

Desertification and its impact on agriculture production in Siwa Oasis

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ABSTRACT

The study aims to: 1) identify indicators of desertification in general their causes, 2) examine the impact of this phenomenon on agricultural production of Siwa Oasis, 3) identify the efficient use of agricultural resources in light of the spread of this phenomenon, and 4) measure the economic cost borne by society as a result of desertification and ways to minimize and avoid the impact on short and long-term. Both descriptive and quantitative statistics methods were used to carry out this study, including the relative importance, Chi Square test, simple & multiple regression, extract functions of production, costs & standards of economic and productive efficiency in connection to use agricultural resources. Data were collected from 160 farmers in Siwa Oasis, 100 of them were affected by the phenomenon of desertification, while the other 60 were not. The higher soil salinity is the most important cause of desertification. The calculated value of Chi Square was 31.25 and 32.75 which explain the significant differences between views of study samples regarding the reasons and aspects of desertification respectively. The higher scale of water was the most frequent reason for desertification. In addition to the data indicates that total sample of the study is 2193.5 acres representing 14.8% of gross area cultivated with olive and palm trees, out of such about 1411.5 acres affected by desertification in percentage of 64.3% of total sample and 9.5% of the whole olive and palm area which amounting 1408 acres. Also the data refers to about 872 acres of the sample unaffected which representing 35.7% of the sample trees and 5.3% of total area cultivated with olive and dates palm in the oasis. Information indicates that the total amount of loss of palm production contained in the sample, as the affected desertification production loss amounted 1288 tons, the maximum amount of unaffected category reaches 626 tons, then the next category is the first reaching 481 tons and finally the third category amounts 181 tons of the loss of olive production in the following percentages: 48.6%, 37.3% and 14.1% respectively. As well as the date refers to the value of olive loss production reached EGP 3.220 million, the maximum value is EGP 1.565 million for unaffected category and followed by EGP 2.202 million for the first category and at last the third category in value of EGP 0.453 million of total loss of dates palm area affected by desertification. From the above, the result of the affected area of the sample cultivated with olive and palm amounting 1411.5 acres, in loss of EGP 8.949 million which is the amount of loss due to impact of fields by causes of desertification.

In light of the study's findings, we recommend the following:

- 1- Provide the financial credits necessary to complete sewage project in the oasis which is the main element to complete this project. Since it represents the significant solution to the problems arising from the bad sewage in the oasis, mainly the high level of lands and increased salinity of agricultural soil.
- 2- Reengineer oasis's existing sewage due to its technical problems, such as many curves and inefficient lining and misuse of inhabitants.
- 3- Put a clear plan for urban planning either regarding construction or investing projects, in addition to remove agricultural lands encroachments through applying the laws strictly and impose punishment to the criminal of agricultural lands encroachment.
- 4- Put agricultural strategy in the oasis to pay more interest to undertake projects of fixing sand dunes, specifically in the new lands.
- 5- Provide guidance, by the respective guidance authority, to farmers regarding methodology of preparing the organic fertilizer and enhance its specifications as one of methods to treat soil salinity.

Key words: soil salinity, climate changes, causes & aspects of desertification.

Introduction

Desertification is a global problem. Many countries suffer from this phenomenon, especially the countries where dry, semiarid or subhumid climate. The area of the dry land around the world amounting 5.2 billion hectare, out of this area more than 3.6 billion hectare affected by the desertification of various levels. This phenomenon threatens about 1.25 billion people. The financial loss caused by decrease of land productivity reaches USD 2.5 per year affected 110 counties around the world.

There is a difference between desertification and desert; whereas the desert is a natural environmental system formed under the universal system and according to geological constitution (such as *Ṣaḥrā' al-Kubrā*, 'the Great Desert' - The Rub' al Khali 'the Empty Quarter'). While the desertification is defined as deterioration of the lands and productivity decrease due to various factors, the irrational investment comes on top of these factors and climate change at last.

During 1970s, UN announced that the Egypt is among the top world countries regarding the desertification due to tough nature of its desert. It has 86% extreme arid lands and about 14% arid lands. Egypt occupies about million km square in the western north of Africa, also it takes part of the great desert belt from Atlantic Ocean across Africa till the Arab island. The climate in Egypt is likely moderate through the coasts of Mediterranean Sea, dry in the Delta and Nile Valley and very dry in desert. These climate changes lead to deteriorate of the soil and affect its level from area to another.

Desertification can be defined as deterioration of producing land fertility, either natural pasture or irrigated of dry farming lands, which result in decreasing of biological production of lands. Thus it became less productivity and may lose its fertility totally. The pastures may miss its natural green cover and replaced with undesired plants and toxic thistles, the trees and small trees would disappear and replaced with grass with less economic benefits which couldn't protect or fix the soil. The dry soil may deteriorate due to plow during dry times, which result in wind erosion and the soil can't keep the water and provide the suitable environment for planting. The irrigated lands may deteriorate because of unscientific irrigation, since the salt may be increase or raise the level of underground water and so decreasing the productivity.

In other words, desertification is a full or partial deterioration of environmental systems elements, which result in reducing the productivity of lands and converting such to semi-desert areas because of the extensive exploitation of it resources by human, misadministration and other unsuitable environmental factors as well, especially the climate circumstances, in addition to the repeated recurring dry, i.e. "desertification is a changing in the environmental systems causing circumstances more dry and more deserted."

Desertification leads to decline food productivity because the cultivable land, fertilize pastures, especially in the dry and semi-dry areas, are decrease. Through the studies by UN, it appears that the total area of desertification reached 46 million km² around the world, out of such 9.76 million km² in the Arab Nations which total area is 14.1 million km². Thus desertification is a great issue regarding size and results.

Some studies referred to that the total area of the Arab Nations amounting 14.1 million km², representing 10.15% of world land. The cultivable land in Arab Nations reaches 14.5% of the total lands out of it only 4.5% under the agricultural investment. Also there fair amount of area currently invested, suffer from deterioration in form or another. The desertification in Arab Nation amounts 9.76 million km² (68.4% of total area). Arab countries are varied regarding percentage of desertification. Whereas it reaches in Arabian peninsula to 89.6%, about 77.7% in al Maghreb, and decline to reach to 44.5% in Nile basin and African horn, and the least percentage in Arabic east which not exceed 35.6%. However we find another result subsequent reading the threatened areas to subject to desertification, in Arabic east it reaches 48.6% then 28.6% in Nile basin, 16.5% in al Maghreb and finally 9% in Arabian peninsula.

The studies observe that the agriculture in Siwah Oasis depends on the underground water flow from wells and springs throughout the oasis which are around 1275 well and spring pumping about 255 million m³ water per year, out of such about 222 million m³ being utilized in irrigation and the rest flows to the low areas "lakes" that amounting 33 million m³ representing the destination of unutilized water.

It became clear that this pattern of utilizing water resources is one of most important reasons of desertification according to the results of the study subsequently. Since it has been indicted that the high salinity of soil, caused by irrational irrigation throughout the random digging of wells by farmers long time ago, resulted in increasing the rates of agriculture sewage, hence lead to increasing the issue of agricultural sewage which threaten thousands of cultivated acres in the oasis.

Moreover it composed four sewage swamps; "al Maraqui" with area of "9 km²", "Siwah" amountin "32 km²", "Aghormy" about "5 km²" and "kareshet" with area of "16 km²".

Forms of desertification:

The main forms and aspects of desertification that often may be its reasons can be summarized as follows:

1. **Erosion:** a Latin term means removal or corrosion of surface. The main factor of soil erosion is irrational utilization of land. Among its types: **water erosion and wind erosion.**
2. **Salinization:** accumulation of water soft dissolution salt in the soil which leads to decline of productivity. When these salts reach to specific limit, the soil wouldn't be available for agriculture investment and turned to desert.

3. **Aridification:** The significant exhaustion of underground water, especially the close to surface, may lead to widen desertification and dry. When the quantity of this water declines due to the dry climate and rear rain over the year, it would negatively effect on quantity and type of water.

4. **Soil & water pollution:** Water and earth resources are exposed to many contaminations whether solid, liquid, gas or even biological contaminations.

5. **Losing plant nutrients from the soil:** the extensive utilization of lands in cultivation led to losing a lot of nutrient elements especially the minor elements, resulting in declining soil fertility and thus its productivity.

Levels of desertification:

Desertification consequences are relevant to its level, thus it can be divided into the following three levels:

1. **Moderate desertification:** The beginning of vegetation cover regression due to wind and water degradation, salinity, chemical contamination or mismanagement of natural resources. During this stage the recourses productivity decrease to reach more than 25% of its ability prior desertification.

2. **Great desertification:** continuation of aspects and reasons of desertification to became very difficult to remedy this phenomenon and thus the recourses productivity decreases to be more than 50% of its ability prior desertification.

3. **Extreme desertification:** This is the final phase where the land becomes bare ground with no production, and it becomes impossible to restore the soil to the previous stages through the traditional means.

Research problem:

The process of desert lands reclamation and use these lands for agricultural production is difficult with high economic cost. Hence it became necessary to maintain, manage and utilize the same for the economic and social optimal usage in order to achieve the intended from this process. The study problem is the spread of desertification of agriculture lands in Siwah Oasis due to many various reasons. And so became one of obstacles of optimal exploit and achieving the objectives regarding lands utilization. Desertification phenomenon results in resources wasting, also higher economic costs incurred by the society due to desertification spread.

Study objectives:

The study aims to identify indicators of desertification in general and its causes in Siwah particularly. Also to examine the impact of this phenomenon on agricultural production of the respective Oasis, through study its economic impact on the production, the productivity and the areas cultivated with the most important crops planted in the Oasis. To identify the efficient use of agricultural resources in light of the spread of this phenomenon in the Oasis, to measure the economic cost borne by society as result of the desertification spread and ways to minimize and avoid the impact on short and long-term, such as its impact on the cultivated areas, total production. In addition to know its impact on rising the costs of the agricultural production, hence on net return of such production. To realize the social effects of this phenomenon through finding work opportunities and discontinuing the work of workers of agricultural sector in the oasis (unemployment), beside the impact on the income of sample's farmers.

Search methodology and data sources:

The study, to achieve its targets, depends on both descriptive statistics and quantitative statistics methods. Regarding the descriptive analysis is represented by the relative importance of many indicators of the study and Chi Square test. For the quantitative analysis is represented by simple and multiple regression and extract functions of production, standards of productivity efficiency, such as total production elasticity for the countries producing agricultural materials, and standards of economic efficiency such as average total income, average total costs, average net return, and investment revenues per pound, for sample of farmers in Siwah Oasis, reached roughly 160 farmers. This sample has been divided into two categories; affected by the desertification and unaffected by the same phenomenon.

The study depends on two main data sources: First: published and unpublished secondary information from Information Center of Agriculture Directorate in Marsa Matrouh , Agriculture Directorate in Siwah and Information Center of Siwah City Headquarter. Second: civic information for sample of farmers in the oasis through questionnaire form set out to study the impact of desertification in Siwah.

Region of the study:

Siwah Oasis has a low geographical site with a lot of underground water. Its area is about 1050 km², the agricultural production represents the principle activity of oasis inhabitants, whereas the cultivated area the amounting 14500 acres.

The agriculture depends on the underground water from wells and springs throughout the oasis which are around 1275 well and spring pumping about 255 million m³ water per year, out of such about 222 million m³ being utilized in the outstanding irrigation and the rest flows to the low areas "lakes" that amounting 33 million m³ representing the ultimate destination of unutilized water. This led to formation of four sewage swamps; "al Maraqi" with area of "9 km²", "Siwah" amountin "32 km²", "Aghormy" about "5 km²" and "kareshet" with area of "16 km²".

Crops of the study:

Siwah has ancient lands has been cultivated since long time ago, most of these lands were cultivated with principle crops like palm trees and olive, since the oasis has comparative advantage of production of these crops and so the crop pattern has been put according to the oasis climate and environmental circumstances. New areas were added to these lands which its crop pattern has been changed and became cultivated mainly with vegetables and grain crops, it is noted that the variety of crops in the oasis such as vegetables, horticultural and field crops generally. Information in Table (1) states the relative importance of the cultivated area in the oasis whereas it reached 18426 acres descending sorted as follows: olive, palm trees, alflafla, fruits, winter vegetables and citrus fruits by 48.6%, 31.8%, 15.4%, 1.9%, 1.1%, 0.8% and 0.4% respectively. Olive and palm trees represent the most significant crops in the oasis as the occupy 94.5% of the cultivated area in the oasis.

This information indicates that olive and dates-palm are the most important crops cultivated in the oasis, due to their environmental and climate characteristics match this environment, in addition to availability of the agricultural factors needed by these crops such as agricultural soil and climate. Due the relative importance of olive and palms, where they are about 80.4% of the cultivated area of the oasis and they have significant economic contribute as significant source of farmers income in Th oasis. Hence they have a great impact on the agriculture production generally and farmers specifically. So olive and palm farmers had been chosen for study purposes.

Table 1: the relative importance of the cultivated area according the crops in the Oasis 2011

Crop	Continued				Seasonal			Total
	Olive	Palms	Fruits	Citrus fruits	Dates-Palm	Alflafla	Winter vegetables	
Area (Acre)	8950	5856	190	80	350	2850	150	18426
%	48.6	31.8	1.1	0.4	1.9	15.4	0.8	100

Source: Information Center – Agriculture Directorate in Matrouh – 2011

*Study findings and discussion:**Development of the cultivated area in the oasis:*

Information of table 2 shows the development of the cultivated area in the oasis during the period (2011/1997). It refers to increase of the cultivated area from 14042 acres in 1997 (base year) to about 18426 acres in 2009. The development of the cultivated areas has three phases, since the area increase from 14042 acres in 1997 to reach 14763 acres in 2001. From the following year, it has shrieked to 9409 acres in 2006 and increased again to 18426 in 2011.

It is observed that this clear fluctuation in the cultivated area is due to cultivating wide range of the reclaimed fields with the major crops of olive and dates palm during the first phase. During the second phase, the old fields in oasis were affected by the improper irrigation methods and wasting the water resources of the oasis, hence the agriculture swage raised and sewage swamps had been constituted. These resulted in soil salinity and the soil became unsuitable for cultivation, this phase effected by factors other than desertification. During the third phase the reclamation of new spaces increased in the oasis, however the old areas corrupted because of high rate of salinity and constitution of swamps that limit the cultivating fields.

*- Sample of the civic study:**1- Sort the sample by farmers:*

Data in the table (3) shows that the study sample reached 160 landlords divided into two categories, affected by the desertification about 100 landlords representing 62% of the study sample, while the unaffected farmers by the same phenomenon are about 60 landlords which is 37.5% of the study sample.

Table 2: Development of the cultivated area in the oasis during the period (1997-2009) (Base year 1997)

Year	Cultivated area	Record
1997	14042	100
1998	14062	100.1
1999	14742	104.9
2000	14763	105.1
2001	14751	105
2002	14566	103.7
2003	14449	102.9
2004	14428	102.7
2005	9430	67.2
2006	9409	67
2007	9913	70.6
2008	14712	104.8
2009	15116	106.6
2010	15807	112.6
2011	18426	131.2

Source: Information Center – Agriculture Directorate in Matrouh – 2011

Table 3: Sort study sample by affected landlords by desertification

Affected by desertification		Unaffected by desertification		Total	
Count	%	Count	%	Count	%
100	62.5	60	37.5	160	100

Source: Information as per study sample questionnaire in March – 2012

2- Sort the sample by impact on the crops:

Information of table (4) indicates that gross area cultivated with olive and dates palm which about 14806 representing 80% of the gross cultivated area in the oasis. Where the area of olive is 8950 acres in percentage of 60.4% and the area of palm is 5856 acres representing 39.6% respectively of the gross cultivated area in the oasis.

Moreover the data from the sample that has been chosen on the basis of the impact of desertification and sorted by the relative importance of the cultivated area with olive and palms. About 97 farmer cultivating olive representing 60.6% of sample farmers, out of them land of 67 farmers affected with desertification with percentage of 69% and 30 farmers representing 31% of farmers cultivate olive respectively. As well as the information indicates that the sample of farmers cultivating palms reached 39.4% of total sample, out of such 33 landlords which is 52.4% their lands were affected by desertification and about 30 farmers representing 47.6% where their lands didn't affect by desertification.

Table 4: Sort study sample by impact of crops by desertification

Olive				Palm				Total	
Affected		Unaffected		Affected		Unaffected			
Area (acre)	%	Area (acre)	%	Area (acre)	%	Area (acre)	%	Area (acre)	%
67	69	30	31	33	52.4	30	47.6	160	100
97		60.6		63	39.4			160	100
8950		60.4		5856	39.6			14806	100

Source: Information as per study sample questionnaire in March – 2012

3- Sort the sample by impact of acquisition categories:

Table (5) indicates that the sort of sample by acquisition categories and the impact of desertification on olive and palms fields. Since its descending order as per its relative importance is (less than 15 acres), (less than 8 acres), (more than 20 acres) and (less than 20 acres) in the following percentages 54%, 20%, 16% and 10% respectively of the total areas cultivated with olive contained in study sample.

For lands cultivated with palm trees, the descending order as per its relative importance is (less than 8 acres), (less than 15 acres), (more than 20 acres) and (less than 20 acres) in the following percentages 50%, 33.3%, 10% and 6.7% respectively of the total area cultivated with palm which contained in study sample.

From the aforesaid, it's clear the most affected category is that less than 15 acre which is the common acquisition in the oasis. Among its characteristics, the financing ability is low; hence it needs financial and technical support to struggle this phenomenon.

Table 5: Sort study sample by impact of acquisition categories by desertification

Acquisition category	Olive						Palm					
	Affected category			Unaffected category			Affected category			Unaffected category		
	Count	Area	%	Count	Area	%	Count	Area	%	Count	Area	%
Less than 8 acres	10	65	20	9	58.5	30	19	123.5	38	15	97.5	50
Less than 15 acres	27	405	54	11	165	36.7	21	315	42	10	150	33.3
Less than 20 acres	5	85	10	6	102	20	4	68	8	2	34	6.7
More than 20 acres	8	200	16	4	100	13.3	6	150	12	3	75	10
Total	50	755	100	30	425.5	100	50	656.5	100	30	356.5	100
% area cultivated in the ample	64			36			1180.5			64.8		
% area cultivated in the oasis	8.4			4.7			8950			35.2		
							11.2			6.1		
										5856		

Source: Information collected and calculated from questionnaire of study sample 2011 – 2012

Reasons of desertification in study area:

Mismanagement of water resources in the oasis is one of the most causes of desertification, where the underground water is the only water resource due to the rear rain. The underground water automatically flow because of the pressure of the natural springs (220 springs) in addition to (1040 shallow wells) and (58 surveillance and productive wells)

The common irrigation system is flood irrigation whereas the lands get irrigated by the springs through irrigation channels, some of such as covered with cement end with field dust irrigation point. The modern irrigation system was applied to specific sand land areas in south of the oasis (Investing projects).

In respect with agricultural sewage system, the theory of sewage based on natural water balance between swamps' input (sewage water) and its output of evaporated water due to sun heat specially in the summer. This balance is no longer existing because of the increased amount of swamps sewage. Where this sewage and uncontrolled water through field sewage which move to relatively low areas composing sewage swamps.

According to technical researches about nature of the soil in the oasis indicated that there are many significant reasons resulted in desertification such as; unavailability of natural area in the oasis, existence of solid non-water port stratum, using flood irrigation, since the majority of lands are saline, natural springs that is hard to control such, there are springs inside the swamps leak water directly in the swamps and non-natural balance between evaporation and the water coming to swamps, specially in the winter.

Table (6) indicates that among the most important aspects of desertification in the oasis, which descending ordered, as follows: high level of underground water, high salinity of agricultural soil, bad state of agricultural swage, erosion of agricultural lands and increasing sand dunes. Also the value of Chi Square test for each desertification aspect of study sample indicates, regarding the first proposal, that reach 31.25 comparing to table value amounting 7.81 at significance level of 0.01, which manifest that there are many artificial differences between views of study sample, standing from it is considered one of desertification aspects in favor of the greatest repetition as agreeing that the higher scale of water and land level is one of desertification aspects. In respect with the second, the calculated value of Chi Square test about 23.75 comparing to table value amounting 7.81 at significance level of 0.01, which manifest that there are many artificial differences between views of study sample, standing from it is considered one of desertification aspects in favor of the greatest repetition as agreeing that the higher salinity of the soil is one of desertification aspects.

For the third proposal, the calculated value of Chi Square test is 273.9 comparing to table value amounting 7.81 at significance level of 0.01, which manifest that there are many artificial differences between views of study sample, standing from it is considered one of desertification aspects in favor of the greatest repetition as agreeing that the sand dunes are not among of the desertification aspects.

For the fourth proposal, the calculated value of Chi Square test is 30.15 comparing to table value amounting 7.81 at significance level of 0.01, which manifest that there are many artificial differences between views of study sample, standing from it is considered one of desertification aspects in favor of the greatest repetition as agreeing that the bad state of agriculture sewage is one of the desertification aspects in the oasis.

Regarding the fifth proposal, the calculated value of Chi Square test is 142.8 comparing to table value amounting 7.81 at significance level of 0.01, which manifest that there are many artificial differences between views of study sample, standing from it is considered one of desertification aspects in favor of the greatest repetition as agreeing that the erosion of agriculture lands is not one of the desertification aspects in the oasis.

From aforementioned information, it became clear that the higher level of underground water, high salinity of the soil and bad-state of agricultural sewage are desertification causes in the oasis.

Table 6: Relative importance of desertification causes in the oasis

Cause	Options				Relative importance						Weight ed average	Calculate d Chi2
	Totally agree	Very agree	Agree	Not agree	Agree		Not agree		Total			
					Count	%	Count	%	count	%		
High level of underground water	55	25	20	60	100	62.5	60	37.5	160	100	39.2	31.25
High salinity of agricultural soil	50	25	25	60	100	62.5	60	37.5	160	100	37.5	23.75
Increasing sand dunes	3	7	20	130	30	18.7	130	81.3	160	100	19.8	273.9
Bad-state of agricultural swage	24	37	30	69	91	56.9	69	43.1	160	100	33.6	30.15
Erosion of agricultural lands	3	13	44	100	60	37.5	100	62.5	160	100	23.9	142.8

Source: Information collected and calculated from questionnaire of civic study sample 2012

- Table Chi Square at significance level of 0.01 and freedom degrees 3 equal 7.81.

Impact of desertification on the agricultural production in Siwah:

First: The economic impacts of this phenomenon in Siwah:

The agricultural production is affected by desertification, this impact could be measured through many variables like; affected field area, its productivity, agricultural production loss, higher cost of production crops in the oasis and net return from agricultural production. Therefore we will address this phenomenon through studying its impact on the significant crops in the oasis represented by olive and palms, as mentioned above.

1- Impact of desertification on the cultivated area as per the sample:

Table (7) indicates that the area cultivated with olive trees in the sample amounting 1180.5 acres in 13.2% of the total olive area in the oasis, out of such about 755 acres affected by desertification in percentage of 64% of the sample and 8.4% of the whole olive area in the oasis. Also the data refers to about 425.5 acres of olive unaffected which representing 36% of olive sample trees and 4.7% of total area cultivated with olive in the oasis.

In connection with palm fields, the data show that palm sample amounting 2193.5 acres in percent of 17.3% of the total palm area in the oasis, out of such about 656.5 acres affected by desertification in percentage of 64.8% of palm sample and 11.2% of the whole olive area in the oasis. Also the data refers to about 356.5 acres of palm unaffected which representing 35.2% of the sample trees and 6.1% of total area cultivated with dates palm in the oasis.

In addition to the data indicates that total sample of the study is 2193.5 acres representing 14.8% of gross area cultivated with olive and palm trees, out of such about 1411.5 acres affected by desertification in percentage of 64.3% of total sample and 9.5% of the whole olive and palm area which amounting 1408 acres. Also the data refers to about 782 acres of the sample unaffected which representing 35.7% of the sample trees and 5.3% of total area cultivated with olive and dates palm in the oasis.

From aforementioned findings, it is concluded that about 8.4% of olive and 11.2% of palm fields in the oasis are with desertification, which lead to waste one of agricultural resources and its productive efficiency; accordingly it has negative impacts on farmers directly and indirectly on the national economy.

Table 7: Impact of desertification on the cultivated area as per the sample

Crop	Affected area	% sample of crop	% crop in the oasis	Unaffected area	% sample of crop	% crop in the oasis	%	Total area	% Sample	% oasis
Olive	755	64	8.4	425.5	36	4.7	100	1180.5	53.8	13.2
Palm	656.5	64.8	11.2	356.5	35.2	6.1	100	1013	46.2	17.3
% total area	1411.5	64.3	9.5	782	35.7	5.3	100	2193.5	100	14.8

Source: Information collected and calculated from tables (4 & 5).

Impact of desertification on gross production, quantity and value of sample crops loss:

Information in table (8) indicates that the sample was sorted, on basis of percentage of impact on the cultivated area, into four categories (First category 25% of the cultivated area, unaffected area amounting 50% of the cultivated area and 100% of the cultivated area). Since the data observes that the affected area of olive fields reached roughly 755 acres, out of such about 405 acres in percent of 53.7% under the first category, about 285 acres in percent of 37.7% under unaffected area category, around 65 acres representing 8.6% under the third category and according to data there is no any cultivated area 100% affected as whole.

Data also manifests that the total amount of loss of olive production contained in the sample, as the affected desertification production loss amounted 1910.6 tons, the maximum amount of unaffected category reaches 869.3 tons, then the next category is the first reaching 779.7 tons and finally the third category amounts 261.6 tons of the loss of olive production in the following percentages: 45.5%, 40.8% and 13.7% respectively. As well as the date refers to the value of olive loss production reached EGP 5.729 million, the maximum value is EGP 2.607 million for unaffected category and followed by EGP 2.338 million for the first category and at last the third category in value of EGP 0.784 million of total loss of olive area affected by desertification.

Information indicates that the total amount of loss of palm production contained in the sample, as the affected desertification production loss amounted 1288 tons, the maximum amount of unaffected category reaches 626 tons, then the next category is the first reaching 481 tons and finally the third category amounts 181 tons of the loss of olive production in the following percentages: 48.6%, 37.3% and 14.1% respectively. As well as the date refers to the value of olive loss production reached EGP 3.220 million, the maximum value is EGP 1.565 million for unaffected category and followed by EGP 2.202 million for the first category and at last the third category in value of EGP 0.453 million of total loss of dates palm area affected by desertification.

From the above, the result of the affected area of the sample cultivated with olive and palm amounting 1411.5 acres, in loss of EGP 8.949 million which is the amount of loss due to impact of fields by causes of desertification.

Table 8: Impact of desertification on gross production and agrecultral production loss quantity and value for the sample according to desertification percentage.

	Olive									Palm								
Percent of impact	Affected category									Affected category								
	Area	%	Trees count/acre	Average production/tree	Gross production/acre	Average gross production of area	Gross production of area	Quantity of loss	Value of loss	Area	%	Trees count/acre	Average production/tree	Gross production/acre	Average gross production of area	Gross production of area	Quantity of loss	Value of loss
25%	405	53.6	50	70	3500	1417500	3078000	1660500	4981500	405	61.7	64	70	4480	1814400	2268000	453600	1134000
50%	285	37.7	45	60	2700	679500	2166000	1396500	4189500	207	31.5	43	60	2580	534060	1159200	625140	1562850
75%	65	8.6	35	50	1750	113750	494000	380250	1140750	44.5	6.8	22	60	1320	58740	204700	145960	364900
100 %	0	0.0	0	0	0	0	0	0	0	0	0.0	0	0	0	0	0	0	0
Total	755	100	Total loss of olive						10311750	656.5	100	Total loss of palms						3061750
Total value of loss because of desertification																		13373500

Source: Collected and calculated from questionnaire forms of study sample 2011 -2012

*Impact of desertification on average costs, total revenues and net return for the sample:**Dates-palm crop:*

Data in the table (9) refers to budget items of palm trees cultivated in the fields affected by desertification in the sample. Whereas it shows that the average costs of production per acre reached EGP 5420 which is the most important item in percentage above 74.7%,. This percentage includes the highest cost for production suppliers like organic and chemical fertilizers for about 31.4%, followed by 22.1% for harvest, costs of alternative opportunity which is annual rental of 12.9% and 8.3% irrigation costs.

Also the same data indicates decrease average of costs of unaffected lands to be EGP 5040 per acre which is the most important item in percentage above 75.5%, the highest cost is related to production suppliers from organic to chemical fertilizers for about 30.8%, followed by 23.8% for harvest, then costs of alternative opportunity which is annual rental of 13.9% and 9% irrigation costs.

From this data it became clear that cost of unaffected lands is 7% lower than the lands affected by desertification causes. This decrease is attributed to lower costs of many items; the most important of such is

irrigation cost, hence operating hours and manpower for the same item. In addition to quantities of chemical fertilizers to treat salinity of agricultural lands.

Table 9: Items of the budget of average cost of palm production (per acre) Within the civic study sample

Cost items	Unaffected lands		Affected lands	
	Average cost (EGP)	%	Average cost (EGP)	%
Field preparation and fixture	100	20	120	2.2
Cost of trimming	120	2.4	150	2.8
Cost of pollination	120	2.4	150	2.8
Cost of irrigation	350	6.9	450	8.3
Cost of grass removal	250	5.0	350	6.5
Cost of chemical fertilizing	300	6.0	50	0.9
Cost of organic fertilizing	230	4.6	400	7.4
Organic fertilizers	1100	21.8	1100	20.3
Chemical fertilizers	450	8.9	600	11.1
Total production suppliers	1550	30.8	1700	31.4
Cost of harvest	1200	23.8	1200	22.1
Transport	120	2.4	150	2.8
Rental	700	13.9	700	12.9
Total	5040	100	5420	100

Source: Information collected and calculated from questionnaire of civic study sample, March 2012

Impact of desertification on economic efficiency standards of palms production in the sample:

Data in table (10) shows the impact of desertification on palm production economic efficiency standards, where it states that the total income from unaffected lands is about EGP 11375 in increase of 71.9% more than the total income of the affected lands which is EGP 6615. According to the data, the average cost of unaffected lands is EGP 5040, at around 7% lower than the average cost of the affected lands which reached EGP 5420. The net revenue of unaffected lands amounting EGP 6335 representing 430% higher than the affected lands amounting EGP 1195. This statistics reflect the impact of desertification on the invested pound profitability which is 1.125% for unaffected lands confirming the economic efficiency of using the agricultural material in desertification-unaffected fields also the amount of loss result from deterioration of the lands affected with desertification causes. Also the agricultural impact resulting from decrease average income per farmer, whose land is affected with desertification, included in the sample.

Table 10: Impact of desertification on economic efficiency standards of palms production according to the sample

Crop	Affected lands	Unaffected lands
Average count of trees (tree)	42	65
Average production per tree (kg)	63	70
Average production per acre (kg)	2646	4550
Average gross income (EGP/acre)	6615	11375
Average total cost (EGP/acre)	5420	5040
Average net revenue (EGP/acre)	1195	6335
Invested pound profitability	0.22	1.25

Source: Information collected and calculated from questionnaire of civic study sample, March 2012

Olive crop:

Data in the table (11) refers to budget items of olive cultivated in the fields affected by desertification in the sample. Whereas it shows that the average costs of production per acre reached EGP 5050 which is the most important item in percentage more than 80.3%,. This percentage includes the highest cost for production suppliers like organic and chemical fertilizers for about 31.7%, followed by 23.8% for harvest, costs of alternative opportunity which is annual rental of 12.2% and 9.2% irrigation costs.

Also the same data indicates decrease average of costs of unaffected lands to be EGP 4350 per acre which is the most important item in percentage above 79.2%, the highest cost is related to production suppliers from organic and chemical fertilizers and harvest for about 26.4%, then costs of alternative opportunity which is annual rental of 17.2% and 9.2% irrigation costs.

From this data it became clear that cost of unaffected lands is 13.9% lower than the lands affected by desertification causes. This decrease is attributed to lower costs of many items; the most important of such is irrigation cost, hence operating hours and labor for the same item. In addition to quantities of organic fertilizers to treat salinity of agricultural lands. It is also became clear the high costs of labor in unaffected fields, due to increase of production which may provide job opportunities; this is indicator of the negative social impacts of

desertification. Since it results in loss opportunities such as harvest and other marketing and work in the farm like sort, packing and transport.

Table 11: Items of the budget of average cost of olive production (per acre) Within the civic study sample

Cost items	Unaffected lands		Affected lands	
	Average cost (EGP)	%	Average cost (EGP)	%
Field preparation and fixture	120	2.8	150	3.0
Cost of trimming	100	2.3	100	2.0
Cost of pollination	400	9.2	500	9.9
Cost of irrigation	150	3.4	200	4.0
Cost of grass removal	100	2.3	100	2.0
Cost of chemical fertilizing	230	5.3	250	5.0
Cost of organic fertilizing	700	16.1	1000	19.8
Organic fertilizers	275	6.3	400	7.9
Chemical fertilizers	175	4.0	200	4.0
Total production suppliers	1150	26.4	1600	31.7
Cost of harvest	1150	26.4	1200	23.8
Transport	200	4.6	200	4.0
Rental	750	17.2	750	14.9
Total	4350	100	5050	100

Source: Information collected and calculated from questionnaire of civic study sample, March 2012

Impact of desertification on economic efficiency standards of olive production in the sample:

Data in table (12) shows the impact of desertification on palm production economic efficiency standards, where it states that the total income average from unaffected lands is about EGP 11550 in increase of 42.6% more than the total income of the affected lands which is EGP 8100. According to the data, the average cost of unaffected lands is EGP 4350, at around 16.1% lower than the average cost of the affected lands which reached EGP 5050. The net revenue of unaffected lands amounting EGP 7200 representing 136.1% higher than the affected lands amounting EGP 3050. This statistics reflect the impact of desertification on the invested pound profitability which is 1.65% for unaffected lands confirming the economic efficiency of using the agricultural material in desertification-unaffected fields also the amount of loss result from deterioration of the lands affected with desertification causes. Also the agricultural impact resulting from decrease average income per farmer, whose land is affected with desertification, included in the sample.

Table 12: Impact of desertification on economic efficiency standards of olive production according to the sample

Crop	Affected lands	Unaffected lands
Average count of trees (tree)	45	55
Average production per tree (kg)	60	70
Average production per acre (kg)	2700	3850
Average gross income (EGP/acre)	8100	11550
Average total cost (EGP/acre)	5050	4350
Average net revenue (EGP/acre)	3050	7200
Invested pound profitability	0.60	1065

Source: Information collected and calculated from questionnaire of civic study sample, March 2012

Impact of desertification on production functions regarding the sample:

(A) Production functions of dates-palm crop for landlords in the sample:

Data in the table (13) indicates the production functions for landlords as per category of their possession. Formula (1), production formula of palm production in the desertification-affected lands, shows a statically significance positive relationship between dates production and cultivated area, labor, machines (e.g. irrigation, plow and grass removing), and quantity of mineral and organic fertilizers. Namely, if these elements increased by one unit, the gross production will increase by 0.301, 0.26, 0.71, 0.91 and 0.063 tons respectively. The high parameter of labor is attributed to its importance in produce palm, where this category mainly depend on manpower significantly, to execute the agricultural processes such as preparing fields, pinching, grass removal and harvest which is undertaken manually. Value of production elements flexibility used in logarithmic function reached 0.78. In other words, the raise of return per unit like increase quantities of all productive elements such as trees count, organic and chemical fertilizers and labor amount by 1% results in increasing the production by 0.78 per acre.

Formula (2), production formula of palm production in the desertification-unaaffected lands, shows a statically significance positive relationship between quantity of dates production and cultivated area, labor, machines (e.g. irrigation, plow and grass removing) and quantity of mineral and organic fertilizers. Namely, if these elements increased by one unit, the gross production will increase by 0.194, 0.098, 0.178, and 0.189 tons respectively. Value of production elements flexibility used in logarithmic function reached 1.027. In other words, the raise of return per unit like increase quantities of all productive elements such as trees count, organic and chemical fertilizers and labor amount by 1% results in increasing the production by 1.027 per acre.

From the value of production flexibility, it is clear that palm farmers of unaffected lands produce during the phase (economic phase) of phrases of law of diminishing returns.

From aforesaid, regarding the lands affected with desertification causes, there is no production element effect (tree count), because these lands are affected and decrease tree count per acre. While this element is high in unaffected lands.

Table 13: Production functions of dates-palm crop for landlords in the sample

s.	Category	Formula	F	R 2	Average gross
1	Affected	Log Y8 O= 4.56 + Log X1 0.301 + Log X2 0,26 + Log X3 0.071 + Log X4 0.91 + Log X5 0.063 **(5.476) **(11.154) **(5.721) **(5.004) **(4.42)	273.4	0.85	0.78
2	Unaffected	Log Y8 O= 4.736 + Log X1 0.187 + Log X2 0.097 + Log X3 0.348+ Log X5 0.158 + Log X6 0.179 **(5.476) **(11.154) **(5.721) **(5.004) **(4.42)	161.3	0.86	1.027*

Source: Collected and calculated from forms of questionnaire of study sample, season 2009 -2010

Whereas:

Y8O2 = estimative value of the datess produced quantity in ton during the observing O. X1 = the cultivated area per acre, X2 = labor (man/day), X3 = machine work (hour/day), x4 = organic fertilizer per m³, x5 = inorganic fertilizer per the effective unit. X6 =count of trees.

* The values between practices refer to cost (C), and (*) refers to statistical significance level at 0.05 and (**) at 0.01.

(B) Production functions of winter olive crop for landlords in the sample:

Data in the table (14) indicates the production functions for landlords as per category of their possession. Formula (1), production formula of palm production in the desertification-affected lands, shows a statically significance positive relationship between datess production and cultivated area, labor, machines (e.g. irrigation, plow and grass removing), and quantity of mineral and organic fertilizers. Namely, if these elements increased by one unit, the gross production will increase by 0.102, 0.310, 0.13, 0.014 and 0.18 tons respectively. The high parameter of labor is attributed to its importance in produce olive, where this category mainly depend on manpower significantly, to execute the agricultural processes such as preparing fields, pinching, grass removal and harvest which is undertaken manually. Value of production elements flexibility used in logarithmic function reached 0.73. In other words, the raise of return per unit like increase quantities of all productive elements such as area, labor (man/day), machines per hour, organic fertilizer in m³ and chemical fertilizers per effective unit by only one unit results in increasing the gross production of winter olive by 0.73 ton.

Formula (2), production formula of palm production in the desertification-unaaffected lands, shows a statically significance positive relationship between quantity of datess production and cultivated area, labor, machines, quantity of mineral and organic fertilizers and trees count. Namely, if these elements increased by one unit, gross production of olive will increase by 0.123, 0.293, 0.22, 0.118, 0.23 and 0.28 tons respectively. Value of production elements flexibility used in logarithmic function reached 1.027. In other words, the raise of return per unit like increase quantities of all productive elements such as trees count, organic and chemical fertilizers and labor amount by one unit, results in increasing the production by 0.805 ton.

From the value of production flexibility, it is clear that olive farmers of unaffected lands produce during the phase (economic phase) of phrases of law of diminishing returns.

Table 14: Production functions of winter olive crop in the sample

s.	Category	Formula	F	R 2	Average gross
1	Affected	Log Y8= 3.556 + Log X1 0.102 + Log X2 0,310 + Log X3 0.13 + Log X4 0014 + Log X5 0.18 (0.3) (0.48) (1.2) (1.01) (1.03) (0.06)	231.3	0.85	0.73
2	Unaffected	Log Y8 = 5.443 + Log X1 0.132 + Log X2 0.293 + Log X3 0.22 + Log X4 0.118 + Log X5 0.23 + Log X6 0.28 (4.7) (5.01) (3.9) (4.01) (4.4) (3.02)	156.3	0.82	*1.27

Source: Collected and calculated from forms of questionnaire of study sample, season 2011 -2012

Whereas:

Y8O2 = estimative value of the datess produced quantity in ton during the observing O. X1 = the cultivated area per acre, X2 = labor (man/day), X3 = machine work (hour/day), x4 = organic fertilizer per m3, x5 = inorganic fertilizer per the effective unit. X6 =count of trees.

* The values between practices refer to cost (C), and (*) refers to statistical significance level at 0.05 and (**) at 0.01.

Recommendations:

In light of the study's findings, we recommend the following:

6- Provide the financial credits necessary to complete sewage project in the oasis which is the main element to complete this project. Since it represents the significant solution to the problems arising from the bad sewage in the oasis, mainly the high level of lands and increased salinity of agricultural soil.

7- Reengineer oasis's existing sewage due to its technical problems, such as many curves and inefficient lining and misuse of inhabitants.

8- Put a clear plan for urban planning either regarding construction or investing projects, in addition to remove agricultural lands encroachments through applying the laws strictly and impose punishment to the criminal of agricultural lands encroachment.

9- Put agricultural strategy in the oasis to pay more interest to undertake projects of fixing sand dunes, specifically in the new lands.

10- Provide guidance, by the respective guidance authority, to farmers regarding methodology of preparing the organic fertilizer and enhance its specifications as one of methods to treat soil salinity.

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