Balancing productivity and sustainability: climate change and economic efficiency in wheat crop farms on salt-affected land

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Abstract

The study aimed to estimate the production economics efficiency indicators for the cultivated wheat crop in the salt-affected lands in Sharkia Governorate. A sample of 102 households has been randomly selected from the studied area. The distribution of farm households across the defined five Villages (clusters) was determined. Interviewed farmers were randomly selected from the five studied villages. The results revealed: First: The effects of a 10% decrease in wheat productivity on indicators of economic efficiency in lands affected by salinity according to farm size are: (1) for the farmer. Small, both total costs and variable costs per unit increased by 11.1%. Farm margin, net profit per acre, net water return, casual margin per acre, and water productivity decreased by 25.4, 16.1, 16.1, 12.1 and 10.0%, respectively. (2) For large farms, total costs and variable costs per ardab were increased by 11.1%. Farm margin, net profit per acre, net return on water crossing, margin per acre, and water productivity decreased by 25.2, 15.6, 15.6, 11.8 and 10.0%, respectively. (3) At the average level, total costs and variable costs per ardab increased by 11.1%. Farm margin, net profit per acre, net return on water, margin per acre, and water productivity decreased by 25.3, 15.8, 15.8, 12.0 and 10.0%, respectively. Second: The effects of a 20% increase in wheat seed prices on indicators of economic efficiency in lands affected by salinity according to farm size. At the average level, the total costs and variable costs per ardab increased by 1.3% and 1.9%, respectively. Farmers' margin, net profit per acre, net water return, casual margin per acre, and farmer incentives decreased by 3.0, 1.5, 1.5, 1.1 and 1.5%, respectively. The research recommends the need to maintain lands affected by salts due to their impact on the productivity of the wheat crop, as well as so that agriculture can continue.

Keywords: Climate changes; efficiency; indicators; net profit.

1. Introduction

Water is the natural resource that exerts the greatest constraint on Egypt's agricultural production system. Most of Egypt's cultivated lands depend on irrigation from Nile. However, Egypt's agriculture is under pressure to justify its use of water resource, which is scarce due to increased competition for water resources. On the other hand, accumulation of excessive salt in irrigated soils of Egypt affects negatively crop

yields, reduce the effectiveness of irrigation, ruin soil structure, and affect other soil properties. High level of water table and shortage in irrigation water supply in the salt-affected land doubles from the harmful effects of salinity problems. Consequently, the average productivity of the cultivated crops in salt-affected land is less than half of corresponding averages at the national level. More than 500 thousand feddan of cultivated lands in the North of Delta Governorates are salt-affected lands. These lands are in Sharkia, Qaliubia, Dommotta, Port said and Kafr Elshiekh Governorates.

Problem of the study

Rise of temperatures degrees because of the climate changes will lead to lack of efficiency and effectiveness of some agricultural and farming services at the north Delta land cause some problems at farm level. The shortage in efficiency and effectiveness of the agricultural extension services, the irrigation and drainage services and the agricultural credit will effect on the technical and the economic variables at the farm level representing (i) decrease in the farmers income per feddan, (ii) decrease in the yields or productivity of major cultivated crops in the studied area (Such as wheat), (iii) increase in the quantities of the farm inputs used (e.g., fertilizers and seed), (iv) increase in the level of the salinity and ground-table water and (v) increase in the level of some variable cost items. Consequently, the deterioration of the previous technical and economic variables leads directly or indirectly to the degradation of soil fertility.

Objective of the study

Winter and summer crops are cultivating in the salt-affected land located in North of Delta. The main cultivated crops in the studied area are wheat, sugar beet, berseem (Egyptian clover), maize, rice, cotton and vegetables. The main objectives of the study are: (1) estimating the production economics efficiency indicators for the cultivated wheat crop in the salt-affected lands in Sharkia Governorate. (2) Investigating the impacts of the hypothetical climate changes on the production economics for the cultivated wheat crop in the salt-affected lands in Sharkia Governorate. So, the hypothetical impacts of the climate changes on the economic efficiency indicators for the cultivated wheat crop in salt-affected land have been identified and measured during three scenarios: (i) the impacts of decrease in the wheat productivity by 10%, (ii) the impacts of increase in the wheat seeds by 20% and (iii) the impacts of increase in the quantities used from fertilizers, seeds and labor by 10%.

2. Methodology and data base

Governorate have been selected to collect the qualitative and quantitative inputs and outputs data. A sample of 102 households has been randomly selected from the studied area. The distribution of farm households across the defined five Villages (clusters) was determined. Interviewed farmers were randomly selected from the five studied villages (Tarek EbnZiad, ElSalah, AlEzdhar, Khaled Ebn-Elwalied and AlRowad). The selected sample reflects the studied cultivated crop, the farm scales (i.e., small and large farms). The data represented in the table below illustrates that only 15 farms are (less than 5 feddans), representing 15% of the sample, 87 farms are (5 feddans or more), representing 85% of the sample of 102 farms, considering that the model farm size is 5 feddans because the most of household farmers are graduates farms.

Farm size or scale	Frequency	Percent
Less than 5 feddans	15	14.7
5 feddans and more	87	85.3
Total	102	100

Source: *compiled and calculated from the field primary data, 2020.*

The crop budget technique for the studied cultivated crop in the studied area has been used to accomplish the previous objectives of the study. The main studied economic efficiency indicators are the gross margin above the variable costs per feddan, per ton of product and per man- day, net profit per feddan and per ton of product, total revenue per ton of product, variable and total costs per ton of product, farmer incentive, farmer margin, productivity of water unit and the net return to water unit. The crop budgets for the wheat crop according to the farm scale have been used to estimate the previous indicators. In

addition, the hypothetical changes in the levels of the yield and some production requirements (i.e., seeds, fertilizers and labor) for the studied crop because of the changes in the levels of the temperature (as approxy variable for the climate changes) have been investigated and identified. So, the impacts of the hypothetical changes in the levels of the yield, seeds and some production requirements for the wheat crop on the economic efficiency indicators have been estimated and measured.

3. Results and discussion

3.1. *The crop budgets and the economic efficiency indicators for wheat crop by the farm production scales*

The inputs and the outputs, the production and the economic efficiency indicators for the wheat farms according to the farm production scales and at the average in the studied area during 2020 season are presented in Tables 1, 2 and 3, respectively.

3.1.1. *The small-scale production farms*

The numbers of the wheat farms are estimated at 15 small-scale farms (i.e., less than 5 feddan). The averages cultivated areas of wheat is estimated at 1.18 feddan. The results in Table 1 indicate that: (i) the averages of the main yield, the farm-gate price and the total return value of the wheat are estimated at 16.55 ardab per feddan, 750 LE/ ardab and 12412.5 LE/feddan, respectively. In addition, the average total return value of the by-product is estimated at 3948.5 LE/feddan. Consequently, the total return of wheat at the small-scale farms is estimated at 16361 LE/feddan.

(ii) The averages quantities of the main inputs used are estimated at 64.55 kg of seeds, 92.68 effective units of nitrogen, 24.11 effective units of phosphate, 5.00 effective units of potassium, 26.59 hours for mechanical work, 6.36 man-day for human labor and 2831.81 m^3 of irrigation water.

(iii) For the variable costs items, the average costs of seeds, nitrogen, phosphate, potassium, other fertilizers, pesticides, mechanical work, human labor and transportation are estimated at 592.64

LE/feddan, 840.46 LE/feddan, 382.96 LE/feddan, 137.50 LE/feddan, 264.02 LE/feddan, 293.66 LE/feddan, 2617.63 LE/feddan, 843.84 LE/feddan and 165.00 LE/feddan, respectively. The average total variable costs for wheat at the small-scale farms are estimated at 6137 LE/feddan. As well as the average total fixed costs (land rent) in this farm scale is estimated at 2500.00 LE/feddan/season. Consequently, the average total costs of wheat are estimated at 8636 LE/feddan and 522 LE/Ardab.

(iv) For the economic efficiency indicators: the averages gross margins per feddan, per ardab, and per man-day are estimated at 10224 LE/feddan, 617.8 LE/ardab and 1608 LE/man-day. The averages of net profit per feddan and per ardeb are estimated at 7725 LE/feddan and 467 LE/ ardab. The farmer incentive, the farmer margin, the productivity of irrigation water and the net return to irrigation water are estimated at 62%, 228 LE/ardeb, 5.8 kg/1000 m^3 and 2.7 LE/m^3, respectively.

3.1.2. *The large-scale production farms*

The numbers of the wheat farms are estimated at 87 large-scale farms (i.e., 5 Feddans and more) and the averages cultivated areas of the wheat are almost estimated at 5 feddans. The results in Table 2 indicate that: (i) the average main yields, the farm-gate price, the total return value of the wheat is estimated at 15.67 Ardeb per feddan, 785 LE/Ardab and 12301 LE/feddan, respectively. In addition, the average total return value of the by-product is estimated at 4125 LE/feddan. Consequently, the total return of wheat at the large-scale farms is estimated at 16426 LE/feddan.

(ii) The averages quantities of the main inputs used are estimated at 65.00 kg of seeds, 92.08 effective units of nitrogen, 25.00 effective units of phosphate, 5.00 effective units of potassium, 27.33 hours for mechanical work, 6.83 man-day for human labor and 3037.51 cubic meters of irrigation water.

(iii) For the variable costs items, the average costs of seeds, nitrogen, phosphate, potassium, other

fertilizers, pesticides, mechanical work, human labor and transportation are estimated at 541.67, 893.38, 340.00, 75.00, 328.13, 318.52, 2721.17, 935.65 and 150.00 LE/feddan, respectively. The average total variable costs for wheat at the large-scale farms are estimated at 6038 LE/feddan. As well as the average total fixed costs (i.e., land rent) in this farm scale is estimated at 2500 LE/feddan/season. Consequently, the average total costs of wheat are estimated at 8538 LE/feddan and 545 LE/Ardeb.

(iv) For the economic efficiency indicators: the averages gross margins per feddan, per Ardeb, and per man-day are estimated at 10388 LE/feddan, 663 LE/Ardeb and 1521 LE/man-day. The averages of net profit per feddan and per Ardeb are estimated at 7888 LE/feddan and 503 LE/Ardeb. The farmer incentive, the farmer margin, the productivity of irrigation water and the net return to irrigation water are estimated at 64%, 240 LE/Ardeb, 5.2 kg /1000 m^3 and 2.6 LE/m^3, respectively.

Table 1. Crop Budget, Production and Economic efficiency indicators for Wheat Small-Scale farms under the studied area, 2020.

Item	Unit	Quantity	Price (LE/unit)	Value (LE)	%
I. Output Items					
- Main Product	Ardeb	16.55	750	12412.5	76%
- By-product	Straw load	7.45	530	3948.5	24%
Total Output	LE			16361	
II. Cost Items					
Variable costs:					
1. Seed/Seedlings	kg/no.	64.55	9.18	592.6	6.9%
2. Fertilizers:					
- Nitrogen	Kg	92.68	9.07	840.6	9.7%
- Phosphate	Kg	24.11	15.89	383.1	4.4%
- Potassium	Kg	5	27.5	137.5	1.6%
- Compost	Kg	0	0	0.0	0.0%
- Other	Kg	1.45	181.52	263.2	3.0%
3. Pesticides:	LE	1.18	248.48	293.2	3.4%
4. Machinery	Hour	26.59	98.44	2617.5	30.3%
5. Labor	man/day	6.36	132.6	843.3	9.8%
7. Transport	LE	0.5	330	165.0	1.9%
8. *Water Use	m3	2831.81			0.0%
Sub-total	LE			6136.1	71.1%
Fixed costs:					0.0%
9. Land Rent	LE	1	2500	2500	28.9%
Sub-total	LE			2500	28.9%
Total Cost	LE			8636.1	100.0%
III. Profit Account:					
- Gross Margin/fed.	LE/fed.			10224.9	
- Gross Margin/Ardeb	LE/ardeb			617.8	
-Gross Margin/ man-day	LE/manday			1607.7	
- Net Profit/fed.	LE/fed.			7724.9	
- Net Profit/Ardab	LE/ardeb			466.8	
- Revenue/Ardeb	LE/ardeb			988.6	
- Variable cost/Ardab	LE/ardeb			370.8	
- Total cost/Ardab	LE/ardeb			521.8	
- Farmer incentive	%			62%	
- Farmer margin	LE/ardeb			228.2	
- Productivity to Water	Kg/000m3			5.8	
- Net Return to Water	LE/m3			2.7	

Quantity of Irrigation Water (m^3/Feddan) = Flow rate (m^3/hr) × Total no. irrigation hours.
Source: *Compiled and calculated from the field primary data, 2019/2020.*

Table 2. Crop budget, production and economic efficiency indicators for wheat large- scale farms under the studied area, 2020.

Item	Unit	Quantity	Price (LE/unit)	Value (LE)	%
I. Output Items					
- Main Product	Ardeb	15.67	785	12300.95	75%
- By-product	Straw load	7.5	550	4125	25%
Total Output	LE			16425.95	
II. Cost Items					
Variable costs:					
1. Seed/Seedlings	kg/no.	65	8.33	541.5	6.30%
2. Fertilizers:					
- Nitrogen	Kg	92.08	9.7	893.2	10.50%
- Phosphate	Kg	25	13.6	340	4.00%
- Potassium	Kg	5	15	75	0.90%
- Compost	Kg	0	0	0	0.00%
- Other	Kg	1.35	177	239	2.80%
3. Pesticides:	LE	1.33	238.89	317.7	3.70%
4. Machinery	Hour	26.33	99.56	2621.4	30.70%
5. Labor	man/day	6.83	126	860.6	10.10%
7. Transport	LE	0.5	300	150	1.80%
8. *Water Use	m3	3037.51			0.00%
Sub-total	LE			6038.3	70.70%
Fixed costs:					
9. Land Rent	LE	1	2500	2500	29.30%
Sub-total	LE			2500	29.30%
Total Cost	LE			8538.3	100.00%
III. Profit Account:					
- Gross Margin/fed.	LE/fed.			10387.7	
- Gross Margin/Ardeb				662.9	
- Gross Margin/ man-day				1520.9	
- Net Profit/fed.	LE/fed.			7887.7	
- Net Profit/Ardab	LE/Ardeb			503.4	
- Revenue/Ardab	LE/Ardeb			1048.2	
- Variable cost/Ardab	LE/Ardeb			385.3	
- Total cost/Ardeb	LE/Ardeb			544.9	
- Farmer incentive	%			64%	
- Farmer margin	LE/Ardeb			240.1	
- Productivity to water	Kg/m3			5.2	
- Net Return to Water	LE/m3			2.6	

Quantity of irrigation water (m³/Feddan) = Flow rate (m³/hr) × Total no. irrigation hours.
Source: *compiled and calculated from the field primary data, 2019/2020.*

3.1.3. At the average level

The results in Table 3 indicate that: (i) the averages main yield, the farm-gate price, the total return value of the wheat is estimated at 16.11 Ardab per feddan, 768 LE/Ardab and 12364 LE/feddan, respectively. In addition, the average total return value of the by-product is estimated at 4037 LE/feddan. Consequently, the total returns of wheat farms are estimated at 16401 LE/feddan. (iii) The averages quantities of the main inputs used are estimated at 64.71 kg of

seeds, 92.47 effective units of nitrogen, 24.42 effective units of phosphate, 5.00 effective units of potassium, 26.85 hours for mechanical work, 6.53 man-day for human labor and 2904.41 cubic meters of irrigation water. (v) For the variable costs items, the average costs of seeds, nitrogen, phosphate, potassium, other fertilizers, pesticides, mechanical work, human labor and transportation are estimated at 574.74 LE/feddan, 859.22 LE/feddan, 368.26, 115.44, 286.24, 302.77, 2653.98, 875.78 and 159.71 LE/feddan,

respectively. The average total variable costs for wheat farms are estimated at 6089 LE/feddan. As well as the average total fixed costs (i.e., land rent) in this farm scale is estimated at 2500 LE/feddan/season. Consequently, the average total costs of wheat are estimated at 8589 LE/feddan and 533 LE/Ardab.

Table 3. Crop budget, production and economic efficiency indicators for wheat at average level under the studied area, 2020.

Item	Unit	Quantity	Price (LE/unit)	Value (LE)	%
I. Output Items					
- Main Product	Ardeb	16.11	767.5	12364.4	75%
- By-product	Straw load	7.475	540	4036.5	25%
Total Output	LE			16400.9	
II. Cost Items					
Variable costs:					
1. Seed/Seedlings	kg/no.	64.775	8.755	567.1	6.6%
2. Fertilizers:					
- Nitrogen	Kg	92.38	9.385	867.0	10.1%
- Phosphate	Kg	24.555	14.745	362.1	4.2%
- Potassium	Kg	5	21.25	106.3	1.2%
- Compost	Kg	0	0	0.0	0.0%
- Other	Kg	1.4	179.26	251.0	2.9%
3. Pesticides:	LE	1.255	243.685	305.8	3.6%
4. Machinery	Hour	26.46	99	2619.5	30.5%
5. Labor	man/day	6.595	129.3	852.7	9.9%
7. Transport	LE	0.5	315	157.5	1.8%
8. * Water Use	m3	2934.66			
Sub-total	LE			6089.0	70.9%
Fixed costs:					
9. Land Rent	LE	1	2500	2500	29.1%
Sub-total	LE			2500	29.1%
Total Cost	LE			8589.0	100.0%
III. Profit Account:					
- Gross Margin/fed.	LE/fed.			10312.0	
- Gross Margin/Ardeb				640.1	
- Gross Margin/ man-day				1563.6	
- Net Profit/fed.	LE/fed.			7812.0	
- Net Profit/Ardeb	LE/Ardab			484.9	
- Revenue/Ardeb	LE/Ardab			1018.1	
- Variable cost/Ardeb	LE/Ardab			378.0	
- Total cost/Ardeb	LE/Ardab			533.1	
- Farmer incentive	%			63%	
- Farmer margin	LE/Ardab			234.4	
- Productivity to Water	Kg/m^3			5.5	
- Net Return to Water	LE/m^3			2.7	

* Quantity of irrigation water (m^3/Feddan) = Flow rate (m^3/hr) × Total no. irrigation hours.
***Source:** Compiled and calculated from the field primary data, 2019/2020.*

(iv) For the economic efficiency indicators: the averages gross margins per feddan, per Ardab, and per man-day are estimated at 10312 LE/feddan, 640 LE/Ardeb and 1564 LE/man-day, respectively. The averages of net profit per feddan and per Ardab are estimated at 7812 LE/feddan and 485 LE/Ardab. The farmer incentive, the farmer margin, the productivity of irrigation water and the net return to irrigation water are estimated at 63%, 234 LE/Ardeb, 5.5 kg /1000 m^3 and 2.7 LE/m^3, respectively.

3.2. Comparing the small-scale versus large-scale economic efficiency indicators

The results in Table 4 show that: (1) The indicators of the gross margin, the net profit per ardab, revenue per ardab, farmer incentive, farmer margin in the large farm scales is better than the corresponding indicators for the small farm scales. This is due mainly to that the farm-gate price for the large farm scales is slightly higher than the farm-gate price for wheat in the small farm scales. (2) The indicators of the gross margin per man-day, the productivity to water in the small farm scales are slightly better than the corresponding indicators for the large farm scales. This is due mainly to the yield of wheat and the water quantity used for the small farm scales is slightly better than the corresponding inputs in the large farm scales.

Table 4. Comparing the economic efficiency indicators for wheat according to the farm production scale under the studied area, 2020.

III. Profit Account:	Unite	average	small scale farms		large scale farms	
		values	Values	%	Values	%
- Gross Margin/fed.	LE/fed.	10312	10224.9	-0.8%	10387.7	0.7%
- Gross Margin/Ardeb	LE/ardeb	640.1	617.8	-3.5%	662.9	3.6%
-Gross Margin/ man-day	LE/manday	1563.6	1607.7	2.8%	1520.9	-2.7%
- Net Profit/fed.	LE/fed.	7812	7724.9	-1.1%	7887.7	1.0%
- Net Profit/Ardab	LE/ardeb	484.9	466.8	-3.7%	503.4	3.8%
- Revenue/Ardab	LE/ardeb	1018.1	988.6	-2.9%	1048.2	3.0%
- Variable cost/Ardab	LE/ardeb	378	370.8	-1.9%	385.3	1.9%
- Total cost/Ardab	LE/ardeb	533.1	521.8	-2.1%	544.9	2.2%
- Farmer incentive	%	63%	62%	-1.6%	64%	1.6%
- Farmer margin	LE/ardeb	234.4	228.2	-2.6%	240.1	2.4%
- Productivity to water	Kg/000m3	5.5	5.8	5.5%	5.2	-5.5%
- Net return to water	LE/m3	2.7	2.7	0.0%	2.6	-3.7%

Source: *compiled and calculated from Tables 1-3.*

3.3. Impacts of the climate changes on economic efficiency indicators for wheat crop by farm scale in salt-affected lands

In this part of the study the impacts of the hypothetical climate changes on the economic efficiency indicators for wheat crop by farm production scale will be estimated and measured. An assuming that: (i) the productivity of wheat will decrease by 10%, (ii) The price of wheat seeds will increase by 20% and (iii) some production requirements will increase by 10% when the temperature degrees increase because of the climate changes. So, the impacts of the three previous scenarios have been estimated below.

3.3.1. Impacts of decrease in wheat productivity by 10%

The impacts of the decrease in the wheat productivity by 10% on the economic efficiency indicators in the salt-affected lands by farm scale are presented in Table (4). The main results in the table can be summarized as follows: (1) for small farm scale farms, both total costs and variable costs per Ardab have been increased by 11.1%. the farmer margin, net profit per feddan, net return to water, cross margin per feddan, productivity to water have been decrease by 25.4, 16.1, 16.1, 12.1 and 10.0%, respectively. (2) For large scale farms, the total costs and variable costs per Ardeb have been increased by 11.1%. The farmer margin, net profit per feddan, net

return to water cross, margin per feddan and productivity to water have been decrease by 25.2, 15.6, 15.6, 11.8 and 10.0%, respectively. (3) At the average level, both total costs and variable costs per Ardeb have been increased by 11.1%.

the farmer margin, net profit per feddan, net return to water cross, margin per feddan and productivity to water have been decrease by 25.3, 15.8, 15.8, 12.0 and 10.0%, respectively.

Table 4. Impacts of decrease in wheat productivity by 10% on economic efficiency indicators in salt-affected lands by farm scale, 2020.

Items	Small scale			Large scale			Average		
	current values	base values	change %	current values	base values	change %	current values	base values	change %
III. Profit Account									
- Gross Margin/fed.	8983.7	10224.9	-12.1	9157.6	10387.7	-11.8	9075.5	10312.0	-12.0
- Gross Margin/Ardeb	603.1	617.8	-2.4	649.3	662.9	-2.0	625.9	640.1	-2.2
- Gross Margin/manday	1412.5	1607.7	-12.1	1340.8	1520.9	-11.8	1376.1	1563.6	-12.0
- Net Profit/fed.	6483.7	7724.9	-16.1	6657.6	7887.7	-15.6	6575.5	7812.0	-15.8
- Net Profit/Ardab	435.3	466.8	-6.7	472.1	503.4	-6.2	453.5	484.9	-6.5
-Revenue/Ardab	1015.1	988.6	2.7	1077.5	1048.2	2.8	1045.9	1018.1	2.7
- Variable cost/Ardab	412.0	370.8	11.1	428.2	385.3	11.1	420.0	378.0	11.1
- Total cost/Ardab	579.8	521.8	11.1	605.4	544.9	11.1	592.4	533.1	11.1
- Farmer incentive	58.0%	62.2%	-6.7%	60.1%	64.1%	-6.2%	59.1%	63.2%	-6.5
- Farmer margin	170.2	228.2	-25.4	179.6	240.1	-25.2	175.1	234.4	-25.3
- Productivity to Water	5.3	5.8	-10.0	4.6	5.2	-10.0	4.9	5.5	-10.0
- Net Return to Water	2.3	2.7	-16.1	2.2	2.6	-15.6	2.2	2.7	-15.8

Source: Compiled and calculated from the field primary data, 2020.

3.3.2. Impacts of increase in wheat seeds prices by 20%

The impacts of the increase in the wheat seeds prices by 20% on the economic efficiency indicators in the salt-affected lands by farm scale are presented in Table 5. The main results in the table can be summarized as follows: (1) for small scale farms, the total costs and variable costs per Ardeb have been increased by 1.4 and 1.9%. The farmer margin, net profit per feddan, net return to water, cross margin per feddan and farmer incentive have decreased by 3.1, 1.5, 1.5, 1.2 and 1.5%, respectively. (2) For large scale farms, the

total costs and variable costs per Ardeb have been increased by 1.3% and 1.8%, respectively. The farmer margin, net profit per feddan, net return to water, cross margin per feddan and farmer incentive have been decreased by 2.9, 1.4, 1.4, 1 and 1.4%, respectively. (3) At the average level, the total costs and variable costs per Ardeb have been increased by 1.3 and 1.9%, respectively. the farmer margin, net profit per feddan, net return to water, cross margin per feddan and the farmer incentive have been decreased by 3.0, 1.5, 1.5, 1.1 and 1.5%, respectively.

Table 5. Impacts of increase in wheat seeds by 20% on economic efficiency indicators in salt-affected lands by farm scale, 2020.

Items	Small scale			Large scale			Average		
	current values	base values	change %	current values	base values	change %	current values	base values	change %
III. Profit Account:									
- Gross Margin/fed.	10106.4	10224.9	-1.2	10279.4	10387.7	-1.0	10198.5	10312.0	-1.1
- Gross Margin/Ardab	610.7	617.8	-1.2	656.0	662.9	-1.0	633.1	640.1	-1.1
- Gross Margin/ man-day	1589.1	1607.7	-1.2	1505.0	1520.9	-1.0	1546.4	1563.6	-1.1
- Net Profit/fed.	7606.4	7724.9	-1.5	7779.4	7887.7	-1.4	7698.5	7812.0	-1.5
- Net Profit/Ardab	459.6	466.8	-1.5	496.4	503.4	-1.4	477.9	484.9	-1.5
- Revenue/Ardab	988.6	988.6	0.0	1048.2	1048.2	0.0	1018.1	1018.1	0.0
- Variable cost/Ardab	377.9	370.8	1.9	392.3	385.3	1.8	385.0	378.0	1.9
- Total cost/Ardab	529.0	521.8	1.4	551.8	544.9	1.3	540.2	533.1	1.3
- Farmer incentive	61.3%	62.2%	-1.5%	63.2%	64.1%	-1.4%	62.3%	63.2%	-1.5%
- Farmer margin	221.0	228.2	-3.1	233.2	240.1	-2.9	227.3	234.4	-3.0
- Productivity to Water	5.8	5.8	0.0	5.2	5.2	0.0	5.5	5.5	0.0
- Net Return to Water	2.7	2.7	-1.5	2.6	2.6	-1.4	2.6	2.7	-1.5

Source: *Compiled and calculated from the field primary data, 2020.*

3.3.3. Impacts of increase in the quantities used for the production requirements by 10%

The impacts of the increase in the quantities used from the fertilizers and labor by 10% on the economic efficiency indicators in the salt-affected lands by farm scale are presented in Table 6. The main results in the table can be summarized as follows: (1) for small scale farms, the total costs and variable costs per Ardab have been increased by 3.5 and 5%. The farmer margin, net profit per feddan, net return to water, cross margin per feddan and farmer incentive have decreased by 8.1, 4, 4, 3 and 4%, respectively. (2) For large scale farms, the total costs, and variable costs per Ardab have been increased by 3.5 and 4.9%, respectively. The farmer margin, net profit per feddan, net return to water, cross margin per feddan and farmer incentive have decreased by 7.8, 3.7, 3.7, 2.8 and 3.7%, respectively. (3) At the average level, the total costs and variable costs per Ardab have been increased by 3.5% and 4.9%, respectively. The farmer margin, net profit per feddan, net return to water, cross margin per feddan and the farmer incentive have decreased by 8, 3.8, 3.8, 2.9 and 3.8%, respectively.

Table 6. Impacts of increase in production requirements by 10% on economic efficiency indicators in salt-affected lands by farm scale, 2020.

Items	Small scale			Large scale			Average		
	Current values	Base values	Change %	Current values	Base values	Change %	Current values	Base values	Change %
III. Profit Account:									
- Gross Margin/fed.	9918.9	10224.9	-3.0%	10092.7	10387.7	-2.8%	10011.3	10312.0	-2.9%
- Gross Margin/ArdAb	599.3	617.8	-3.0%	644.1	662.9	-2.8%	621.4	640.1	-2.9%
- Gross Margin/man-day	1417.8	1607.7	-11.8%	1343.4	1520.9	-11.7%	1380.0	1563.6	-11.7%
- Net Profit/fed.	7418.9	7724.9	-4.0%	7592.7	7887.7	-3.7%	7511.3	7812.0	-3.8%
- Net Profit/ArdAb	448.3	466.8	-4.0%	484.5	503.4	-3.7%	466.3	484.9	-3.8%
- Revenue/ArdAb	988.6	988.6	0.0%	1048.2	1048.2	0.0%	1018.1	1018.1	0.0%
- Variable cost/ArdAb	389.2	370.8	5.0%	404.2	385.3	4.9%	396.6	378.0	4.9%
- Total cost/ArdAb	540.3	521.8	3.5%	563.7	544.9	3.5%	551.8	533.1	3.5%
- Farmer incentive	59.8%	62.2%	-4.0%	61.7%	64.1%	-3.7%	60.7%	63.2%	-3.8%
- Farmer margin	209.7	228.2	-8.1%	221.3	240.1	-7.8%	215.7	234.4	-8.0%
- Productivity to Water	5.8	5.8	0.0%	5.2	5.2	0.0%	5.5	5.5	0.0%
- Net Return to Water	2.6	2.7	-4.0%	2.5	2.6	-3.7%	2.6	2.7	-3.8%

Source: Compiled and calculated from the field primary data, 2020.

4. Conclusion and recommendation

In conclusion, the research recommends the need to maintain lands affected by salts due to their impact on the productivity of the wheat crop, as well as so that agriculture can continue.

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