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THE IMPACTS OF FARMING PROBLEMS OF SALT-AFFECTED SOILS AND THE FARM LOCATION ON THE FARM INCOME

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ABSTRACT

Farmers in the salt- affected soils suffer from many farming problems, such as: irrigation water shortage supply, using drainage water, irregular irrigation rotation, high level of water table and high level of soil salinity. Consequently, are these farming problems and the farm location affect the farm income in the salt- affected soils, This paper try to analyze the impact of irrigation on farm income of households in the studied salt –affected sites. The studied sites have been selected as example of the salt-affected soils, were; El-Rowad, Tark Ben Ziad, El-Ezdehar, El-Eslah and Khaled Ben El Waleed. Now more than ever water becomes a major issue to support development efforts on a scale like never before. Egypt will be facing growing challenges to meet the rapidly growing demand for water resources and maybe reducing water supply during the coming few years. New approaches and management are urgently needed to avert severe water scarcities as agriculture consumes 85% of total water consumption; any improvement in efficiency at the farm level will be of major importance. The water management problem is currently increasing in the context of the on-going national transition from a government-controlled market with government intervention in the management of all activities to a free-market economy. Furthermore, due to the ambitious programs of desert agricultural development, the shortage of water supplies is becoming more serious after Ethiopia's Renaissance *(El Nahdda) dam*. Issues of equitable distribution of dwindling water supplies are becoming more serious and more is needed to assure fair access to water and more efficient use and allocation of it. The main objectives of the study are: (i) Estimate the correlation relationships among the total return of studied crops and inputs. (ii) Investigate the main factors affecting the total return of the studied crops. (iii) Measure the impacts of the farming problems on the total return of crops. (iv) Estimate the impact of the farm location along the channel on the total return of cultivated crops. (v) Calculate the impacts of the farming problems on the total return of farm. (vi) Estimate the Multiple Impacts of the farming problems on the total return of farm. The expected results are: The additional units of the studied inputs will increase the total return- within the economic production stage- of the studied selected crops. The farm location along the channel (micro private canal) and the farming problems will affect the total return of the farm.

Key words: Salt-affected soils, soil salinity, farming problems, farm location, farm income.

INTRODUCTION

Egypt's population density has roughly doubled over the last three decades, which has placed enormous pressure on its food and water security. Unfortunately, the fertile land on the Nile Delta, are in decline, due to soil erosion, desertification and salinity. A diminishing capacity to produce food crops is the result. In addition environmental and political dimensions threaten Egypt's water supply (Vella, 2012).

Some farm lands in Egypt are salt- affected soil, so farmers in this land suffer from many farming problems. Such as: irrigation water shortage supply, using drainage water, irregular irrigation rotation, high level of water table and high level of soil salinity. Management of salt-affected soils requires a combination of

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agronomic practices and socioeconomic considerations. For instance, reclamation of saline soils may begin with the provision of effective drainage and good quality irrigation water to lower the levels of soluble salts. Where salinity is increasing as a problem on an irrigated farm, it may be necessary to select crops varieties that have a greater tolerance to salts (FAO, 2005).

Moreover, where the land is severely salt-affected, it may be more economical to take it out of production and address the negative environmental impacts (FAO, 2005).

Now more than ever water becomes a major issue to support development efforts on a scale like never before. The changing global climate poses the greatest challenge to Egypt's food and water security. The UN's Environment Program lists Egypt as highly vulnerable to its impending impacts. Particularly at risk are the country's coastal zones, water resources and agriculture. Egypt will experience coastal damage from rising sea levels, together with land deterioration and soil salinity. So, food production in southern Egypt is expected to decline by 30% by 2050, according to the World Food Program. The combination of environmental, economic and political challenges, presents a difficult situation in Egypt as it undergoes democratic transition. Based on these challenges, there is a moderate to high risk that Egypt will develop both food and water crises in the next decades (Vella, 2012).

Crop productions of salt- affected soils are significantly reduced and consequently have negative effects on food security. The consequences are damaging in both socioeconomic and environmental terms. So, Lester P. Brown, president of the Washington-based Worldwatch Institute, points out that while the immediate effects of soil erosion are economic, in the long run its ultimate effects are social. "When soils are depleted and crops are poorly nourished, people are often undernourished as well. Failure to respond to the erosion threat will lead not only to the degradation of land, but to the degradation of life itself (Watson, 1995). Prevention and reclamation of salt- affected soils require on integrated management approach, including consideration of socioeconomic aspects, monitoring and maintenance of irrigation schemes and reuse and/or safe disposal of drainage water, lining of canals and channels should be undertaken up to reduce seepage loses.

Since farmers in the salt- affected soils suffer from many farming problems, so the study ask, are these farming problems and the farm location affect the farm income in the salt-affected soils This study tries to analyze the impact of irrigation on farm income of households in the five benchmark sites. The total return by crop or by farm is approximation variable for the farm income. So that, the main factors affecting the total returns will investigate and estimate. The studied sites* have been selected as example of the salt-affected soils, were; El-Rowad, Tark Ben Ziad, El Ezdehar, El-Eslah and Khaled Ben El Waleed.

Objectives

Now more than ever water becomes a major issue to support development efforts on a scale like never before. Egypt will be facing growing challenges to meet the rapidly growing demand for water resources and maybe reducing water supply during the coming few years. New approaches and management are urgently needed to avert severe water scarcities as agriculture consumes 85% of total water consumption; any improvement in efficiency at the farm level will be of major importance.

The water management problem is currently increasing in the context of the on-going national transition from a government-controlled market with government intervention in the management of all activities to a free-market economy. Furthermore, due to the ambitious programs of desert agricultural development, the shortage of water supplies is becoming more serious after Ethiopia's Renaissance *dam*. Issues of equitable distribution of dwindling water supplies are becoming more serious and more is needed to assure fair access to water and more efficient use and allocation of it. The main objectives of the study are: (i) estimate the correlation relationships among total return of studied crops and the production factors. (ii) Investigate the main factors affecting total return

* The studied area close to El-Manazalah lake, soils at this sites is classified as salt-affected siols.

of the studied crops. (iii) Measure the impacts of farming problems on total return of crops. (iv) Estimate the impact of farm location along the channel on total return of cultivated crops. (v) Calculate the impacts of farming problems on total return of farm. (vi) Estimate the multiple Impacts of farming problems on total return of farm.

Problem of the Study

Any area like the studied area in Egypt suffering from some farming problems such as; increasing the level of water table, high level of soil salinity, irregular irrigation rotation and using drainage water, which influence soil properties and environment, cause decreasing of the soil productivity (Farifteh *et al.,* 2005). Therefore, they are negatively correlated with soil fertility. Excessive salinity accelerate land degradation processes and decrease crop yields and agricultural production (FAO, 1988). In order to make optimal use of these lands and to prevent further degradation, both ameliorative as well as preventive measures need to be employed (Rao *et al.,* 1998).

Consequently, net returns of producers will be affected negativity, while consumer's prices are increasing rapidly. Unfortunately, climate changes and global warming have great negatively effects through increasing salinity and water table on soil fertility and land degradation. So, the importance of this study arise through highlight and measure the impacts of farming problems of salt- affected soils and farm location on the farm income.

Hypothesis of the Study

1. There are positive effect - within certain limits (the economic production stage) according to the production function - of production inputs (*i.e.*: fertilizers, seeds, irrigation water.....) on the total retune of the studied crops.
2. There are great impacts of farming problems (*i.e.*: shortage of the water supply, using drainage water, irregular irrigation rotation, high level of table water.......) on the total revenue of the studied crops and total farm income.
3. There are significant impacts of the farm location along the channel on the farm income.

The sample framework and the methodology

The data summarized in Table 1 conclude the following results: (i) The studied sites consist of five villages, which have mentioned before, (ii) Five branch canals (*i.e.,* El Sa'aidy Canal, El Salam branch Canals No.1 , 2 , 3 and 5) irrigate the studied sites, (iii) The numbers of population in each selected village, (iv) The cultivated domain in each studied village and (v) The total numbers of graduate and hurt (*i.e.* Beneficiaries) holders in each studied village.

A random stratified cluster sample size of 150 holders from the five studied villages were targeted or suggested according the number of the population in each village, 152 holders or farmers have been interviewed actually and randomly from the five studied villages (cluster). The actual numbers of interviewed farmers in each studied village are shown in Table 2.

The inputs and outputs data have been conducted from the selected villages. The quantitative and qualitative statistical analyses has been used to accomplish the previous objective. The multiple regression and dummy variables models have been used to estimate: (i) The impacts of the inputs on the outputs and (ii) The impacts of the farming problems on the farm income in the salt-affected soils.

Findings and Discussion

Frist of all, it's important to refer to the productivity of the studied area, to know how much low is it? The actual average yield of studied crops in (2010/2011) is quite relatively low, they are 12.75 tons, 8.04 ardabs and 2.03 tons) pre faddan for sugar beet, wheat and rice respectively, comparing to (20.33 tons, 15.93 ardabs and 4.03 tons) per faddan in (10/2011) for Egypt and (20.33 tons, 17.45 ardabs and 3.74 tons) per faddan for El-Sharquia Governorate (MALR, 2012). Because salt-affected soils reduce both the ability of crops to take up water and the availability of micro-nutrients, they also concentrate ions toxic to plants and may degrade the soil structure (FAO, 2005).

Table 1. The sample farm according to irrigation source, cultivated area and number of holders in the studied sites

Village	Irrigation source (Irrigation canal)	Population	Cultivated area (fad.)*	No. of holders		
				Graduate	Beneficiaries (hurt holders)	Total
El- Rowad	El Sa'aidy Canal (San El Hagar branch Canal)	1503	2035	407	15	422
Tark Ben Ziad	El-Salam branch Canals No.1 and 2	611	960	187	9	196
El- Ezdehar	El-Salam branch Canal No. 3	1664	2535	427	148	575
El-Eslah	El-Salam branch Canals No. 3 and 5	759	1705	221	147	368
Khaled Ben El-Waleed	El-Salam branch Canal No.1	2014	1980	331	75	406
Total		6551	9215	1573	394	1967

Source: Collected and computed from the target villages. (*) fad = 4200 m^2

Table 2. The targeted and actual sample size conducted from the studied villages in the salt-affected soils

Targeted Villages	Targeted sample size	Actual sample size	
		No. of holders	(%)
Khaled Ben-El-Waleed	32	31	20.4%
Tarek Ben -Ziad	15	20	13.2%
El-Rowad	44	40	26.3%
El-Eslah	28	28	18.4%
Al-Ezdehar	31	33	22.7%
Total	150	152	100%

Source: computed from Table (1).

The Correlation Relationship Among Total Returns and Inputs

The correlation relationship among total returns of the studied crops and the inputs (nitrogen and phosphorus, seeds and irrigation water) have been estimated and explained. The simple correlation matrix for the previous factors (*i.e.*, total return, nitrogen, phosphorus, seeds and irrigation water)* has been identified and computed. In addition, it used to exclude the highly correlated explanatory variables from the relationship, for example labor and seed have been excluded from equation (1). The results are shown in Table 3 and there are as follow:

* The variables (inputs) have insignificant effect have been neglected from the estimation. e.g. labor, phosphate and so on.

Sugar beet

The simple correlation coefficients among total returns of sugar beet, nitrogen, phosphorus and irrigation water have been determined and estimated in Table 3. The results in the Table state that the correlation relationship among the total returns of sugar beet and the previous inputs are positive, relatively high and highly statistically significant. Consequently the additional units of the studied inputs will increase total return of sugar beet, (within the second stage of the production function-the economic stage).

Rice

The simple correlation coefficients among total return of rice, nitrogen, phosphorus, seed and irrigation water have been determined and

Table 3. The simple correlation coefficients among total returns of sugar beet, rice, wheat nitrogen, phosphorus, seed and irrigation water

Production factor	Correlation coefficient		
	Sugar beet	Rice	Wheat
Nitrogen	0.43	0.44	0.44
Seed	-----	0.48	0.43
Phosphorus	0.28	0.34	0.54
Irrigation water	0.30	0.31	0.34
Sig. level (1- tailed)			
Nitrogen	0.00008	0.000002	0.001
Seed	-----	0.0000002	0.001
Phosphorus	0.00794	0.0008582	0.000
Irrigation water	0.00481	8.582E-04	0.011
Number of observations			
Nitrogen	75	103	45
Seed	75	103	45
Phosphorus	75	103	45
Irrigation water	75	103	45

Source: Computed from Table (1).

estimated in Table 3. The results in the Table state that the correlation relationship among total return of rice and the previous inputs are positive, relatively high and highly statistically significant, thus the additional units of the studied inputs will increase total return of rice, (within the economic stage).

Wheat

The simple correlation coefficients among total return of wheat, nitrogen, phosphorus, seed and irrigation water have been determined and estimated in Table 3. The results show that the simple correlation relationship among total return of wheat and the previous inputs are positive, relatively high and highly statistically significant, therefore the additional units of the studied inputs will increase total return of wheat, (within the economic stage).

The Main Factors Affecting Total Returns of the Studied Crops

The main cultivated crops in the salt-affected soils are; sugar beet, rice and wheat. The impacts of seeds, nitrogen, phosphorous and water consumed on total return from these crops have been investigated and estimated in this section of the study.

Sugar beet

The main factors affecting total return of sugar beet are presented in the model (1). The model parameters indicated that: (i) The μ = overall mean (*i.e.* intercept) of total return of sugar beet is estimated at 2088 LE/faddan. (ii) The positive impact of the nitrogen on total return of sugar beet is estimated at 4.5 LE/unit of nitrogen. (iii) The positive impact of the phosphorous on total return of sugar beet is estimated at 1.4 LE/unit of phosphorous. (iv) The positive impact of irrigation water on total return of sugar beet is estimated at 0.14 LE/cubic meter of water. (v) The positive impacts of the studied factors on total return of sugar beet are statistically significant (where all investigated parameters are significant at α = 0.05 or less). (vi) The estimated model is statistically significant, where the f-ratio is estimated at 9.3. (vii) The variations in the studied factors (*i.e.* determination coefficient) explain only 28% of the variations in total return of sugar beet.

$$Y_{sb} = 2088 + 4.5\ \text{nit} + 1.4\ \text{phos} + 0.14\ \text{wat..} \quad (1)^{+}$$
$$(5.5)^{**}\ (3.7)^{**}\ \ (1.8)^{*}\ \ (2.4)^{*}$$
$$\bar{R}^2 = 0.28 \qquad \text{F. ratio} = (9.3)^{**}$$

+ μ = intercept= overall mean (grand mean).
(Note: Coefficient;4.5,1.4 and 0.14 = marginal return = value of marginal productivity)

Where:

Y_{sb} = total return of sugar beet in the studied farms.

Nit = quantity used of nitrogen in sugar beet production.

Phos= quantity used of phosphorous in sugar beet production.

Wat = quantity used of irrigation water in sugar beet production.

* means the parameter is significant at $\alpha = 0.05$.

** means the parameter is significant at $\alpha = 0.01$.

Rice

The main factors affecting total return of rice are presented in the model (2). The model parameters indicated that: (i) The overall mean (*i.e.* intercept) of total return of rice is estimated at 413 LE/faddan. (ii) The positive impact of the seeds on total return of rice is estimated at 17.7 LE/kg of seed. (iii) The positive impact of the nitrogen on total return of rice is estimated at 4.3 LE/unit of nitrogen. (iv) The positive impact of the phosphorous on total return of rice is estimated at 5.5 LE/unit of phosphorous. (v) The positive impact of irrigation water on total return of rice is estimated at 0.13 LE/cubic meter of water. (vi) The positive impacts of the studied factors on total return of rice are statistically significant (*i.e.,* all investigated parameters are significant at $\alpha = 0.01$). (vii) The estimated model is statistically significant, *i.e.,* the f-ratio is estimated at 18.7. (viii) the variations in the studied factors explain about 43% of the variations in total return of rice.

$$Y_{rice}=413+17.7\,seed+4.3\,nit+5.5\,phos+0.13\,wat\ldots(2)$$

$$(2.8)^{**}\ (3.5)^{**}\quad (2.7)^{**}\quad (3.8)^{**}\quad (3.6)^{**}$$

$$\bar{R}^2 = 0.43 \qquad \text{F. ratio} = (18.7)^{**}$$

Where:

Y_{rice} = total return of rice in the studied farms.

Nit = quantity used of nitrogen fertilizer in rice production.

Phos = quantity used of phosphorous fertilizer in rice production.

Wat = quantity used of irrigation water in rice production.

* means the parameter is significant at $\alpha = 0.05$

** means the parameter is significant at $\alpha = 0.01$

Wheat

The main factors affecting total return of wheat are presented in the model (3). The model parameters indicated that: (i) The positive impact of the seeds on total return of wheat is estimated at 23.9 LE/kg of seed. (ii) The positive impact of the nitrogen on total return of wheat is estimated at 3.1 LE/unit of nitrogen. (iv) The positive impact of the phosphorous on total return of wheat is estimated at 14.9 LE/unit of phosphorous. (v) The positive impact of irrigation water on total return of wheat is estimated at 0.19 LE/cubic meter of water. (vi) The positive impacts of the studied factors on total return of wheat are statistically significant. (vii) The estimated model is statistically significant, where the f-ratio is estimated at 8.7 and all model's parameters are significant. (viii) The variations in the studied factors explain about 47% of the variations in total return of wheat.

$$Y_{wht}=-1913+23.9\,seed+3.1\,nit+14.9\,phos+0.19\,wat.\ (3)^{+}$$

$$(1.9)^{*}\ (2.2)^{*}\quad (2.7)^{**}\ (2.9)^{**}\quad (2.2)^{*}$$

$$\bar{R}^2 = 0.47 \qquad \text{F. ratio} = (8.7)^{**}$$

Where:

Y_{wht} = total return of wheat in the studied farms.

Nit = quantity used of nitrogen in wheat production.

Phos = quantity used of phosphorous in wheat production.

Wat = quantity used of irrigation water in wheat production.

* means the parameter is significant at $\alpha = 0.05$

** means the parameter is significant at $\alpha = 0.01$

The Impacts of the Farming Problems on Total Returns of Crops

Farmers in the salt-affected land suffer from many farming problems. The main problems are: (i) Irrigation water shortage supply, (ii) Using drainage water, (iii) Irregular irrigation rotation, (iv) High level of water table and (v) High level of soil salinity. The interviewed

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+μ: (Negative intercept) may reflects negative economic efficiency (or inefficiency)of all inputs to a production process, *i.e.* TFP of the studied inputs is negative. {Snedecor, 1980} farmers in the studied area have been divided into three categories according to the impacts of the previous problems on the farmers; (i) Severe impacts, (ii) Weak impacts and (iii) No impacts. The relationship among the impacts of previous problems on total returns from the crops have been measured and investigated. The dummy variable model has been used to measure these relationships. The μ term measures the severe impacts of the studied problems on total return. The results were as follow:

Sugar beet total return

The estimated mathematical relationships among total returns of sugar beet and the previous farming problems are measured in the models (4) to (7).

Water shortage supply

The estimated mathematical relationships among total returns of sugar beet and the impacts of the water shortage problem are measured in the model (4):

$$Y_{sb} = 1202.3 + 567.4\ weak + 1518.4\ No \quad \ldots\ldots (4)$$

$$(3.3)^{**} \quad (1.7)^{*} \quad (3.4)^{**}$$

$$\overline{R}^2 = 0.28 \qquad F.\ ratio = (6.5)^{**}$$

Where:

Y_{sb} = sugar beet total return in LE.

Weak = the impacts of the studied problems is weak.

No = there is no impacts of the studied problems.

The estimated parameters in model (4) show that: (i) Total return of sugar beet for the famers facing severe impacts of the water shortage is estimated at 1202.3 LE/faddan. (ii) The farmers facing weak impacts of the water shortage achieve total returns greater than the first farmers' category by 567.4 LE/faddan. (iii) The farmers who do not suffer from the impacts of the water shortage achieve total return greater than the first farmers' category by 1518.4 LE/faddan. That means total returns of sugar beet for the third category is estimated at 2720.7 LE/faddan. (iv) The estimated model and it's parameters are statistically significant. (v) The variations in the water shortage explain 28% of the variations in total returns of sugar beet.

Using drainage water

The estimated mathematical relationships among total returns of sugar beet and the impacts of the using drainage water problem are measured in the model (5):

$$Y_{sb} = 1713.8 + 286.9\ weak + 1109.4\ No \quad \ldots\ldots (5)$$

$$(5.5)^{**} \quad (1.7)^{*} \quad (2.3)^{*}$$

$$\overline{R}^2 = 0.19 \qquad F.\ ratio = (3.7)^{*}$$

Where:

Y_{sb} = sugar beet total return in LE.

Weak = the impacts of the studied problems is weak.

No = there is no impacts of the studied problems.

The estimated parameters in model (5) show that: (i) Total return of sugar beet for the famers facing severe impacts of using drainage water is estimated at 1713.8 LE/faddan. (ii) The farmers facing weak impacts of using drainage water achieve total return greater than the first farmers' category by 286.9 LE/faddan. (iii) The farmers who do not suffer from the impacts of using drainage water achieve total return greater than the first farmers' category by 1109.4 LE/faddan. That means total return of sugar beet for the third category is estimated at 2823.2 LE/faddan. (iv) The estimated model and it's parameters are statistically significant. (v) The variations in the using drainage water explain 19% of the variations in total returns of sugar beet.

Irregular irrigation rotation

The estimated mathematical relationships among total returns of sugar beet and the impacts of the Irregular irrigation rotation problem are measured in the model (6):

$$Y_{sb} = 1834.4 + 733.1\ weak + 279.9\ No \quad \ldots\ldots\ldots\ldots (6)$$

$$(6.1)^{**} \quad (1.8)^{*} \quad (1.7)^{*}$$

$$\overline{R}^2 = 0.12 \qquad F.\ ratio = (3.1)^{*}$$

Where:

Y_{sb} = sugar beet total return in LE.

Weak = the impacts of the studied problems is weak.

No = there is no impacts of the studied problems.

The estimated parameters in model (6) show that: (i) Total return of sugar beet for the famers facing severe impacts of irregular irrigation rotation is estimated at 1834.4 LE/faddan. (ii) The farmers facing weak impacts of irregular irrigation rotation achieve total return greater than the first farmers' category by 733.1 LE/faddan. (iii) The farmers who do not suffer from the impacts of irregular irrigation rotation achieve total return greater than the first farmers' category by 279.9 LE/faddan. That means total return of sugar beet for the third category is estimated at 2114.3 LE/faddan. (iv) The estimated model and it's parameters are statistically significant. (v) The variations in the irregular irrigation rotation explain 12% of the variations in total returns of sugar beet.

High level of water table

The estimated mathematical relationships among the total returns of sugar beet and the impacts of the high level of water table problem are measured in the model (7):

$$Y_{sb} = 1468.4 + 1509\ \text{weak} + 147.9\ \text{No} \quad \ldots\ldots\ldots\ldots (7)$$

$$(3.6)^{**} \quad (3.0)^{**} \qquad (2.3)^{*}$$

$$\bar{R}^2 = 0.30 \qquad \text{F. ratio} = (7.4)^{**}$$

Where:

Y_{sb} = sugar beet total return in LE.

Weak = the impacts of the studied problems is weak.

No = there is no impacts of the studied problems.

The estimated parameters in model (7) show that: (i) Total return of sugar beet for the famers facing severe impacts of the high level of water table is estimated at 1468.4 LE/faddan. (ii) The farmers facing weak impacts of the high level of water table achieve total returns greater than the first farmers' category by 1509 LE/faddan. (iii) The farmers who do not suffer from the impacts of the high level of table water achieve total return greater than the first farmers' category by 147.9 LE/faddan. That means the total returns of sugar beet for the third category is estimated at 1616.3 LE/faddan. (iv) The estimated model and the parameters in model (7) are statistically significant. (v) The variations in the high level of water table explain 30% of the variations in the total returns of sugar beet.

Rice total return

The estimated mathematical relationships among total return of rice and the previous farming problems are measured in the models (8) to (12).

Water shortage supply

The estimated mathematical relationships among total returns of rice and the impacts of the water shortage supply problem are measured in the model (8):

$$Y_r = 2429.9 + 337.8\ \text{weak} + 448.5\ \text{No} \quad \ldots\ldots (8)$$

$$(7.41)^{**} \quad (3.78)^{**} \qquad (1.7)^{*}$$

$$\bar{R}^2 = 0.18 \qquad \text{F. ratio} = (3.6)^{**}$$

Where:

Y_r = rice total return in LE.

Weak = the impacts of the studied problems is weak.

No= there is no impacts of the studied problems.

The estimated parameters in model (8) show that: (i) Total return of rice for the famers facing severe impacts of the water shortage supply is estimated at 2429.9 LE/faddan. (ii) The farmers facing weak impacts of the water shortage supply achieve total return greater than the first farmers' category by 337.8 LE/faddan. (iii) The farmers who do not suffer from the impacts of the water shortage supply achieve total return greater than the first farmers' category by 448.5 LE/faddan, that means; total return of rice for the third category is estimated at 2878.4 LE/faddan. (iv) The estimated model and it's parameters are statistically significant. (v) The variations in the water shortage supply explain 18% of the variations in total return of rice.

Using drainage water

The estimated mathematical relationships among total returns of rice and the impacts of the using drainage water problem are measured in the model (9):

$$Y_r = 2313 + 499.2\ \text{weak} + 893.2\ \text{No} \quad \ldots\ldots\ldots (9)$$

$$(8.6)^{**} \quad (1.9)^{*} \qquad (2.2)^{*}$$

$$\bar{R}^2 = 0.18 \qquad \text{F ratio} = (3.7)^{*}$$

Where:

Y_r = rice total return in LE.

Weak = the impacts of the studied problems is weak.

No = there is no impacts of the studied problems.

The estimated parameters in model (9) show that: (i) Total return of rice for famers facing severe impacts of using drainage water is estimated at 2313 LE/faddan. (ii) The farmers facing weak impacts of using drainage water achieve total return greater than the first farmers' category by 499.2 LE/faddan. (iii) The farmers who do not suffer from the impacts of using drainage water achieve total return greater than the first farmers' category by 893.2 LE/faddan. That means; total return of rice for the third category is estimated at 3206.2 LE/faddan. (iv) The estimated model and it's parameters are statistically significant. (v) The variations in the using drainage water explain 18% of the variations in total returns of rice.

Irregular irrigation rotation

The estimated mathematical relationships among total returns of rice and the impacts of the irregular irrigation rotation problem are measured in the model (10):

$$Y_r = 2239.3 + 1496.5\ \text{weak} + 492.8\ \text{No} \quad \ldots\ldots\ldots \quad (10)$$
$$(8.9)^{**} \quad (3.5)^{**} \quad (1.7)^{*}$$
$$\bar{R}^2 = 0.28 \qquad \text{F. ratio} = (6.2)^{**}$$

Where:

Y_r = rice total return in LE.

Weak = the impacts of the studied problems is weak.

No = there is no impacts of the studied problems.

The estimated parameters in model (10) state that: (i) Total return of rice for famers facing severe impacts of irregular irrigation rotation is estimated at 2239.3 LE/faddan. (ii) The farmers facing weak impacts of irregular irrigation rotation achieve total returns greater than the first farmers' category by 1496.5 LE/faddan. (iii) The farmers who do not suffer from the impacts of irregular irrigation rotation achieve total return greater than the first farmers' category by 492.8 LE/faddan that means; total return of rice for the third category is estimated at 2732.1 LE/faddan. (iv) The estimated model and it's parameters are statistically significant. (v) The variations in the irregular irrigation rotation explain 28% of the variations in total returns of rice.

High level of water table

The estimated mathematical relationships among total returns of rice and the impacts of the high level of water table problem are measured in the models (11):

$$Y_r = 2032.1 + 1336.1\ \text{weak} + 481.4\ \text{No} \quad \ldots\ldots\ldots \quad (11)$$
$$(5.7)^{*} \quad (3.1)^{**} \quad (1.8)^{*}$$
$$\bar{R}^2 = 0.26 \qquad \text{F. ratio} = (5.6)^{**}$$

Where:

Y_r = rice total return in LE.

Weak = the impacts of the studied problems is weak.

No = there is no impacts of the studied problems.

The estimated parameters in model (11) show that: (i) Total return of rice for famers facing severe impacts of the high level of water table is estimated at 2032.1 LE/faddan. (ii) The farmers facing weak impacts of the high level of water table achieve total return greater than the first farmers' category by 1336.1 LE/faddan. (iii) The farmers who do not suffer from the impacts of the high level of water table achieve total return greater than the first farmers' category by 481.4 LE/faddan, that means; total return of rice for the third category is estimated at 2513.5 LE/faddan. (iv) The estimated model and it's parameters are statistically significant. (v) The variations in the high level of water table explain 26% of the variations in total return of rice.

High level of soil salinity

The estimated mathematical relationships among total return of rice and the impacts of the high level of soil salinity problem are measured in the model (12):

$$Y_r = -5.2 + 3959.7\ \text{weak} + 2255.6\ \text{No} \quad \ldots\ldots\ldots \quad (12)$$
$$(0.9) \quad (2.2)^{*} \quad (1.9)^{*}$$
$$\bar{R}^2 = 0.42 \qquad \text{F. ratio} = (15.5)^{**}$$

Where:

Y_r = rice total return in LE.

Weak = the impacts of the studied problems is weak.

No = there is no impacts of the studied problems.

The estimated parameters in model (12) show that: (i) Total return of rice for famers facing severe impacts of high level of soil salinity is estimated at -5.2 LE/faddan *(i.e.,* they achieve quite losses). (ii) The farmers facing weak impacts of high level of soil salinity achieve total return greater than the first farmers' category by 3959.7 LE/faddan. (iii) The farmers who do not suffer from the impacts of the high level of soil salinity achieve total return greater than the first farmers' category by 2255.6 LE/faddan. (iv) The estimated model and it's parameters are statistically significant. (v) The variations in the high level of soil salinity explain 42% of the variations in total return of rice.

Wheat total return

The estimated mathematical relationships among total return of wheat and the previous farming problems are measured in the models (13) to (16).

Water shortage supply

The estimated mathematical relationships among total return of wheat and the impacts of the water shortage supply problem are measured in the model (13):

$$Y_w = 801 + 1136.8 \text{ weak} + 118.6 \text{ No} \quad \ldots\ldots\ldots (13)$$

$$(2.4)^{*} \quad (2.6)^{**} \qquad (1.7)^{*}$$

$$\overline{R}^2 = 0.24 \qquad \text{F. ratio} = (4.6)^{**}$$

Where:

Y_w = wheat total return in LE.

Weak = the impacts of the studied problems is weak.

No = there is no impacts of the studied problems.

The estimated parameters in model (13) show that: (i) Total return of wheat for the famers facing severe impacts of water shortage supply is estimated at 801 LE/faddan. (ii) The farmers facing weak impacts of water shortage supply achieve total return greater than the first farmers' category by 1136.8 LE/faddan. (iii) The farmers who do not suffer from the impacts of water shortage supply achieve total return greater than the first farmers' category by 118.6 LE/faddan, that means; total return of wheat for the third category is estimated at 919.6 LE/faddan. (iv) The estimated model and it's parameters are statistically significant. (v) The variations in water shortage supply explain 24% of the variations in total return of wheat.

Using drainage water

The estimated mathematical relationships among total return of wheat and the impacts of using drainage water problem are measured in the model (14):

$$Y_w = 781.5 + 513.8 \text{ weak} + 772.9 \text{ No} \quad \ldots\ldots\ldots (14)$$

$$(2.7)^{**} \quad (1.7)^{*} \qquad (1.8)^{*}$$

$$\overline{R}^2 = 0.15 \qquad \text{F. ratio} = (3.7)^{*}$$

Where:

Y_w = wheat total return in LE.

Weak = the impacts of the studied problems is weak.

No = there is no impacts of the studied problems.

The estimated parameters in model (14) show that: (i) Total return of wheat for famers facing severe impacts of using drainage water is estimated at 781.5 LE/faddan. (ii) The farmers facing weak impacts of using drainage water achieve total return greater than the first farmers' category by 513.8 LE/faddan. (iii) The farmers who do not suffer from the impacts of using drainage water achieve total return greater than the first farmers' category by 772.9 LE/faddan, that means; total return of wheat for the third category is estimated at 1554.4 LE/faddan. (iv) The estimated model and it's parameters are statistically significant. (v) The variations in using drainage water explain 15% of the variations in total return of wheat.

Irregular irrigation rotation

The estimated mathematical relationships among total return of wheat and the impacts of irregular irrigation rotation problem are measured in the model (15):

$$Y_w = 909 + 493.2 \text{ weak} + 428.1 \text{ No} \quad \ldots\ldots\ldots (15)$$

$$(3.4)^{**} \quad (1.8)^{*} \qquad (1.9)^{*}$$

$$\overline{R}^2 = 0.21 \qquad \text{F. ratio} = (3.2)^{*}$$

Where:

Y_w = wheat total return in LE.

Weak = the impacts of the studied problems is weak.

No = there is no impacts of the studied problems.

The estimated parameters in model (15) state that: (i) Total return of wheat for famers facing severe impacts of irregular irrigation rotation is estimated at 909 LE/faddan. (ii) The farmers facing weak impacts of irregular irrigation rotation achieve total returns greater than the first farmers' category by 493.2 LE/faddan. (iii)

The farmers who do not suffer from the impacts of irregular irrigation rotation achieve total return greater than the first farmers' category by 428.1 LE/faddan, that means; total returns of wheat for the third category is estimated at 1337.1 LE/faddan. (iv) The estimated model and it's parameters are statistically significant. (v) The variations in irregular irrigation rotation explain 21% of the variations in total return of wheat.

High level of water table

The estimated mathematical relationships among total return of wheat and the impacts of high level of water table problem are measured in the model (16):

$$Y_w = 854.2 + 160\ \text{weak} + 631.4\ \text{No} \quad \text{...........} \quad (16)$$
$$(2.6)^{**} \quad (1.7)^{*} \quad (1.8)^{*}$$

$$\overline{R}^2 = 0.24 \qquad \text{F. ratio} = (3.6)^{*}$$

Where:

Y_w = wheat total return in LE.

Weak = the impacts of the studied problems is weak.

No = there is no impacts of the studied problems.

The estimated parameters in model (16) show that: (i) Total return of wheat for famers facing severe impacts of high level of water table is estimated at 854.2 LE/faddan. (ii) The farmers facing weak impacts of high level of water table achieve total return greater than the first farmers' category by 160 LE/faddan. (iii) The farmers who do not suffer from the impacts of high level of water table achieve total return greater than the first farmers' category by 631.4 LE/faddan, That means ;total return of wheat for the third category is estimated at 1485.6 LE/faddan. (iv) The estimated model and it's parameters are statistically significant. (v) The variations in high level of water table explain 24% of the variations in total return of wheat.

The Impact of the Farm Location Along the Channel on Total Return

Mathematical model using the dummy variable technique has been estimated to measure the impacts of the farm location on the channel (*i.e.*, head, middle and tail) on the total return from the farm or from the studied crops. The μ term (*i.e.* dummy variable or the overall mean) in the model measures the impact of the farm located at the tail of channel on farm's total return or from the studied crops. The results were as follow:

Total return of farm

The estimated dummy variable model (17) state that: (i) The total return of farm achieved by the farms located at the tail of channel is estimated at 5418.3 LE/farm. (ii) The total return achieved by the farms located at the head of channel is estimated at 7155.3 LE/farm (*i.e.*, 1737 LE/farm more than the total return of the farms located at the tail). (iii) The total returns achieved by the farms located at the middle of channel is estimated at 8223.8 LE/farm (*i.e.*, 2805.5 LE/farm more than the total return of the farms located at the tail). Consequently, the impact of the middle location on the total return of farm (*i.e.*, 2805.5 LE/farm) is greater than the impact of the head location (*i.e.*, 1737 LE/ farm). (iv) The estimated model and its parameters are statistically significant. The variations in the farm location explain 27% of the variations in total return of farm.

$$Y_{trf} = 5418.3 + 1737.0\ \text{head} + 2805.5\ \text{middle}.... \ (17)$$
$$(8.8)^{**} \quad (1.9)^{*} \quad (3.4)^{**}$$
$$\overline{R}^2 = 0.27 \qquad \text{F. ratio} = (5.8)^{**}$$

Where:

Y_{trf} = total return of farm in LE.

The constant term = the impact of the farm location on channel at the tail.

Head = the impact of the farm location on channel at the head.

Middle = the impact of the farm location on channel at the middle.

Rice total return

The estimated dummy variable model (18) indicates that: (i) Total return of rice achieved by the farms located at the tail of channel is estimated at 2164.4 LE/faddan. (ii) Total return achieved by the farms located at the head of channel is estimated at 2753.9 LE/faddan (*i.e.*, 589.5 LE/faddan more than total return of the farms located at the tail). (iii)Total return of rice achieved by the farms located at the middle of channel is estimated at 3200.9 LE/faddan (*i.e.*, 1036.5 LE/faddan more than total return of the farms located at the tail). Consequently, the impact of the middle location on total return of rice is greater than the impact of the head location. (iv) The estimated model and it's parameters are statistically significant. The variations in the farm location explain 23% of the variations in total return of rice.

$$Y_r = 2164.4 + 589.5 \text{ head} + 1036.5 \text{ middle} \quad \ldots\ldots (18)$$
$$(7.9)^{**} \quad (1.7)^{*} \quad (2.9)^{**}$$
$$\bar{R}^2 = 0.23 \qquad \text{F. ratio} = (4.1)^{*}$$

Where:

Y_r = total return of rice in LE.

The constant term = the impact of the farm location on channel at the tail.

head = the impact of the farm location on channel at the head.

middle = the impact of the farm location on channel at the middle.

Sugar beet Total return

The estimated dummy variable model (19) indicates that: (i) Total return of sugar beet achieved by the farms located at the tail of channel is estimated at 1576.8 LE/faddan. (ii) Total return achieved by the farms located at the head of channel is estimated at 2131.6 LE/faddan (*i.e.,* 554.8 LE/faddan more than total return of the farms located at the tail). (iii) Total return of sugar beet achieved by the farms located at the middle of channel is estimated at 2494.5 LE/faddan (*i.e.,* 917.7 LE/faddan more than total return of the farms located at the tail). Consequently, the impact of the middle location on total return of sugar beet is greater than the impact of the head location. (iv) The estimated model and it's parameters are statistically significant. The variations in the farm location explain 27% of the variations in total return of sugar beet.

$$Y_{sb} = 1576.8 + 554.8 \text{ head} + 917.7 \text{ middle} \quad \ldots.. (19)$$
$$(4.95)^{**} \quad (1.8)^{*} \quad (2.2)^{*}$$
$$\bar{R}^2 = 0.27 \qquad \text{F. ratio} = (3.3)^{*}$$

Where:

Y_{sb} = total return of sugar beet in LE.

The constant term = the impact of the farm location on channel at the tail.

head = the impact of the farm location on channel at the head.

middle = the impact of the farm location on channel at the middle.

Wheat total return

The estimated dummy variable model (20) indicates that: (i) Total return of wheat achieved by the farms located at the tail of channel is estimated at 691 LE/faddan. (ii) Total return of wheat achieved by the farms located at the head of channel is estimated at 1343.8 LE/faddan (*i.e.,* 652.8 LE/faddan more than total return of the farms located at the tail). (iii) Total return of wheat achieved by the farms located at the middle of channel is estimated at 1500.9 LE/faddan (*i.e.,* 809.9 LE/faddan more than total returns of the farms located at the tail). Consequently, the impact of the middle location on total return of wheat is greater than the impact of the head location. (iv) The estimated model and it's parameters are statistically significant. The variations in the farm location explain 18% of the variations in total return of wheat.

$$Y_w = 691 + 652.8 \text{ head} + 809.9 \text{ middle} \quad \ldots\ldots\ldots (20)$$
$$(2.4)^{**} \quad (1.8)^{*} \quad (2.2)^{*}$$
$$\bar{R}^2 = 0.18 \qquad \text{F. ratio} = (3.4)^{*}$$

Where:

Y_w = the total return of wheat in LE.

The constant term = the impact of the farm location on channel at the tail.

head = the impact of the farm location on channel at the head.

middle = the impact of the farm location on channel at the middle.

The Impacts of the Farming Problems on the Farm's Total Returns

In this part of the study, the impacts of the previous farming problems on the total return of the farm have been investigated and measured using the dummy variables model. The intercept term measures the impact of the severe impact of the studied farming problems. The results were as follow:

Water shortage supply

The estimated mathematical relationships among total return of farm and the impacts of the water shortage supply problem are measured in the model (21). The estimated parameters show that: (i) Total return of farm for the famers facing severe impacts of water shortage supply is estimated at 5141 LE/farm. (ii) Farmers facing weak impacts of water shortage supply achieve total return per farm is estimated at 8640 LE/farm *(i.e.,* 3499 LE/farm greater than the first farmers' category). (iii) Farmers who do not suffer from the impacts of the water shortage supply achieve total return per farm is estimated at 6911 LE/farm. (iv) The estimated model and it's parameters are statistically significant. (v) The variations in water shortage supply explain 8% of the variations in total returns per farm.

$$Y_{trf} = 5141 + 3499\ weak + 1770\ No \quad \text{............} \quad (21)$$
$$(7.1)^{**}\ (3.7)^{**} \qquad (2.1)^{*}$$

$\bar{R}^2 = 0.08$ F. ratio = $(6.7)^{**}$

Where:

Y_{trf} = total return per farm in LE.

Weak = the impacts of the studied problems is weak.

No = there is no impacts of the studied problems.

Using drainage water

The estimated mathematical relationships among the total return of farm and the impacts of using drainage water problem are measured in the model (22). The estimated parameters show that: (i) Total return of farm for the famers facing severe impacts of using drainage water problem is estimated at 5757 LE/farm. (ii) Farmers facing weak impacts of using drainage water problem achieve total returns per farm is estimated at 7458 LE/farm (*i.e.,* 1701 LE/farm greater than the first farmers' category). (iii) Farmers who do not suffer from the impacts of using drainage water problem achieve total return per farm is estimated at 7917 LE/farm. Consequently farmers who do not suffer from the impacts of using drainage water problem achieve total return per farm is greater than the others. (iv) The estimated model and it's parameters are statistically significant. (v) The variations in the using drainage water problem explain 21% of the variations in total return per farm.

$$Y_{trf} = 5757 + 1701\ weak + 2160\ No \quad \text{...........} \quad (22)$$
$$(9.4)^{**}\ (3.9)^{**} \qquad (2.3)^{*}$$

$\bar{R}^2 = 0.21$ F. ratio = $(3.4)^{*}$

Where:

Y_{trf} = total return per farm in LE.

Weak = the impacts of the studied problems is weak.

No = there is no impacts of the studied problems.

Irregular irrigation rotation

The estimated mathematical relationships among total return of farm and the impacts of irregular irrigation rotation problem are measured in the model (23). The estimated parameters show that: (i) Total return of farm for famers facing severe impacts of irregular irrigation rotation problem is estimated at 5753 LE/farm. (ii) Farmers facing weak impacts of irregular irrigation rotation problem achieve total return per farm is estimated at 9387.7 LE/farm (*i.e.,* 3634.7 LE/farm greater than the first farmers' category). (iii) Farmers who do not suffer from the impacts of irregular irrigation rotation problem achieve total return per farm is estimated at 7050.3 LE/farm. (iv) The estimated model and it's parameters are statistically significant. (v) The variations in the irregular irrigation rotation problem explain 29% of the variations in total return per farm.

$$Y_{trf} = 5753 + 3634.7\ weak + 1297.3\ No \quad \text{.........} \quad (23)$$
$$(10.1)^{**} \qquad (3.7)^{**} \qquad (1.7)^{*}$$

$\bar{R}^2 = 0.29$ F ratio = 6.9^{**}

Where:

Y_{trf} = total return per farm in LE.

Weak = the impacts of the studied problems is weak.

No = there is no impacts of the studied problems.

High level of soil salinity

The estimated mathematical relationships among total returns of farm and the impacts of high level of soil salinity problem are measured in the model (24). The estimated parameters show that: (i) Total return of farm for famers facing severe impacts of high level of soil salinity problem is estimated at 4050 LE/farm. (ii) Farmers facing weak impacts of high level of soil salinity problem achieve total return per farm is estimated at 9111.7 LE/farm (*i.e.,* 5061.7

LE/farm greater than the first farmers' category). (iii) Farmers who do not suffer from the impacts of high level of soil salinity problem achieve total return per farm is estimated at 6169.8 LE/farm. (iv) The estimated model and it's parameters are statistically significant. (v) The variations in high level of soil salinity problem explain 31% of the variations in total returns per farm.

$$Y_{trf} = 4050 + 5061.7\ weak + 2119.8\ No \quad \ldots\ldots\ (24)$$

$$(0.9)^{**}\quad (1.9)^{*}\qquad (2.3)^{*}$$

$$\overline{R}^2 = 0.31 \qquad F.\ ratio = (7.6)^{**}$$

Where:

Y_{trf} = total return per farm in LE.

Weak = the impacts of the studied problems is weak.

No = there is no impacts of the studied problems.

The Multiple Impacts of the Farming Problems on the Total Returns of Farm

The multiple impacts of the studied farming problems on total return per farm have been measured and investigated using the dummy variables model. The estimated parameters and the multiple-effects model (25) indicate that: (i) The intercept of 884.9 LE/farm measures total return per farms for the farmers facing severe impacts of the studied farming problems. (ii) Farmers facing weak impacts of water shortage supply problem achieve total return greater than the first farmers' category by 3165 LE/farm. (iii) Farmers who do not suffer from the impacts of water shortage supply problem achieve total return greater than the first farmers' category by 2004 LE/farm. (iv) Farmers facing weak impacts of using drainage water problem achieve total return greater than the first farmers' category by 353.8 LE/farm. (v) Farmers who do not suffer from the impacts of using drainage water problem achieve total return greater than the first farmers' category by 561.7 LE/farm. (vi) Farmers facing weak impacts of irregular irrigation rotation problem achieve total return greater than the first farmers' category by 2241.8 LE/farm. (vii) Farmers who do not suffer from the impacts of irregular irrigation rotation problem achieve total return greater than the first farmers' category by 1159.7 LE/farm. (viii) Farmers facing weak impacts of high level of soil salinity problem achieve total return greater than the first farmers' category by 4836.9 LE/farm. (ix) Farmers who do not suffer from the impacts of high level of soil salinity problem achieve total return greater than the first farmers' category by 2256.3 LE/farm. (x) The estimated model and it's parameters are statistically significant. (xi) The variations in the previous problems (determination coefficient) explain 47% of the variations in total return per farm.

$$Y_{trf}=884.9+3165\ weak_1+2004\ No_1+353.8\ weak_2+561.7\ No_2$$

$$(0.2)\quad (3.3)^{**}\quad (2.3)^{*}\quad (2.4)^{*}\quad (2.9)^{**}$$

$$+ 2241.8\ weak_3+1159.7\ No_3 +4836.9\ weak_4 + 2256.3\ No_4 \ldots(25)$$

$$(2.3)^{*}\quad (1.7)^{*}\quad (1.8)^{*}\quad (2.5)^{*}$$

$$\overline{R}^2 = 0.47 \qquad F.\ ratio = (5.04)^{**}$$

Where:

Y_{trf} = total return per farm in LE.

$Weak_1$ = the impact of the water shortage supply problem is weak.

No_1 = there is no impact of the water shortage supply problem.

$Weak_2$ = the impact of the using drainage water problem is weak.

No_2 = there is no impact of the using drainage water problem.

$Weak_3$ = the impact of the irregular irrigation rotation problems is weak.

No_3 = there is no impact of the irregular irrigation rotation problem.

$Weak_4$ = the impact of the high level of soil salinity problems is weak.

No_4 = there is no impact of the high level of soil salinity problem.

Intercept = the summation of the severe impacts of the studied problems.

The Multiple Impacts of the Previous Farming Problems and the Farm Location on Total Return per Farm Have Been Measured and Investigated Using the Dummy Variable Model

The estimated multiple-effects model and it's parameters indicate that: (i) The intercept of 650.7 LE/farm measures total return per farms for the famers facing the severe impacts of the four previous farming problems, respectively and the channel's tail location. (ii) Farmers facing weak impacts of water shortage supply problem achieve total return greater than the first farmers' category by 2915.8 LE/farm. (iii) Farmers who do not suffer from the impacts of water shortage supply problem achieve total return greater than the first farmers' category by 1990 LE/farm. (iv) Farmers facing weak impacts of using drainage water problem achieve total return greater than the first farmers' category by 301.5 LE/farm. (v) Farmers who do not suffer from the impacts of using drainage water problem achieve total return greater than the first farmers' category by 665 LE/farm. (vi) Farmers facing weak impacts of irregular irrigation rotation problem achieve total return greater than the first farmers' category by 2230.3 LE/farm. (vii) Farmers who do not suffer from the impacts of irregular irrigation rotation problem achieve total return greater than the first farmers' category by 1168.6 LE/farm. (viii) Farmers facing weak impacts of high level of soil salinity problem achieve total return greater than the first farmers' category by 4086.2 LE/farm. (ix) Farmers who do not suffer from the impacts of high level of soil salinity problem achieve total return greater than the first farmers' category by 1647 LE/farm. (x) Farms located at the head of channel achieve total return greater than the first farmers' category by 483.5 LE/farm.(xi)Farms located at the middle of channel achieve total return greater than the first farmers' category by 2016.5 LE/farm.(xii)The estimated model and it's parameters are statistically significant. (xiii)The variation in the studied problems and the farm location (determination coefficient) explain 51% of the variation in total return per farm.

$$Y_{trf}=650.7+2915.8\ weak_1+1990\ No_1+301.5\ weak_2+665\ No_2$$
$$(0.5)\quad (3.1)^{**}\quad (2.4)^{*}\quad (2.3)^{*}\quad (1.7)^{*}$$
$$+\ 2230.3\ weak_3 + 1168.6\ No_3 + 4086.2\ weak_4 + 1647\ No_4$$
$$(2.3)^{*}\quad (1.7)^{*}\quad (1.9)^{*}\quad (2.8)^{**}$$
$$+\ 483.5\ head + 2016.5\ middle \ldots\ldots (26)$$
$$(2.5)^{*}\quad (2.6)^{**}$$
$$\bar{R}^2 = 0.51 \qquad F.\ ratio = (4.95)^{**}$$

Where:

Y_{trf} = total return per farm in LE.

$Weak_1$ = the impact of the water shortage supply problem is weak.

No_1 = there is no impact of the water shortage supply problem.

$Weak_2$ = the impact of the using drainage water problem is weak.

No_2 = there is no impact of the using drainage water problem.

$Weak_3$ = the impact of the irregular irrigation rotation problems is weak.

No_3 = there is no impact of the irregular irrigation rotation problem.

$Weak_4$ = the impact of the high level of soil salinity problem is weak.

No_4 = there is no impact of the high level of soil salinity problem.

Head = the impact of the farm location on channel at the head.

Middle = the impact of the farm location on channel at the middle.

Intercept= the summation of the severe impact of the studied problems and the impact of the channel tail location.

Conclusion

Study's results of the estimation the relationship among total return of the selected studied crops: (sugar beet, rice and wheat) and the inputs (nitrogen, phosphorus, seeds and irrigation water), are:

Firstly: The additional units of the studied inputs will increase total return of the studied selected crops (within the second stage of the production function, the economic stage). The simple correlation relationship among total returns of rice and wheat and the studied inputs are positive, relatively high and highly statistically significant. The correlation relationship among total return of sugar beet and nitrogen, phosphorus and irrigation water are positive, relatively high and highly statistically significant.

Secondly: With the respect to the main factors affecting total return of the studied crops, the results show that: Only 28% of the variations in total return of sugar beet, explained by the variation in the studied inputs included in the equation. About 43% of the variation in total return of rice, explained by the variation in the studied inputs which are; nitrogen, phosphorus, seed and irrigation water. About 47% of the variation in total return of wheat, explained by the variation in the previous inputs.

Thirdly: With respect to the impacts of the salt-affected soil's farming problems on total returns of the selected studied crops, the results show that: The variation in the water shortage supply explains; 28%, 18% and 24% of the variation in total return of sugar beet ,rice and wheat respectively. The variation in the irregular irrigation rotation explains; 12%, 28% and 21% of the variation in the total returns of sugar beet, rice and wheat respectively. The variation in the high level of water table explains; 30%, 26% and 24% of the variation in the total returns of sugar beet, rice and wheat respectively.

The variation in the high level of soil salinity explains; 42% of the variation in the total returns of rice. The variation in the using drainage water explains; 19%, 18% and 15% of the variation in the total returns of sugar beet, rice and wheat respectively.

Fourthly: With respect to the impact of the farm location along the channel on the total returns, the results show that: The variation in the farm location along the channel explains 23%, 27% and 18% in total return of rice, sugar beet and wheat.

Fifthly: The impact of the farming problems on the farm's total return, the results reveal that; the variations in the water shortage supply, using drainage water, irregular irrigation rotation and high level of soil salinity explain 8%, 21% , 29% and 31% of the variation in the farm's total return.

Sixthly: The multiple impacts of farming problems and farm location, the results show that; the variations in these problems explain 47% of the variation in total return per farm. Also, the variations in the previous problems and farm location explain 51% of the variation in total return.

Since Egypt faces noteworthy food and water challenges over the next decades, restrictions on domestic food production, limited water resources and shrinking fertile and arable land. Moreover desertification and soil deterioration are lessening the area available for vegetation. Also, global climate changes which exacerbates environmental variations, is predicted to have severe consequences for Egypt's food and water security.

However from a sustainability point of view it is important to emphasize that making optimal use of soil-affected lands and preventing further degradation both preventive and ameliorative measures need to be employed. In order to reclaim existing salt- affected soils, and to prevent degradation of fertile land, information on their nature, magnitude, extent and spatial distribution is a prerequisite. In case irrigation water overuse, where salinity is increasing as a problem on an irrigated farm, it be necessary to select crop varieties that have a greater tolerance to salt. Site effects did significantly impact crop income, also interactions involving site effects were observed for farm income. Yield reduction from salt- affected soils is mainly associated with a lower farm income.

Reclamation of already salt- affected soils through appropriate use of amendment fertilizers and leaching, should be undertaken both by the tillers as well as the Government. Salt – resistant crops should be raised. It's important to find ways of better utilizing salt –affected soils productivity, such as introduce more efficient irrigation systems, better water management, changing cropping patterns by growing crops that consumes less water.

Further research should be carried out on the natural, social, economic, environmental and political implications using salt- affected soils as a strategic instrument in horizontal expansion policy. Also water saving strategies have become a priority in agricultural researches. Ensuring the availability of sufficient and affordable food for the population require economic policies that build resilience in Egypt's agricultural sector to variable trends in international food markets.

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تأثير المشكلات الزراعية فى الأراضى المتأثرة بالملوحة وموقع المزرعة على الدخل المزرعى

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من المتوقع أن تواجه مصر في العقود القليلة القادمة أزمة مائية حادة تهدد أمنها الغذائى، فهى من أكثر الدول تضررا بفعل التغيرات المناخية والتى يترتب عليها تغير منسوب المياه فى نهر النيل، وإرتفاع منسوب مياه البحر وغرق كثير من الأراضى الزراعية فى دلتا مصر بسبب دخول المياه المالحة إلى المناطق الساحلية فى الدلتا، وتغير المحاصيل الزراعية بفعل ظاهر ة الإحتباس الحرارى، فضلا عن الآثار الكارثية لسد الألفية (سد النهضة الأثيوبى)، خاصة خلال سنوات ملء السد بما يهدد الأمن المائى المصرى، يضاف إليه الممارسات الزراعية غير الرشيدة، والإعتماد على نظم تقليدية وشبكات متهالكة للرى والصرف، فالزراعة المروية غير الرشيدة والتى لا تراعى التوازن بين الرى الغامر والصرف القاصر تتسبب فى تملح التربة وزيادة منسوب المياه الجوفية، وبصفة عامة يعانى الفلاحون فى الأراضى الزراعية المالحة - والمتملحة – من كثير من المشكلات الزراعية منها: نقص المعروض من مياه الرى، وإستخدام مياه الصرف ، وعدم انتظام مناوبات الرى، وإرتفاع منسوب المياه الجوفية، وإرتفاع درجة ملوحة التربة، ومن هنا يثار التساؤل التالى: هل تؤثر المشكلات الزراعية فى الأراضى المتأثرة بالملوحة وكذلك موقع المزرعة بالنسبة لقنوات الرى على الدخل المزرعى؟ وتحاول هذه الدراسة تحليل أثر مشكلات الرى على الدخل المزرعى فى خمس مناطق نموذجية للأراضى المتأثرة بالملوحة: وهى قرى الرواد، وطارق بن زياد، والإزدهار، والإصلاح، وخالد بن الوليد، وهى من الأراضي المجاورة لبحيرة المنزلة والتى تم تجفيفها وزراعتها، ومما لا شك فيه أن أزمة المياه تزداد حده مع تزايد الطلب على المياه نتيجة لزيادة السكان، وزيادة الطلب على الغذاء والتوجه نحو زراعة الأراضى الصحراوية ، فى ذات الوقت الذى تتضاءل فيه الأراضى الزراعية الخصبة إما بسبب التعدى عليها بالبناء أو تدهورها وتملحها نتيجة للممارسات الزراعية غير الرشيدة. وتتمثل أهداف هذه الدراسة فى: قياس علاقة الإرتباط بين الدخل الإجمالى من المحاصيل محل الدراسة- بنجر السكر، والأرز، والقمح- (وهى تمثل المحاصيل الرئيسة التى يتم زراعتها فى هذه المناطق ذات التربة المالحة) وعناصر الإنتاج، تحديد أهم عناصر الإنتاج تأثيراً على الدخل الكلى من المحاصيل محل الدراسة، قياس أثر المشكلات الزراعية التى يعانى منها الفلاحون فى هذه المناطق على الدخل المزرعى، قياس أثر موقع المزرعة بالنسبة لقنوات الرى على الدخل الكلى من المحاصيل محل الدراسة، قياس أثر المشكلات الزراعية على الدخل المزرعى، قياس الأثر الكلى للمشكلات الزراعية على الدخل المزرعى، ومن المتوقع أن يترتب على الوحدات الإضافية من مدخلات الإنتاج زيادة فى الدخل الكلى من المحاصيل محل الدراسة.كذلك من المتوقع أن يؤثر موقع المزرعة بالنسبة لقنوات الرى والمشكلات الزراعية على الدخل الكلى للمزرعة، وقد أثبتت نتائج الدراسة صحة هذه التوقعات.

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