: Lessons from Recent Experience؛Background Paper for the Second Global Conference on Agriculture, Food Security and Climate Change؛Food and Agriculture Organization of the United Nations: Rome, Italy, 2012.

Feloor G, Bahaman AS, Aminah A, Khairuddin I (2011). The Role of Social Influence and Innovation Characteristics in the Adoption of Integrated Pest Management (IPM) Practices by Paddy Farmers in Malaysia. In: International Conference on Social Science and Humanities, vol 5. IACSIT Press, Singapore, pp. 217e220.

Hassan AA (2022). Climate Change and Its Impact on Sustainable Crop Production . Sustainable Agriculture in Egypt, Springer Nature Switzerland AG 2022.

Hazem SK, Abdel Raouf SB, Bader MA, Fahd A, Gary S (2019). "Climate Change Adaptation in the Delta Nile Region of Egypt: Implications for Agricultural Extension" Sustainability 2019, 11, 685

Heba El, Fathy El (2020). Rice Production in Egypt: The Challenges of Climate Change andWater Deficiency, Springer Nature Switzerland AG ,2020, publication at: https://www.researchgate.net/publication/340516277

IPCC Climate Change (2014). Synthesis Report. In Contribution of Working Groups , "Report of the Intergovernmental Panel on Climate Change ",Geneva, Switzerland, 2014.

Kassem HS. Abdel Raouf SB. Bader MAl. Fahd OAl, Gary SS (2019). "Climate Change Adaptation

in the Delta Nile Region of Egypt: Implications for Agricultural Extension" *Sustainability* 11, no. 3: 685.
https://doi.org/10.3390/su11030685

Kheir AMS, El Baroudy A, Aiad MA, Zoghdan MG, Abd El-Aziz MA, Ali MGM, Fullen MA (2019). Impacts of rising temperature, carbon dioxide concentration and sea level on wheat production in North Nile delta. Sci Total Environ. 2019 Feb 15;651(Pt 2):3161-3173. doi: 10.1016/j.scitotenv.2018.10.209. Epub 2018 Oct 16. PMID: 30463166.

Madhu B (2019). Role of Information, Communication and Technology (ICT) in Rural Development. Paper presented at National Seminar on Rural Development Paradigms and Livelihood Security in India, Maharaja Agrasen Mahavidyalaya, Jagadhri, Haryana (India). March 1-2, 2019

Mahmoud MF, Sarhan AS (2016). The Potential Scenarios of the Impacts of Climate Change on Egyptian Resources and Agricultural Plant Production. Open Journal of Applied Sciences. Vol.6. 270-268. 10.4236/ojapps.2016.64027.

McCarl BA, Musumba M, Smith JB, Kirshen P, Jones R, El-Ganzori A, Ali MA, Kotb M, El-Shinnawy I, El-Agizy M, Bayoumi M, Hynninen R (2015). Climate change vulnerability and adaptation strategies in Egypt'sagricultural sector. Mitig. Adapt. Strateg. Glob. Chang Mitigation and Adaptation Strategies for Global Change. 20 (7): 1097-1109
http://dx.doi.org/10.1007/s11027-013-9520-9

Mohamed B, Olaf P, Himangana G (2019). Climate Change, Food Security and Natural Resource Management,Regional Case Studies from Three Continents, Springer Nature Switzerland AG, 2019.
https://doi.org/10.1007/978-3-319-97091-2

Omar MM, Ahmed MAM, Reinhard H (2021). Impacts of climate change on water quantity, water salinity, food security, and socioeconomy in Egypt, Water Science and Engineering, Volume 14, Issue 1, 2021,

Mostafa, Soha M, Osama W, Walaa YEl, Samia MEl, Martina Z, Hany FA (2021). "Potential Climate Change Impacts on Water Resources in Egypt" Water 13, no. 12: 1715. https://doi.org/10.3390/w13121715Samiha Ouda , Abd El-Hafeez Zohry ,Tahany Noreldin,"Deficit Irrigation A Remedy for Water Scarcity", (eBook), Springer Nature Switzerland ,AG, 2020

Tetsuji T (2018). Agricultural Self-sufficiency and Market Stability: A Revenue-neutral Approach to Wheat Sector in Egypt, Journal of Food Security, 2018, Vol. 6, No. 1, 31-41, Available online at http://pubs.sciepub.com/jfs/6/1/4

Tetsuji T (2018). Agricultural Self-sufficiency and Market Stability: A Revenue-neutral Approach to Wheat Sector in Egypt, Journal of Food Security, Vol. 6, No. 1, 2018. Available online at http://pubs.sciepub.com/jfs/6/1/4 ©Science and Education Publishing DOI:10.12691/jfs-6-1-4

Zeydan BA (2005). The Nile Delta in a global vision. In Proceedings of the Ninth International Water Technology Conference 2005, Sharm El-Sheikh, Egypt, 17–20 March 2005; Mansoura University.

باشا، رانيا حمدي عبد الصادق، الخولي، محمد إبراهيم عبد الحميد (٢٠١٨). دراسة تحليلية لإدراك الزراع للتغيرات المناخية وتأثيرها علي الإنتاج الزراعي في محافظة الشرقية، مجلة الزقازيق للبحوث الزراعية، مجلد ٤٥، عدد ٦أ.

حسين ، أحمد عنتر بخيت (٢٠٢١). معارف زراع القمح بآثار التغيرات المناخية على إنتاجيتهم المحصولية وكيفية مواجهتها ببعض قرى منطقة العامرية بمحافظة الإسكندرية .المجلة العربية للعلوم الزراعية، المؤسسة العربية للتربية والعلوم والآداب، مج 4 ، ع 11 ، ص ص22 – 1

خطاب، مجدي عبد الوهاب، والشاذلي، محمد فتحي، وأنور، الصاوي محمد، وصالح، محمد صبري (٢٠١٦). التحليل العاملي لنظام نقل أثر التدريب في كلية الزراعة –جامعة الإسكندرية، مجلة الإسكندرية للتبادل العلمي، مجلد ٣٧، العدد ١، صفحات ٧٠–٨٣.

فرج، صفوت (١٩٨٠). التحليل العاملي في العلوم السلوكية، دار الفكر العربي، القاهرة.

فرج، محمد، وخليل، فائزة (٢٠١٤). استخدام التحليل العاملي في تحديد أهم العوامل التي تؤثر في هجرة الكفاءات العلمية السودانية: دراسة اقتصادية إحصائية لحالة الكفاءات العلمية السودانية بالمملكة العربية السعودية، أماراباك، مجلد(٥)، عدد(١٢).

الملخص العربي

ممارسات مزارعي القمح للتوافق مع تغير المناخ في دلتا نهر النيل بمصر

رضوة ماهر عطا وأحمد عبد الحميد محمد فهمي

قسم المجتمع الريفي والإرشاد الزراعي، كلية الزراعة، جامعة القاهرة، القاهرة، مصر

يعاني زراع القمح في دلتا نهر النيل بمصر من الحساسية لتغير المناخ وخاصة التباينات الشديدة في الاحوال المائية المناخية. فظواهر مثل الأمطار الغزيرة والجفاف وتملح التربة تؤثر بشكل متزايد وسلبي على إنتاج وإنتاجية محاصيلهم، بما يؤدي إلي آثار بعيده المدي علي أوضاعهم الاجتماعية والاقتصادية والبيئية. ويمكن لخدمات المعلومات الدقيقة عن الاحوال المائية المناخية، والتي يتم توصيلها للمزارعين في الوقت المناسب، أن تساعد المزارعين في تحسين استجابتهم لهذه التغيرات وبالتالي تحسين عملية اتخاذ القرارات المزرعية.

تستهدف هذه الدراسة الاجابة علي الأسئلة التالية: ما هى الحزمة الفنية المتاحة حالياً لأفضل الممارسات المتعلقة بإدارة محصول القمح خاصة تلك الممارسات التي تستجيب للضغوط المتعلقة بالمناخ، ما هي مستويات تطبيق أو تبني هذه الممارسات بين مزارعي القمح في دلتا نهر النيل بمصر، ما هي العلاقات بين مستويات تطبيق أو تبني خصائص هؤلاء المزارعين، وقد أجريت الدراسة في ثلاث قري مركو سيدي سالم وهي (دمرو، وكوم الدهب، ومنشأ عباس) بمحافظة كفر الشيخ والتي تقع في شمال مصر علي طول فرع النيل الغربي. وبالرجوع إلي الدراسات البحثية الحديثة تم تحديد ٢٨ ممارسة متعلقة بالتوافق مع ضغوط الماء والمناخ في دلتا نهر النيل بمصر. وقد تم جمع البيانات الميدانية من خلال المقابلة الشخصية مع ٢٧٨ مزارعاً وذلك باستخدام استبيان تم تصميمه لأغراض جمع البيانات.

ويمكن تلخيص أهم النتائج على النحو التالي:

- أتضح أن المزارعين المبحوثين لديهم قدرة علي الوصول إلي المعلومات من خلال خمس مصادر رئيسية وهي الاتصالات الرسمية، والاتصالات الغير رسمية، وبرامج التعليم والتدريب، ووسائل الاعلام الجماهيري التقليدية (التليفزيون)، وكذلك وسائل الاتصال والمعلومات الحديثة والتواصل الاجتماعي، ورغم ذلك فإن الاتصالات غير الرسمية وخاصة مع المزارعين وتجار مستلزمات الانتاج من القطاع الخاص كانوا المصدر الرئيسي لمعلومات المزارعين وذلك بالاضافة إلي خبرات المزارعين السابقة.
- لقد أظهر المزارعين احتياجهم إلي معلومات أكثر دقة ومحدده بتوقيت واضح وموثوقة ويمكن تنفيذعا وتطبيقها لتحسين عملية اتخاذ القرارات الزراعية، وعليه تم استنتاج أن هناك إمكانات واحتياج عالي لخدمات معلومات متعلقة بالظروف أو التباينات المائية المناخية بحث تكون معده لظروف المزارعين في منطقة الدراسة.
- توضح النتائج أن غالبية الزراع المبحوثين بنسبة (٧٠.١%) يتسمون بمستوي تنفيذي متوسط بينما (١٤.٧%) مستوي تنفيذهم منخفض، وهذا يشير إلي أن غالبيتهم لايقومون بتنفيذ العمليات الزراعية المتعلقة بتحقيق تكيفهم الزراعي لمحصول القمح في ظل التغيرات المناخية الجارية، على الرغم من أن تلك الممارسات لو تم تنفيذها يمكن أن تحقق زيادة ملموسة في إنتاجية محصول القمح وتجنبه لبعض المشاكل الإنتاجية الناجمة عن التغيرات المناخية.
- أظهرت نتائج التحليل العاملي وجود ثلاثة عوامل رئيسية معبره عن درجة ممارسات الزراع المبحوثين المتعلقة بالتوصيات الفنية الخاصة بتفادي آثار التغيرات المناخية علي إنتاجية محصول القمح وهي، كفاءة الانتاج الزراعي وتتضمن ثلاثة متغيرات، والمعلومات المبتكرة والجديرة بالثقة ويتضمن أربع متغيرات، والتأثير الشخصي القائم علي الخبرة ويتضمن ثلاثة متغيرات، وتفسر العوامل الثلاثة مجتمعة ٥٢.٣٤ % من التباين الكلى في درجة ممارسات الزراع المبحوثين المتعلقة بالتوصيات الفنية الخاصة بتفادي آثار التغيرات المناخية علي إنتاجية محصول القمح.

الكلمات المفتاحية: المعلومات المائية والمناخية ؛ قرارات زراعية؛ دلتا النيل؛ مصر