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RESEARCH ARTICLE OPEN ACCESS

ESTIMATING THE WATER NEEDS OF WHEAT CROP IN LIGHT OF CLIMATIC CHANGES IN BENI SUEF GOVERNORATE

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ABSTRACT

The water needs of agricultural crops are one of the most important factors affecting the selection of crops suitable for agriculture, which affect crop productivity and thus the availability of human food. The problem of the study is the limited water resources, which is one of the most important reasons for the food gap of grain crops, including wheat, and the problem of water losses has a negative impact on the amount of available water resources and thus affecting the productivity of agricultural crops in general and grain crops in particular, the most important of which is the crop Wheat.

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INTRODUCTION

Water is the lifeblood of life, and no living creature can survive without it. The estimated amount of water in the world is about 1500 million cubic kilometers, covering about 71% of the Earth's area. The water needs of agricultural crops are one of the most important factors affecting the selection of crops suitable for agriculture, which affect the productivity of crops and thus the availability of human food. Also, being familiar with them is of great importance in the field of planning and managing water resources. It is estimated that the wheat crop is one of the most important grain crops, with an area of 3.16 million feddans, representing about 44.37% of the total grain area, which amounted to 7.28 million feddans, representing about 45.34% of the total cropped area, which amounted to about 16.06% million feddans in 2018. The main objective of the research is to estimate the water needs of wheat crop in Beni Suef Governorate. The research relied on methods of descriptive and quantitative statistical analysis of secondary data, in addition to the use of statistical methods of analysis. The Cropwat program was used to estimate the water needs of the wheat crop in BeniSuef Governorate.

The most important results were

1. The average quantity of wheat production in Egypt during the period (2005-2020) reached about 8514 thousand tons, and this quantity is increasing around its arithmetic average due to the limited area cultivated with wheat.
2. The average imports of wheat crop during the same period were estimated at 8,573 thousand tons, and it was found that the food gap of wheat increased as a result of the increase in domestic consumption over domestic product.
3. The average consumption of wheat was estimated at 17,009 thousand tons during the study period.
4. The average nutritional gap of wheat was estimated at 8495 thousand tons due to the insufficiency of local production for consumption of the crop to increase the population, and the limited cultivated area of the crop.
5. The average self-sufficiency of wheat was estimated at 51% during the study period due to the population's dependence on the crop mainly.

6 The average annual per capita share of wheat during the study period was about 137 kg / year, and it was found that it fluctuates around its arithmetic average.
7 BeniSuef governorate is considered one of the most important governorates in Central Egypt in cultivating the wheat crop with a percentage of 21.59% of the area of the region, and a rate of 3.99% of the wheat area in the Republic during the study period. The governorate's total production of wheat reached 22.51% of the region's production, with a rate of 4.27% of the total production of the Republic, with a feddan productivity of 2.96 tons / feddan during the study period.
8 The average amount of water available in Egypt was about 74.12 billion cubic meters during the study period.
9 The average water rating is estimated at 1906 m3 / feddan, which indicates that the wheat crop is one of the crops that have a relatively high water ration.
10 The amount of irrigation water lost for wheat crop in BeniSuef Governorate reached an annual average of 78.39 cubic meters/feddan/ season.
11 The water requirement for the wheat season in total in BeniSuef Governorate was about 1185.66 cubic meters / feddan / season.

Research problem: The limited water resources are one of the most important reasons for the food gap of cereal crops, including wheat, and the problem of water losses has a negative impact on the amount of available water resources and thus affects the productivity of agricultural crops in general and grain crops in particular, the most important of which is the wheat crop.

The aim of the research: The research mainly aims to estimate the water needs of wheat crop in light of climatic changes in BeniSuef Governorate, through:

Studying the current situation of wheat production and consumption in Egypt.- 1
2- Studying the relative importance of the cultivated area, production and productivity of wheat crop in BeniSuef Governorate.
3- Studying the current status of water resources, their sources and their uses.
4- Estimation of the water meter and the productivity efficiency of a cubic meter of it for wheat crop in BeniSuef Governorate.
5- Estimation of the water needs of wheat crop in BeniSuef Governorate.

Research method and data sources: The research relied on the methods of descriptive and quantitative statistical analysis of secondary data, in addition to the use of statistical methods of analysis. The Cropwat program was used to estimate the water needs of the wheat crop in BeniSuef Governorate. The research also relied on the secondary data of the Economic Affairs Sector of the Ministry of Agriculture and Land Reclamation and the bulletins issued by the Central Agency for Public Mobilization and Statistics, the data of the secondary bulletin for statistics of irrigation and water resources, the annual bulletin of environment statistics, in addition to the data of the Central Laboratory for Agricultural Climate, the General Authority for Meteorology.

DISCUSS THE RESULTS

First: The current situation of production, consumption and self-sufficiency of the wheat crop in Egypt:

It is clear from the study of the data in Table No. (1)

Table 1. The current situation of the most important variables of the wheat crop and self-sufficiency rates in Egypt during the period (2005-2020)

the years	Production quantity (thousand tons)	Import quantity (thousand tons)	Consumption (thousand tons)	Gap (thousand tons)	Self-sufficiency%	Per capita (kg/year)
2005	8141	5688	13352	5211	61.0	135.0
2006	8274	5811	14257	5983	58.0	141.2
2007	7379	5911	13771	6393	53.6	132.9
2008	7977	4078	14545	6568	54.8	136.6
2009	8523	4060	14593	6070	58.4	135.4
2010	7169	9774	14980	7811	47.9	133.9
2011	8371	9800	16878	8507	49.6	135.0
2012	8795	6538	15659	6863	56.2	121.7
2013	9460	7870	17210	7750	55.0	132.3
2014	9280	8126	17025	7745	54.0	127.5
2015	9608	9001	18411	8803	52.2	128.8
2016	9345	10820	19410	10065	48.1	133.0
2017	8421	12061	19707	11286	42.7	148.6
2018	8346	12390	19714	11369	42.3	145.7
2019	8559	12493	20847	12288	41.1	149.5
2020	8580	12747	2180	13200	39.4	148.8
average	8514	8573	17009	8495	51.0	137.0

Source: Compiled and calculated from the Ministry of Agriculture and Land Reclamation - Food Balance Bulletin - Miscellaneous Issues

Local production: It turns out that the minimum quantity of wheat production in Egypt amounted to about 8141 thousand tons in 2005, while the maximum production amounted to 9608 thousand tons in 2015 with an average of 8514 thousand tons during the period (2005-2020), and by studying Table No. (2) of the general time trend equations Equation No. (1) shows that there is a statistically insignificant annual increase - which indicates that the local production of wheat crop in Egypt is increasing around its arithmetic average, during the study period, which is attributed to the limited area planted with the wheat crop, as well as the continuous increase in the population, despite From the increase in acre productivity of different varieties of the crop in Egypt.

Imports: The data of Table No. (2) showed that the imports of the wheat crop ranged between a minimum of about 4,060 thousand tons during 2009, and a maximum of about 12,747 thousand tons during the year 2020. The average imports of the wheat crop during the study period were estimated at 8,573 thousand tons. The time series trend equation No. (2) in Table No. (2) showed that the wheat crop imports have taken an annual increasing time trend and statistically significant estimated at 552.4 thousand tons, representing about 6.5% of the average imports during

the study period, due to the increase in the food gap of wheat resulting from the excess of consumption over the domestic product and thus relying on imports to try to bridge that gap.

Table 2. Equations of the general time trend of wheat variables in Egypt during the period (2005-2020)

Equation number	Variable	The equation	R2	F	Average
1	Production quantity (thousand tons)	Y=7935+68.03x (1.9)	0.23	3.99	8514
2	Import quantity (thousand tons)	Y=3877.6+552.4x (6.69)**	0.76	44.83**	8573
3	Consumption (thousand tons)	Y=12298.9+554.1 (17.5)**	0.96	306.5**	17009
4	Food gap (thousand tons)	Y=4362.9+486.06x (10.5)**	0.89	110.7**	8495
5	Self-sufficiency %	Y=61.1-1.19x (5.97)**	0.72	35.6**	51
6	Per capita (kg/year)	Y=130.25+0.749x (1.83)	0.19	3.35	137

Source: compiled and calculated from Table No.(1)

Consumption: It was clear from the data of Table No. (2) that the consumption of the wheat crop during the period (2005-2020) ranged between a minimum of about 13352 thousand tons at the beginning of the studied period, and a maximum of about 21,780 thousand tons at the end of the period - this is naturally due to the increase The successive population, where the population mainly depends on wheat, while the average consumption of the wheat crop in Egypt during the period (2005-2020) was estimated at 17,009 thousand tons. The general time trend equation No. (3) in Table No. (2) showed that the amount of consumption It took a general time trend that increased annually and statistically significant, estimated at 552.1 thousand tons, representing about 3.24% of the average amount of consumption during the period.

The Nutritional gap: The data of Table No. (1) showed that the food gap of the wheat crop reached its minimum at the beginning of the period, estimated at 5,211 thousand tons in 2005, while it continued to increase until it reached the maximum limit at the end of the period by about 13,200 thousand tons, where the average food gap was estimated Of wheat in Egypt during the study period about 8495 thousand tons. The general time trend equation No. (4) in Table No. (2) showed that the nutritional gap of the wheat crop has taken a general trend that increases annually and is statistically significant, estimated at about486.06 thousand tons, representing 5.7% of the average of the study period, due to insufficient local production for consumption of the crop as a result of the steady increase in population numbers, as well as the limited cultivated areas of the crop.

Self-sufficiency: The data of Table (1) indicated that the percentage of self-sufficiency of the wheat crop reached a minimum of 39.4% in 2020, while its maximum was 61% during 2005, with an average estimated at 51% during the study period. The general time trend equation No. (5) in the table showed No. (7) that the self-sufficiency of the wheat crop has taken a decreasing annual and statistically significant temporal trend estimated at 1.19%, representing about 2.3% of the average self-sufficiency rate during the study period, due to the limited cultivated area of the crop, as well as the continuous population increase and the dependence of the population The crop is mainly represented in the loaf of bread.

Average per Capita Share: The data of Table No. (1) indicated that the average annual per capita share of the wheat crop ranged between a minimum of about 121.7 kg during 2012, and a maximum of about 149.5 kg during the year 2019, and the average per capita share of wheat during the study period was estimated at about 137 kg/year. The general time trend equation No. (6) in Table No. (2) showed that the per capita share of the wheat crop has taken an annual decreasing time trend and is not statistically significant, which indicates that the average annual per capita share of wheat fluctuates around its arithmetic average during the study period.

The relative importance of the cultivated area, production and productivity of the wheat crop in BeniSuef Governorate: The wheat crop is one of the most important cereal crops cultivated in the winter season, as the annual average of the area planted with the wheat crop reached about 3.15 million feddans during the period (2016-2018), equivalent to about 92.02% of the total area planted with grain crops, including 1.64 million feddans in Lower Egypt and about , 0.085 million feddans in the governorates of Central Egypt, or 18.49%, and about 0.61million feddans in the governorates of Upper Egypt, at a rate of 19.43%. BeniSuef governorate is considered one of the most important governorates of Central Egypt in the cultivation of wheat, as the average cultivated area in the governorate reached 53.125 thousand feddans during (2016-2018), representing 21.59% of the area of the region (58,146 thousand feddans), 3.99% of the wheat area in the Republic. The total production of BeniSuef Governorate amounted to 371.93 thousand tons, representing about 22.51% of the region. 4.27% of the total of the Republic, and the feddan productivity reached 2.96 tons / feddan. It is clear from the data of Table No. (3) that the annual average of the area of wheat in BeniSuef Governorate amounted to about 133.6 thousand acres, representing about 4.28 percent of the total average of the republic's area during the period (2005-2018), which is about 3.1 million acres, as the total production of the crop contributed Wheat in BeniSuef governorate during the study period was about 379.9 thousand tons, representing about 4.47% of the total annual average of the republic, which amounted to about 8.5 million tons during the study period, while the average acre productivity of the crop in BeniSuef governorate was about 2.8 tons / feddan, and the average acre productivity of its theory on The level of the republic is about 2.7 tons / feddan, which indicates that BeniSuef governorate is one of the important governorates in the production of wheat crop in Egypt, and the varieties grown in the governorate are characterized by their high productivity.

Table 3. The most important variables of the wheat crop in BeniSuef Governorate during the period (2005-2018)

	Republic			BaniSweif				
the years	Area (thousand Feddan)	production thousand tons)	Productivity	Area (thousand feddan)	% of the Republic	Production (thousandtons)	% of the Republic	Productivity (tons/feddan)
2005	2985.29	8140.87	2.727	142.9	4.79	394.7	4.85	2.72
2006	3063.70	8275.06	2.701	147.5	4.81	403.0	4.87	2.73
2007	2715.53	7378.09	2.717	116.2	4.28	338.8	4.59	2.54
2008	2920.38	7978.49	2.732	136.0	4.66	391.6	4.91	2.87
2009	3147.03	8522.15	2.708	139.5	4.43	404.7	4.75	2.90
2010	3001.38	7170.30	2.389	127.7	4.25	304.6	4.25	2.39
2011	3048.60	8371.46	2.746	130.6	4.28	378.3	4.52	2.89
2012	3160.66	8796.12	2.783	126.1	3.99	360.3	4.10	2.86
2013	3377.88	9461.43	2.801	142.6	4.22	420.4	4.44	2.95
2014	3393.00	9279.86	2.735	140.6	4.14	381.4	4.11	2.74
2015	3468.86	9608.75	2.77	143.9	4.15	425.5	4.43	2.95
2016	3353.15	9341.88	2.786	132.3	3.95	412.6	4.42	3.12
2017	2921.72	8420.38	2.882	119.9	4.10	355.8	4.23	2.80
2018	3156.84	8346.67	2.644	124.3	3.94	347.3	4.16	2.70
average	3122.43	8502.15	2.72	133.6	4.28	379.9	4.47	2.8

Source: Ministry of Agriculture and Land Reclamation - Economic Affairs Sector - Winter Agricultural Statistics Bulletin - Miscellaneous Issues.

Second: The current status of water resources, their sources and use: By reviewing the evidence of Table No. (4) for the development of water resources in Egypt during the period (2005-2018), it is clear that the amount of water available from the Nile River is stable, estimated at 55.5 billion cubic meters annually, while the annual average of the amount of water resources available from each of the treatment of agricultural drainage and water Underground, sewage treatment, rain, torrential rain and sea water desalination are about 9.18, 6.96, 1.26, 1.12 and 0.011 billion cubic meters, respectively, and the total average amount of water available in Egypt is about 74.12 billion cubic meters during the study period.

Table 4. The development of available water resources in Egypt during the period (2005-2018) in billion cubic meters

the years	The Nile River	waste water treatment	underground water	sewage treatment	rain and torrential	Seawater desalination	Total
2005	55.5	5.1	6.1	1.1	1.3	0.06	69.16
2006	55.5	5.4	6.1	1.2	1.3	0.06	69.56
2007	55.5	5.7	6.1	1.3	1.3	0.06	69.96
2008	55.5	8.0	6.2	1.3	1.3	0.06	72.36
2009	55.5	9.65	6.25	1.1	1.1	0.06	73.66
2010	55.5	8.90	6.3	1.3	1.3	0.05	73.35
2011	55.5	9.3	6.3	1.3	1.29	0.06	73.75
2012	55.5	9.3	7.5	1.3	0.63	0.06	74.29
2013	55.5	9.7	7.7	1.3	0.7	0.1	75.00
2014	55.5	10.1	6.7	1.3	0.9	0.1	74.60
2015	55.5	11.5	6.9	1.2	0.9	0.1	76.10
2016	55.5	11.8	6.9	1.3	0.65	0.1	76.25
2017	55.5	11.8	9.0	1.3	1.65	0.35	79.60
2018	55.5	12.2	9.45	1.3	1.3	0.35	80.10
average	55.5	9.18	6.96	1.26	1.12	0.11	74.12
%of the total	80.25	12.38	9.40	1.70	1.51	0.15	100

Source: 1- Central Agency for Public Mobilization and Statistics - Annual Bulletin of Irrigation and Water Resources Statistics.

Central Agency for Public Mobilization and Statistics - Annual Environment Bulletin: Equation No. (1) in Table No. (5) indicates that the amount of treated water from agricultural drainage has taken an increasing general trend during the study period, with a statistically significant annual increase estimated at 0.54 billion cubic meters of water, representing about 5.9% of its average. The determination is about 0.90, which indicates that about 90%Some of the changes in the amount of treated water from agricultural wastewater are due to factors that are reflected in the time factor - as this refers to the efforts made to make maximum use of water treatment resulting from agricultural wastewater, which is reused several times to be used in the cultivation of other crops.

Table 5. Equations of the time series trend of the available water resources and the amount of water used in agriculture in Egypt during the period (2005-2018)

equation number	Variable	The equation	R2	F	average
1	Treated water from agricultural drainage (billion m3)	Y=5.11+0.54x (10.5)**	0.90	111.5	9.18
2	Ground water (billion m3)	Y=5.4+0.21x (4.6)**	0. 65	21.78**	6.96
3	Wastewater treatment (billion m3)	Y=1.19+0.009x (1.9)*	0.26	3.7*	1.26
4	Rain and flood waters (billion m3)	Y=1.25-0.02x (0.88)	0.06	0.77	1.12
5	Sea water desalination (billion m3)	Y=0.02+0.02x (** 3.6)	0.51	12.4**	0.11
6	Total water resources (billion m3)	Y=68.4+0.76x (12.11)**	0.92	146.7**	74.12
7	Total amount of water used in agriculture (billion m3)	Y=59.05+0.26x (5.3)**	0.71	28.4**	60.98

Source: collected and calculated from the data in Tables No. (5,7)

As equation No. (2) in Table No. (5) shows that the amount of water available from groundwater has taken an increasing general trend during the study period, with a statistically significant annual increase estimated at 0.21 billion cubic meters of water, representing about 3.01% of its average. The determination is about 0.65, which indicates that about 65% of the changes in the amount of groundwater are due to factors that are reflected in the time factor.

Equation No. (3) in Table No. (5) indicates that the amount of water available from treated water from sewage has taken an increasing general trend during the study period with a statistically significant annual increase estimated at 0.009 billion cubic meters of water, representing about 0.71% of its average. The coefficient of determination was about 0.26, which indicates that about 26% of the changes in the amount of treated wastewater are due to factors reflected by the time factor - which indicates that there is a slight annual increase of no more than 0.7% that occurs in the amount of water resulting from wastewater treatment. The health system regulates its use, and this may be attributed to some health considerations in the use of this water and its reuse in the agricultural sector.

Equation No. (4) in Table (5) shows that the amount of water available from rain and floods has taken a general decreasing and not statistically significant trend during the study period - which indicates the fluctuation of the amount of water resources resulting from rain and torrential water fluctuates around its arithmetic average of about 1.12 billion cubic meter, which represents about 1.5% of the total average amount of resources available during the study period - this may be due to the fact that Egypt is one of the areas that does not depend on rain and floods among its main resources in the available water resources .

Equation No. (5) in Table No. (5) shows that the water from seawater desalination has taken an increasing general trend during the study period, with a statistically significant annual increase estimated at 0.02 billion cubic meters of water, representing about 18.18% of its average, and the coefficient of determination reached about 0.51 which indicates that about 51% of the changes in the amount of seawater desalination water are affected by factors that are reflected in the time factor - where the average amount of desalinated seawater during the study period represents about 0.14% of the total average of water resources and this is attributed to the large cost of desalination per square metre. A cube of sea water, which is estimated at ..... pounds / acre.

Equation No. (6) of Table No. (5) shows that the total amount of available water has taken an increasing general trend during the study period, with a statistically significant annual increase estimated at about 0.76 billion cubic meters, representing about 1.2% annually of its arithmetic average during the study period, and the coefficient reached The determination is about 0.92, which indicates 92% of the changes in the amount of available total resources are reflected in the factors of time - it is also clear from Table No. (6) that the amount of water used in agriculture during the study period is estimated at about 60.98It was also shown from equation No. (7) in Table No. (5) that the water used in agriculture has taken a general increasing trend during the study period, with an annual increase estimated at 0.26 billion cubic meters, representing about 0.5% of its average during the study period billion cubic meters, which represents approximately 83% of the total average The amount of water available .

Water meter and production efficiency per cubic meter of water meter for wheat crop*:* It is evident from Table No. (7) that the productivity of a cubic meter of water metered for wheat crop ranged between a minimum of about 1.28 kg / m 3 in 2014, where the water ration was estimated at 2135 m 3 / feddan, and the feddan productivity was about 2740 kg / ft, and a maximum of 1.74 kg / m 3 in 2005, with a water ration of about 1560 m 3 / fed, and a feddan productivity estimated at 2720 kg / fed, and the average water rating of about 1906.8 m 3 / fed during the study period.

Table 7. Feddan productivity and water ration and as part of GDP

the year	feddan productivity (kg/feddan)	Water meter (m3/fed)	Production efficiency per cubic meter kg/m3
2005	2727	1560	1.75
2006	2701	1828	1.48
2007	2717	1872	1.45
2008	2732	1868	1.46
2009	2708	1678	1.61
2010	2389	1734	1.38
2011	2746	1667	1.65
2012	2783	1726	1.61
2013	2801	2085	1.34
2014	2735	2135	1.28
2015	2770	2113	1.31
2016	2768	2039	1.21
2017	2882	2035	1.42
2018	2644	2085	1.28
average	2005	1390	1.34

Source: Compiled and calculated from

1- Data of the Central Agency for Public Mobilization and Statistics, Irrigation and Water Resources Bulletin.
2- Ministry of Agriculture and Land Reclamation, Economic Affairs Sector, Agricultural Statistics Bulletins.

Table No. (8) indicates that the average area cultivated with wheat in the average of the last five years amounted to about 132.2 thousand feddans for the wheat crop, and that the average water ration per feddan of wheat crop was estimated at about 2,134.5 cubic meters per feddan, where the total water ration for the area The average cultivated land for that period amounted to 282.5 thousand cubic meters - which indicates that the wheat crop is one of the crops that have a relatively high water rating, and it is possible to develop and cultivate varieties with low water standards and high productivity or close to the productivity of an acre of wheat crop in BeniSuef Governorate The average per acre productivity was estimated as an average for that period of 2.9 tons / acre .However, the limited water that has occurred in the production variables of crops during the recent times necessitates taking into account the varieties with low water rates, which can be abundant in their cultivation areas in the governorates of Egypt.

Table 8. Area, productivity and water rations of wheat crop in BeniSuef Governorate during the period (2014-2018)

the years	Area (thousand feddan)	Productivity (tons/feddan)	Water meter (m3/fed)	Total water ration for wheat (thousand m3)
2014	140.6	2.74	2135	300.2
2015	143.9	2.95	2113	304.1
2016	132.3	3.12	2309	305.5
2017	119.9	2.80	2035	244.0
2018	124.3	2.70	2085	259.2
average	132.2	2.9	2135.4	282.5

Source: Central Agency for Public Mobilization and Statistics - Annual Bulletin of Castration of Irrigation and Water Resources (sporadic issues)

Water losses of the area planted with wheat in BeniSuef Governorate: It is evident from Table No. (9) that the amount of irrigation water losses in Beni Suef between Aswan and the field ranged between a minimum of 77.37 cubic meters / feddan in 2017 and a maximum of 157.24 cubic meters / feddan in 2006 with an annual average of 78.39 cubic meters / feddan.

Water needs of wheat crop in BeniSuef Governorate: It is clear from Table No. (11) that the wheat crop in BeniSuef governorate reached a coefficient of about 0.30 during the initial growth period, and it is clear that the initial growth phase of the crop's life was divided into three growth periods, two of which were in November, when the actual water requirement was about 0.61 and 0.55 mm / day, and the third growth period was in December, for which the actual water need was estimated at about 0.50 mm / day, and during the three growth periods, it was found that the reference evapotranspiration was about 2.03, 1.83, 1.67 mm / day, respectively, and it was found that the actual need for the crop was 0.6, 5.2, 4.8 mm/period, respectively.

Table 9. Water losses of wheat crop in Egypt and BeniSuef during the period (2005-2018)

the years	Republic		BeniSuef	
	Cultivated area (thousand feddan)	Lost between Aswan and the field	Cultivated area (thousand acres)	The amount of wastage m3/f
2005	2985.29	761	142.9	108.75
2006	3063.7	1066	147.5	157.24
2007	2715.53	799	116.2	92.84
2008	2920.38	897	136	121.99
2009	3147.03	884	139.5	123.32
2010	3001.38	894	127.7	114.16
2011	3048.6	843	130.6	110.10
2012	3160.66	902	126.1	113.74
2013	3377.88	792	142.6	112.94
2014	3393.00	675	140.6	94.91
2015	3468.86	671	143.9	96.56
2016	3353.15	641	132.3	84.80
2017	2921.72	645	119.9	77.34
2018	3156.84	643	124.3	81.07
average	3122.4	585	133.5	78.39

Source: 1- Central Agency for Public Mobilization and Statistics - Irrigation and Water Resources Bulletin. 2- Data of the Directorate of Agriculture in BeniSuef

Water needs of wheat crop in BeniSuef Governorate: It is clear from Table No. (11) that the wheat crop in BeniSuef governorate reached a coefficient of about 0.30 during the initial growth period, and it is clear that the initial growth phase of the crop's life was divided into three growth periods, two of which were in November, when the actual water requirement was about 0.61 and 0.55 mm / day, and the third growth period was in December, for which the actual water need was estimated at about 0.50 mm / day, and during the three growth periods, it was found that the reference evapotranspiration was about 2.03, 1.83, 1.67 mm / day, respectively, and it was found that the actual need for the crop was 0.6, 5.2, 4.8 mm/period, respectively.

Table 10. Stages of water needs for wheat crop in BeniSuef Governorate

the month	Period	growing stages	Yield coefficient KC	Actual water requirement mm/day E/C	Reference evapotranspiration mm/day ETO	Actual water requirement mm/period
November	2	first	0.3	0.61	1.03	0.6
	3	first	0.3	0.55	1.83	5.2
December	2	Development	0.3	0.50	1.67	4.8
	3	Development	0.3	0.45	1.50	4.4
	1	Development	0.44	0.65	1.48	7.1
January	2	Development	0.66	0.96	1.45	9.5
	3	Development	0.86	0.1.24	1.44	12.4
	1	mid season	1.06	1.71	1.61	18.8
February	1	mid season	1.11	1.98	1.78	19.7
	2	mid season	1.11	2.16	1.95	21.5
	3	mid year	1.11	2.52	2.27	20.0
March	1	late year	1.11	2.87	2.59	28.6
	2	late year	1.11	3.22	2.90	32.2
	3	late year	0.97	3.17	3.27	34.9
April	1	late year	0.76	2.76	3.63	27.6
	2	late year	0.55	2.23	4.05	22.3
	3	late year	0.37	1.59	4.30	12.7

Source: CROPWAT FOR WINDOS RESULTS TABLE

Table 11. The average water needs for the growth stages of the wheat crop in BeniSuef Governorate

مرحلة النمو	Yield coefficient KC	Actual water requirement mm/day ETC	Reference evapotranspiration mm/day ETO	Actual water requirement ETC mm/period	Water requirements ETM m3/feddan/season
first	0.30	0.55	1.84	3.53	44.52
Development	0.57	0.83	1.47	8.35	140.28
mid season	1.10	2.25	2.04	21.72	456.12
late season	0.75	2.59	3.63	25.94	544.74
Total					1185.66

Source: collected and calculated from the data of Table No. (10)

As for the stage of development in growth, it took four periods, the first and second periods in December, and the third and fourth in January, with a crop coefficient of 0.30 at the beginning of the stage, and about 0.86 at the end of the stage, and the actual water need during the four periods was about 0.45, 0.65, 0.96, 1.24 mm/ a day, respectively, while the reference evaporation was about 1.5, 1.48, 1.45, 1.44 mm / day, respectively, while the actual water requirement was about 4.4, 7.1, 9.5, 12.4 mm / period, respectively, during that stage .As for the mid-season stage with its five periods, the growth factor of the crop reached 1.06 at the beginning of the period, and about 1.11 at the end of the period, and the actual need was estimated at about 1.71, 1.98, 2.16, 2.52, 2.87 mm / day, respectively, and the reference evapotranspiration during that stage was 1.61, 1.78 , 1.95, 2.27, 2.59 mm / day, respectively, and the total actual need for that stage was 18.8, 19.7, 21.5, 20.0, 28.6 mm / period, respectively. As for the last stage of the season, two periods during the month of March, and three periods during the month of April. The crop coefficient was estimated at 1.11, 0.97, 0.76, 0.55, 0.37 and it was found to be decreasing in preparation for drying the crop and harvester. The actual need was about 3.22, 3.17, 2.76, 2.32, 1.59 mm / day, respectively, and the reference evaporation transpiration was estimated at about 2.90, 3.27, 3.63, 4.05, 4.30 mm/day, respectively, and the actual water requirement was 32.2 mm/period and about 12.7 mm/period at the end of the stage.

Water needs: The amount of water that must be available for plants to grow normally, in addition to the washing needs for soil salinity, and the water lost during the irrigation process - the study was based on the estimation of water needs on the analytical program Cropwat, which depends on the developed Beman-Moneth equation (1) which was recommended by FAO in 1998 It is formulated as follows:

("[{ETO = [0.408X(Rn-G) + Y{ "900" /"T+273" "+U2(ea-ed

Δ+ (Y(1+0.34U2

Where:
ETO = evapotranspiration - crop reference transpiration (mm/day -1(
Rn = net radiation (MJ.m2.Day-1(
G = Soil heat flux (MJ.m2.Day-1(
T = mean temperature (o(
ea = saturated vapor pressure (kilo.Pa. Mo(
ed = real vapor pressure (kilo.Pa. Mo((
U2 = wind speed measured at a height of 2 meters (m/s(
=ΔSlope of the vapor pressure curve (kPa, m5(
=Humidity constant (kPa, m5(
900=Conversion Factor

It is clear from the data of Table No. (11) that the crop coefficient reached its maximum in the mid-season stage, and the lowest at the end of the season, as it was estimated at about 0.30, 0.57. 1.10 and 0.75, respectively, during the planting season, and the actual average need was 0.55, 0.83, 2.25, 2.59 mm/day and about 3.53, 8.35, 21.72, 25.94 mm/period, respectively, during the growth stages, and the reference average evapotranspiration estimated 1.84, 1.47 , 2.04 and 3.63 mm/day, respectively, and the actual water needs in the first stage, development stage, mid-growth stage, and the end of the season were about 44.52, 140.28, 456.12, and 544.74 m3/f, respectively. Cubic / acre / season.

RECOMMENDATIONS

- Developing the methods used to determine the water needs in the governorates, taking into consideration the climatic and technical variables of the wheat crop.
- The speed of lining canals and drains to reduce losses due to water leakage.
- Developing and using modern irrigation systems to make the best use of water resources.
- Raising awareness of farmers about the water needs required for the wheat crop to achieve a minimum of those needs.
- Development and cultivation of varieties that have low water rates and high productivity or close to the productivity of an acre of wheat crop.
- the reviewer:
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- Nasser Suleiman Al-Omari, a comparative study of evapotranspiration estimation methods for the central and eastern regions of the Kingdom of Saudi Arabia using a number of climatic models, Department of Water Resources Science and Management, King Abdulaziz University, 2013.
- Ministry of Agriculture and Land Reclamation, Economic Affairs Sector, Agricultural Statistics Bulletin.

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