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The Economic Effects of applying water management technology on the productivity of the most important field crops in Egypt (Study of the case of sugar beet crop in El Sharkia Governorate)

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Abstract: The agricultural sector is one of the most vital and important sectors in the Egyptian economy as one of the pillars of economic and social development due to its vital and effective role in economic activity. This sector has showed significant development in recently due to the applying modern and advanced technological methods that have been reflected in the performance of this sector in general and on increasing the productivity of feddan of most agricultural crops and increasing the efficiency of the use of agricultural resources. The development of the agricultural sector and the provision of food security in a manner that does not conflict with the goal of maximizing the value of agricultural production and preserving agricultural resources remain a key issue in the economic and social development strategy and among the most important challenges it faces now and, in the future, especially with the increasing demand for food commodities as the population continues to increase. Accordingly, the problem of the study can be presented through the following question: How can the highest productivity and the largest return from sugary crops be achieved to narrow the sugar gap in Egypt, as well as increase the efficiency of the use of the economic resources used in the production of these crops. The main objective of the study is to answer the question through which the study problem was presented, which is to obtain the highest productivity and the largest return from sugar crops to help narrow the sugar gap in Egypt while at the same time raising the efficiency of the use of production resources. To achieve the main goal of the study, there are some sub-goals that should be studied, namely, to study the production capacity of sugar cane and sugar beet crops in Egypt, and to study the structure of the production costs of sugary crops in Egypt. estimating some indicators of the economic efficiency of sugar cane and sugar beet crops in Egypt at real prices, estimating some indicators of economic efficiency and productivity of sugar cane and sugar beet crops in Egypt at real prices, The study used both descriptive and quantitative statistical analysis methods such as percentages, averages, table presentations, charts, estimate of general time trend equations and farm budget analysis The study relied on two main sources of data: the first source, namely, published, and unpublished secondary data issued by government agencies such as the economic affairs sector of the Ministry of Agriculture and Land Reclamation, the Central Agency for Public Mobilization and Statistics and the Ministry of Water Resources and Irrigation and the Food and Agriculture Organization (FAO), as well as data from previous studies and research related to the subject of the study. The second source is the cross-section data through the questionnaire form, which is designed to collect field data to serve the objectives of the study through interviews with sugar beet farmers in El Sharkia governorate.
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1. Introduction:

The agricultural sector is one of the most vital and important sectors in the Egyptian economy as one of the pillars of economic and social development due to its vital and effective role in economic activity. This sector has showed significant development in recently due to the applying modern and advanced technological methods that have been reflected in the performance of this sector in general and on increasing the productivity of feddan of most agricultural crops and increasing the efficiency of the use of agricultural resources. The development of the agricultural sector and the provision of food security in a manner that does not conflict with the goal of maximizing the value of agricultural production and preserving agricultural resources remain a key issue in the economic and social development strategy and among the most important challenges it faces now and, in the future, especially with the increasing demand for food commodities as the population continues to increase.

With the challenges currently facing Egypt related to its limited water resources due to its location within the belt of dry areas highly sensitive to its limited water resources coming from outside its geographical borders, Egypt relies on the Nile River as a major source of water supplying it with about 73% of its water needs according to data from 2018/2019, while the available from other sources does not exceed 27% of these Water resources for the same year (1).This is in addition to Egypt (being an estuary state of the Nile) being affected with the development plans of the Nile Basin countries, which lead to increased water uses in these countries, perhaps the most important of these plans is the Ethiopian Renaissance Dam project, which will lead to a decrease in Egypt's annual share by about 9 to 12 billion cubic meters during the years of filling the dam reservoir estimated at about 74 billion cubic meters. Since the Egyptian agriculture sector is one of the most important water-consuming sectors, which alone consumes about 82% of the total available water resources(2). It is expected that this sector will lose about 2 to 3 million feddans from the agricultural lands, represents about 17% of the total agricultural area. Consequently, it was necessary to increase the volume of water resources by seeking new sources or by maintaining the current availability of them using modern methods and means through which the use of this important resource could be rationalized. It has therefore become necessary to adopt national water policies and strategies to meet the challenges arising from water scarcity and unsustainable uses, as well as to maximize the utilization of water resources.

These policies included actions and programs focused on the development of water resources, exploitation of non-traditional sources, maximizing the utilization of available resources, increasing the efficiency of their use, reducing losses and maintaining water quality. This has been accompanied by the Egyptian government taking many measures of development and institutional reform in order to distribute tasks and identify regulatory relations between institutions working in the water sector and encourage the participation of the private sector and users in water management, especially in the work of operation and maintenance and the development of legislative and legal measures to regulate water uses within the limits of available resources.

Research problem:

The horizontal and vertical agricultural expansion are the wings of agricultural development in general, which is now a vital necessity given the critical importance of agricultural development in overall development, and it is known that water resources are the main axis of the horizontal agricultural expansion, and the appropriate use of these resources is of great importance and effectiveness for the growth and increase of agricultural production. The trend towards continuing to apply water management technology as a practical system to rationalize the use of limited water resources and increase the productivity of feddans and thus increase the economic return of farms comes under the national policy, which is based on investing resources as economic efficiency as possible, including improving water efficiency, through the observed reduction in the efficiency of irrigation water uses, hence the importance of studying the effects of the application of water management technologies on the productivity of the most important crops as well as the impact of these technologies on the efficiency of irrigation water use in the cultivation of these crops.

Research goal:

The main goal of the study is to increase the efficiency of irrigation water use by applying recommended water management ways and methods. This is to identify the impact of the application of water management technology on the production efficiency and costs of the sugar beet crop in El Sharkia governorate. By studying some of the secondary goal of estimating the Polynomial Function for the production of sugar beet crop in El Sharkia governorate, indicators of the production and economic efficiency of the sugar beet crop according to the different irrigation systems in El Sharkia governorate, analysis of the farm budget of the sugar beet crop under different irrigation systems, measures of the efficiency of the return on the used water unit according to the different irrigation systems of the sugar beet crop in El Sharkia governorate.

Research method and data sources:

The study used both descriptive and quantitative statistical analysis methods such as percentages, averages, table presentations, estimate of general time trend equations and farm budget analysis, as well as the method of random Polynomial production functions Stochastic Frontier to identify the productive efficiency of the sugar beet crop according to the various irrigation systems in El Sharkia governorate.

The study relied on two main sources of data: the first source, namely, published, and unpublished secondary data issued by government agencies such

[1] - The Central Agency for Public Mobilization and Statistics, **Egypt in Numbers 2019** March 2019.

[2] - The Central Agency for Public Mobilization and Statistics, **Previous reference.**

as the economic affairs sector of the Ministry of Agriculture and Land Reclamation, the Central Agency for Public Mobilization and Statistics and the Ministry of Water Resources and Irrigation, as well as previous studies and research data related to the subject of the study. The second source is the cross-section data through the questionnaire form, which is designed to collect field data to serve the objectives of the study through interviews with sugar beet farmers in El Sharkia governorate with a (60) questionnaire forms divided into (35) forms according to the traditional surface irrigation system and (25) forms according to the developed surface irrigation system using the ditch method during the agricultural season 2018/2019.

Study area:

El Sharkia governorate is one of the largest agricultural governorates in Egypt, where the governorate is famous for growing the following crops: cotton, wheat, summer rice, faba beans, sugar beet and barley. In terms of area of 4,911 km2, it represents 0.09 of Egypt and has a population of about 7.38 % of the total population in Egypt. El Sharkia governorate also ranks third in terms of the area cultivated with sugar beet crop at the level of the republic since it reaches 74,412 feddans representing about 14.37% of the total area planted with sugar beet at the level of the republic, which is about 517,947 feddans in 2019/2020. Total production is 1.43 million tons, representing about 13.87% of the republic's total output of 10.3 million tons in 2019/2020.

Research results:

First- Estimating the Polynomial Function for the production of sugar beet crop in El Sharkia governorate:

The previous model used to estimate the Random Polynomial Function of the sugar beet crop was applied using cross-section data for three samples of sugar beet farmers in El Sharkia governorate under the three surface irrigation systems with 35 views under the traditional surface irrigation system and 25 views under the developed surface irrigation system in the style of padded ditches. It has also been noted that the use of the (SFA) method is based on a specific version of the production function, the Production Function Cobb Douglas, which is illustrated by the following equation:

Q = aB0 X1B1 X2B2 X3B3 X4B4 X5B5 X6B6 X7B7 X8B8 X9B9 e α d

Where:-

Q : The amount of production per ton of sugar beet crop.

X1 : Total area cultivated with sugar beet crop per Feddan.

X2 : The amount of used seeds (Kg)in the production of sugar beet.

X3 : The amount of nitrogen fertilizer used (Kg) (effective units) in the production of sugar beet.

X4 : The amount of phosphate fertilizer used (Kg) (effective units) in the production of sugar beet.

X5 : The amount of machine work measured by the number of working hours in the production of sugar beet.

X6 : The amount of human work (man/day) including family work and the tenant used to produce the crop.

X7 : The amount of pesticides used (Kg) used in the production of sugar beet.

X8 : The amount of water per cubic meter used in the production of sugar beet, which was estimated by the product of multiplying the number of irrigation hours in the leak force per liter per hour, according to the capacity of each machine with the horse due to the different capacity from irrigated to irrigated and has been compared to the water channels at the field by the water resources and irrigation bulletin issued by the Central Agency for Public Mobilization and Statistics.

X9: The value of nutrients and petty expenses in pounds, which includes the value of purchasing Potassium Fertilizer, organic fertilizer, and agricultural gypsum, has been grouped into a value picture because the program used in measurement (FRONTIER) does not deal with zero values.

Table (1) describes the variables used in the model for the sugar beet crop according to the different traditional surface irrigation styles in the field study sample in El Sharkia governorate, such as the average calculation, the lowest value, the greatest value, the standard deviation and the factor of difference or dispersion in order to indicate the size of variations in the use of variables from farm to another.

(a) Estimating the Polynomial function of sugar beet production according to the traditional surface irrigation system:

The Polynomial production function of the sugar beet sample was estimated under the traditional surface irrigation system using the probability maximization method under two assumptions, the first basic assumption (H0) is that the error element of inefficiency is distributed according to the semi-normal distribution and alternative hypothesis (H1) is that the error element of inefficiency is distributed according to the truncated distribution. By comparing the scheduled and calculated value of log-

Likelihood Function for the distribution of the part of the error of technological inefficiency, it has been shown that the optimal distribution of the error element for inefficiency is distributed according to the half-normal distribution. In order to avoid the phenomenon of multicollinearity between independent variables and based on the results of the correlation matrix, the cultivated area element has been removed from the random polynomial production function of the sugar beet crop under the traditional surface irrigation system. Gamma's statistical morale $\gamma = \sigma_u^2 / (\sigma_v^2 + \sigma_u^2)$ indicates that the estimated error element can be divided into two parts, the first for random error, the second for inefficiency, and therefore the convenience of maximum Likelihood method for estimating the Polynomial Function of sugar beet production under the traditional surface irrigation system, and the value of gamma (γ) coefficient indicates that about 79% of the variation between the observed values and the estimated value on the production horizon is due to inefficient production.

The value of (t) calculated for transactions in Table (1) indicates the morality of the impact of both the amount of seeds , the amount of azote fertilizer, the amount of phosphate fertilizer, the machine work, human work, the amount of used water and the value of nutrients and other petty expenses, while the morality of the effect of the amount of pesticides used has not been demonstrated. It should be noted that all transactions were positively indicated except for the amount of azote fertilizer and the amount of used water where they were negative, which means that the use of these two elements is excessive and that the amount of sugar beet yield responds inversely with the increase in the amount used, and therefore the quantities used must be rationalized. The estimates also reflect the increase in capacity return (total flexibility equals 1,604), which means that an increase in the combined production elements by 1% results in a higher increase in production of 1,064%. Estimating of the technical efficiency of the farms producing sugar beet crops under the traditional surface irrigation system also indicate that the average technical efficiency is about 81%, which indicates that production can be increased by about 19% of the same available resources and in the same technological method.

Table (2) shows the repetitive distribution of sample farms producing sugar beet crops under the traditional surface irrigation system according to the value of the technical efficiency factor, where it is found that the modal category of technical efficiency in the sample is from 80% to 90%, which has the number of farmers 18 farms. they represent about 51.43% of the sample size, while 3 farms with technical efficiency were less than 70%, representing about 8.57% of the total number of farmers sampled in the study, and 10 farmers Its technical efficiency ranges from 70% to 80%, representing about 28.57% of the total number of farms sampled, while the number of farms with technical efficiency of more than 90% is 4 farms representing about 11.43% of the total number of farms in the study sample. By calculating Cumulative Frequencies, it is clear that about 62.86% of the study sample farms achieve technical efficiency of more than 80%, which indicates that sugar beet farmers in El Sharkia governorate Under the traditional surface irrigation system are generally characterized by their ability to employ their agricultural resources efficiently, although this efficiency is relatively low under the traditional surface irrigation system compared to the developed surface irrigation systems.

Table (1): Results of production function estimates of Douglas cup of sugar beet crop under the traditional surface irrigation system using the probability maximization method.

Variable	Lab code	Estimation	Calculated (t) value
Constant	α	1.14	(0.684)
Cultivated area	B1	-	-
The seeds	B2	0.91	3.35***

Azote fertilizer	B3	- 0.53	-2.71**
Phosphate fertilizer	B4	0.38	1.14*
Machine work	B5	0.86	2.55**
Human work	B6	0.33	1.97*
Pesticides	B7	0.05	(0.490)
Amount of water	B8	-0.40	-1.58*
Other	B9	0.004	1.31*
Sigma-square (σ^2)	$\sigma^2 = \sigma_v^2 + \sigma_u^2$	0.117	2.56**
Gamma (γ)	$\gamma = \sigma_u^2 / \sigma^2$	0.788	4.182***
Capacity return	1.604		
Average technological efficiency	0.81		

Source: Data analysis results using FRONTIER (version 4.1c) program.
Moral at a moral level of 1%, ** moral at a moral level of 5%,
* Moral at a moral level of 10%, - the value between the brackets indicates the calculated non-moral (t).

Table (2): The repetitive distribution of sample farms producing sugar beet crops under the traditional surface irrigation system according to the value of the technical efficiency factor

Level of technical efficiency	Number of farms	Relative repetition
Less than 0.70	**3**	**8,57**
0.70 – 0.80	**10**	**28,57**
0.80 – 0.90	**18**	**51,43**
0.90 and over	**4**	**11,43**
Total	**35**	**100%**

Source: Calculated from data analysis results using FRONTIER (version 4.1c) program.

(b) Estimating the Polynomial Function of sugar beet production according to the developed surface irrigation system in the style of padded ditches:

The Polynomial production function of the sugar beet sample was estimated under the developed surface irrigation system in the style of padded ditches using the probability maximization method under two assumptions, the first basic assumption (H0) is that the error element of inefficiency is distributed according to the semi-normal distribution and alternative imposition (H1) is that the error element of inefficiency is distributed according to the truncated distribution. By comparing the scheduled and calculated (log-Likelihood Function) value for the distribution of the part of the error of technological efficiency, it has been shown that the optimal distribution of the error element of inefficiency is distributed according to half-normal distribution. Independent and based on the results of the correlation matrix, the elements of the cultivated area, the amount of seeds and the amount of phosphate fertilizer have been removed from the random Polynomial production function of the sugar beet crop under the developed surface irrigation system in the style of padded ditches. Statistical morale $\gamma = \sigma_u^2 / (\sigma_v^2 + \sigma_u^2)$ indicates that the estimated error element can be divided into two parts, the first for random error, the second for inefficiency, and therefore the suitability of probability maximization method of estimating the Polynomial Function of sugar beet production under the developed surface irrigation system in the style of padded ditches, and the value of gamma (γ) coefficient indicates that about 99% of the variation between the observed values and the estimated value on the production horizon is due to the technical inefficiency of production.

The value of (T) calculated for coefficients in table (3) indicates the morality of the impact of both the cultivated area, the amount of azote fertilizer, human work, the amount of water and other petty expenses, while the morality of the effect of the rest of the elements has not been demonstrated. It should be noted that all coefficients were positively except for the value of the machine other pretty expenses, where they were negative, which means that they were over use, and that the amount of sugar beet produced responds inversely with the increase in the value of these other pretty expenses, so their use should be rationalized. The estimates also reflect the increase in capacity return (total flexibility equals 1.49), which means that an increase in the combined production elements by 1% results in a higher increase in production of 1.49%, and estimates of the technical efficiency of the farms producing sugar beet under the developed surface irrigation system in the style of padded ditches indicate that the average technical efficiency is about 92%, which indicates that production can be increased by about 8% from the same resources available and in the same technical manner.

Table (4) shows the frequency distribution of sample farms producing sugar beet crops under the developed surface irrigation system in the style of padded ditches according to the value of the technical efficiency factor, where it is found that the modal category of technical efficiency of the sample is 90% and more, which has 10 farms, i.e., it represents about 40% of the sample size. While it is found that there are 2 farms with technical efficiency of less than 70% representing about 8% of the total number of farms sample study, and 5 farms with technical efficiency ranging from 70% to 80% representing about 20% of the total number of farms sampled, while the number of farms with technical efficiency ranging from 80% to 90% is 8 farms representing about 32% of the total number of farms in the study sample. By calculating cumulative frequency, about 72% of the study sample farms achieve technical efficiency of more than 80%, which indicates that sugar beet farmers in El Sharkia governorate are characterized by the developed surface irrigation system in the style of padded ditches in general by their ability to employ their agricultural resources more efficiently than achieved in according to the traditional surface irrigation system.

Table (3): Results of production function estimates cup Douglas for sugar beet crop under developed surface irrigation system in the style of padded ditches using the probability maximization method.

Variable	Coefficient code	Estimation	Calculated (t) value
Constant	A	0.69	(0.68)
Cultivated area	B_1	0.78	7.01***
The seeds	B_2	-	-
Azote fertilizer	B_3	0.32	5.04***
Phosphate fertilizer	B_4	-	-
Automated work	B_5	- 0. 28	- 1.13*
Human work	B_6	0.45	6.6***
Exterminators	B_7	-	-
Amount of water	B_8	0.48	4.03***
Other	B_9	0.26-	2.15**-
Sigma-square (σ^2)	$\sigma^2 = \sigma_v^2 + \sigma_u^2$	0.02	6.56***
Gamma (γ),	$\gamma = \sigma_u^2 / \sigma^2$	0.99	63.5***
Capacity return	1.49		
Average technological efficiency	0.92		

Source: Data analysis results using FRONTIER (version 4.1c) program,
Moral at a moral level of 1%, ** moral at a moral level of 5%,
* Moral at a moral level of 10%, - the value between the brackets indicates the calculated non-moral (t).

Table (4): The frequency distribution of sample farms producing sugar beet crop under the developed surface irrigation system in the style of padded ditches according to the value of the technical efficiency factor.

Level of technical efficiency	Number of farms	Relative frequency
Less than 0.70	2	8
0.70 – 0.80	5	20
0.80 – 0.90	8	32
0.90 and over	10	40
Total	25	100%

Source: Calculated from data analysis results using FRONTIER (version 4.1c) program

Second: Indicators of the production and economic efficiency of the sugar beet crop according to the different irrigation systems in El Sharkia governorate:

From the results of the estimate of production functions according to the different irrigation systems of the sugar beet crop in El Sharkia governorate, technical transactions of production elements were estimated and therefore the possibility of calculating technical derivatives such as marginal output, average output, flexibility and economic efficiency of each element.

A) Indicators of the productive and economic efficiency of the sugar beet crop according to the traditional surface irrigation system in the study sample:

Table (5) results indicate that the production flexibilities of production elements (seeds, phosphate fertilizer, machine work, human work, pesticides and the value of other petty expenses) under the traditional surface irrigation system were positive, which means that the amount of production from sugar beet responds directly with Increase in the used quantities of these elements, but for the elements of azote fertilizer and the amount of used water was negative elasticity, i.e. the amount of output from the sugar beet crop responds inversely with the increase in the used quantities, as a change of 1% leads to a change in output of 0.91%, -0.53%, 0.38%, 0.86%, 0.33%, 0.05%, -0.4% and 0.117% for seeds, azote fertilizer, phosphate fertilizer, machine work, human work, the amount of pesticides, the amount of used water , the value of nutrients and other petty expenses respectively. The marginal output of the production elements was derived from the sugar beet production function according to the traditional surface irrigation system in El Sharkia governorate in the same table (5), which is about 0.14, -2.12, 0.46, 4.1, 1.12, 0.51, 0.004, -20 and 0.001 tons for seeds, azote fertilizer, phosphate fertilizer, machine work, human labor, pesticide quantity, water quantity, nutrient value, and other petty expenses respectively. The average output is estimated about 23.12, 6.3, 0.25, 0.82, 0.77, 0.65, 12.4, 0.02 and 96.2 tons for cultivated area, seeds, azote fertilizer, phosphate fertilizer, machine work, human work, pesticides, amount of used water, value of nutrients and other pretty expenses respectively. Estimating the economic efficiency of sugar beet production elements according to the traditional surface irrigation system in El Sharkia governorate and from the same table (5), they are estimated at 59.2%, -7%, 18.64%, 4.1%, 1.3% and 2.02% for seed, azote fertilizer, phosphate fertilizer, machine work, human work and the quantity of pesticides respectively.

b) Indicators of the productive and economic efficiency of the sugar beet crop according to the developed surface irrigation system in the style of the padded ditches with the study sample:

From the results of the same table (5) it is clear that the production elasticity of the production elements (area, azote fertilizer, human work and the amount of used water) under the developed surface irrigation system in the style of padded ditches were positive, which means that the amount of production of sugar beet responds directly with the increase in the used quantities of these elements, but for the value of the machine work and other petty expenses were negative elasticity, as a change of 1% leads to a change in output from sugar beet crop of 0.78%, 0.32%, -0.28%, 0.45%, 0.48% and -0.26% for cultivated area, azote fertilizer, machine work, human work, the amount of used water, the value of nutrients and other petty expenses respectively. The marginal output of the production elements was derived from the sugar beet production function according to the developed surface irrigation system in the style of the padded ditches in El Sharkia governorate in the same table (5), shows it estimated at about 0.31, 0.97, -0.16, 0.51, 480 and -0.002 tons for cultivated area, azote fertilizer, machine work, human work, the amount of used water, the value of nutrients and other petty expenses respectively. The average output is estimated at 25.3, 7.4, 0.33, 0.96, 1.7, 0.88, 22.3, 0.001 and 165.2 tons for cultivated area, seeds, azote fertilizer, phosphate fertilizer, machine work, human work, pesticides, the amount of used water, the value of nutrients and other petty expenses, respectively. Estimating the economic efficiency of the sugar beet production elements according to the developed surface irrigation system in the style of the padded ditches in El Sharkia governorate and from the same table (5) it is estimated at about 3.25%, 11.5%, -0.68% and 0.4% for cultivated area, azote fertilizer, machine work and human work respectively.

Table (5): The productive and economic efficiency of sugar beet production elements by using different surface irrigation systems in El Sharkia governorate for the agricultural season 2018/2019

Irrigation systems	Efficiency indicators	Area	The seeds	Azote fertilizer	Phosphate fertilizer	machine work	Human work	pesticides	Amount of water	Other
Traditional surface irrigation	Productivity flexibility (%)	-	0,91	-0,53	0,38	0,86	0,33	0,05	-0,4	0,117
	Marginal output (ton)	-	0,14	- 2,12	0,46	1,12	0,51	0,004	-20	0,001
	Average output (ton)	23,12	6.3	0.25	0.82	0.77	0.65	12.4	0.02	96.2
	Marginal output value (EGP)	-	2280	-56	97	286	78	344	-0.83	312
	Unit price of element (EGP)	3500	38.5	8	5.2	70	60	170	-	-
	Economic efficiency (%)	-	59,2	-7	18,64	4,1	1,3	2,02	-	-
Developed surface irrigation in the style of padded ditches	Productivity flexibility (%)	0,78	-	0,32	-	-0,28	0,45	-	0,48	-0,26
	Marginal output (ton)	0,31	-	0,97	-	- 0,16	0,51	-	480	- 0,002
	Average output (ton)	25,3	7.4	0.33	0.96	1.7	0.88	22.3	0.001	165.2
	Marginal output value (EGP)	1232 0	-	92	-	-48	24	-	0.58	-483
	Unit price of element (EGP)	3500	38.5	8	5.2	70	60	170	-	-
	Economic efficiency (%)	3,25	-	11,5	-	- 0,68	0,4	-	-	-

- The average price per ton of sugar beet is 625 pounds.

Source: Collected and calculated from the field study sample data for the agricultural season 2018/2019.

Third: Analysis of the farm budget for the sugar beet crop under different irrigation systems: -

It uses many economic indicators that can be calculated from the farm budget for various agricultural crops, the most important of which is total return and net return calculated by subtracting the total costs from total return and return above variable costs and calculated by subtracting the variable costs from total return and the profitability of the pound from variable costs (profitability of the invested pound) It is the feddan net return divided by variable costs and unit profitability of output and calculated by dividing the feddan net return by productivity, the ratio of total return to total costs, the ratio of total return to variable costs, and the net return on the pound per month, It is the result of dividing the net return over the duration of the crop's stay in the field.

The results of Table (6) indicate that the total costs of the sugar beet crop under the traditional surface irrigation system is 450 pound/feddan higher than the total cost of the sugar beet crop according to the developed surface irrigation system in the style of padded ditches. The same table data also indicate the value of net return of sugar beet crop under the developed irrigation system in the style of padded ditches is 1812.5 pounds/feddan higher than the value of net return of sugar beet according to the traditional surface irrigation system. From the results of the same table, both the ratio of return to total costs, the ratio of return to variable costs and the profitability of the invested pound for sugar beet according to the developed irrigation system in the style of padded ditches are ranked first and second respectively. The results of the same table also indicate that the net return on the pound per month for the sugar beet crop according to the developed surface irrigation system in the style of padded ditches is 258.93 pounds/month higher than the net return on the pound per month for sugar beet according to the traditional irrigation system.

Table (6): Analysis of the farm budget of sugar beet feddan under different irrigation systems in El Sharkia governorate for the agricultural season 2018/2019

Item	Traditional irrigation		Irrigation in the style of padded ditches	
	Value	%	Value	%
Variable costs(pound/feddan)	6375	64,46	5925	62,86
Fixed costs(pound/feddan)	3500	35,44	3500	37,14
Total costs(pound/feddan)	9875	100	9425	100
Feddan productivity (ton/ feddan)	23,12		25,3	
Total return(pound/ feddan)	14450		15812,5	
Net return(pound/ feddan)	4575		6387,5	
Return above variable costs(pound)	8075		9887,5	
Percentage of the return / total costs (%)	1,46		1,68	
Percentage of the return / variable costs (%)	2,27		2,69	
Profitability of the invested pound (%)	0,72		1,08	
Profitability of unit of output(pound /ton)	197,88		252,47	
Net return on the pound per month (pound/month)	653,57		912,5	

Source: Collected and calculated from the field study sample data for the agricultural season 2018/2019.

Fourth: Measures of the efficiency of the return on the used water unit according to the various irrigation systems of the sugar beet crop in El Sharkia governorate:

There are several measures used to measure the efficiency of the return on the water unit, including the net return of the water unit, which is result of dividing net return of the crop on the water ration of the crop, the productivity of the water unit, which is the result of dividing the feddan productivity by the water ration, and the needs of the ton from water, which is the result of dividing the water ration on the feddan productivity.

From table (7) data, it is clear that both the net return of the water unit and the water unit productivity of the sugar beet crop reach the maximum according to the developed surface irrigation system in the style of padded ditches of about 3.04 pound/m3 and 12.05 ton/1000 m3 respectively and then net return of the water unit and the productivity of the water unit for sugar beet according to the traditional surface irrigation system at about 2.18 pound/m3 and 11.01 ton/1000 m3 respectively. The ton of sugar beet crop needs of water were maximum according to the traditional surface irrigation system of about 90.84 m3/ton, followed by the ton of sugar beet crop needs of water according to the developed surface irrigation system in the style of padded ditches is about 83.01 m3/ton. The superiority of sugar beet farmers is shown according to the developed surface irrigation system by the padded ditches style according to the water unit return measures.

Table (7) Measures of return efficiency on the used water unit according to the different irrigation systems of the sugar beet crop in El Sharkia governorate for the 2018/19 agricultural season

Item	Traditional surface irrigation	padded ditches style Irrigation
Feddan productivity (ton/feddan)	23,12	25,3
Net return(pound/feddan)	4575	6387,5
Net return of the water unit (pound /m^3)	2,18	3,04
Water unit productivity (ton/1000 m^3)	11,01	12,05
Ton needs of water (m^3/ton)	90,84	83,01

Source: Collected and calculated from field study sample data.

The most important results of the study were:

1- The estimate of the economic efficiency of the elements of sugar beet production according to the traditional surface irrigation system in El Sharkia governorate was found to be estimated at about 59.2%, -7%, 18.64%, 4.1%, 1.3% and 2.02% for the seeds, azote fertilizer, phosphate fertilizer, machine work, human work and the amount of pesticides, respectively.

2- Estimating the economic efficiency of sugar beet production elements according to the developed surface irrigation system in the style of padded ditches in El Sharkia governorate, it was estimated at about 3.25%, 11.5%, -0.68% and 0.4% for area, azote fertilizer, machine work and human work respectively.

3- The total cost of sugar beet crop under the traditional surface irrigation system is 450 pound/feddan higher than the total cost of the sugar beet crop according to the developed surface irrigation system in the style of padded ditches. The net return value of the sugar beet crop under the developed surface irrigation system in the padded ditches style was also shown to be 1,812.5 pound/feddan higher than the net return value of sugar beet under the traditional surface irrigation system. Both the ratio of return to total costs, the ratio of return to variable costs and the profitability of the invested pound in sugar beet according to the developed irrigation system in the style of padded ditches were also found to be in first and second places respectively. The results also indicate that the net return on the pound per month for the sugar beet crop according to the developed surface irrigation system in the style of padded ditches is 258.93 pounds/month higher than the net return on the pound per month for sugar beet according to the traditional surface irrigation system.

4- The results showed that both the net return of the water unit and the productivity of the water unit for the sugar beet crop reach the maximum according to the developed surface irrigation system in the style of padded ditches at about 3.04 pound/m3 and 12.05 ton/1000 m3 respectively and then net return of the water unit and the productivity of the water unit for sugar beet according to the traditional surface irrigation system at about 2.18 pound/m3 and 11.01 ton/1000 m3 respectively for each of them. The tone needs of water of the sugar beet crop were maximum according to the traditional surface irrigation system of about 90.84 m3/ton, followed by the tone needs of water of the sugar beet crop according to the developed surface irrigation system in the style of padded ditches at about 83.01 m3/ton. The superiority of sugar beet farmers is shown according to the developed surface irrigation system by the padded ditches style according to the return of water unit measures.

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