THE IMPACTS OF THE TECHNICAL CHANGES ON THE ECONOMIC SCALES FOR THE EGYPTIAN MAIZE CROP

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ABSTRACT

Maize is the third major field crop grown in the world after rice and wheat. In Egypt, maize, wheat and rice are also the three major grain crops with very similar annual tonnage and similar total values depending upon prices. The main objective of the study is estimating the impacts of technical changes on the optimal and maximum-profit production levels for maize in Sharkia Governorate. Therefore the total costs and average cost curves for the cultivated traditional and modern maize varieties have been estimated and investigated. The relationship between the production costs, the optimal and maximum-profit production levels for traditional and modern maize varieties in Sharkia Governorate have been identified and measured. The secondary and primary field data have been used to accomplish the previous objectives. The primary field data for input and outputs prices and quantities of traditional and modern maize varieties have been obtained from maize farms and analyzed accordingly. The total costs and average cost functions approach have been used to achieve the main objectives of the study. The total costs and average costs functions for the traditional and modern maize varieties have been estimated to measure the impacts of technical changes on the optimal and maximum-profit production levels for maize in Sharkia Governorate. The main results can be summarized as follows: (i) the farmers of the traditional varieties can maximize their profit by producing

28 ardab/feddan where the marginal cost curve intersects the farmgate price (i.e., 300 LE/ardab). The total production cost of traditional maize at the maximum-profit level is estimated at 207.3 LE/ardab. (ii) the farmers of the modern varieties can maximize their profit by producing 30 ardab/feddan where the marginal cost curve intersects the farmgate price (i.e., 300 LE/ardab). The average total production cost of modern maize at the maximum-profit level is estimated at 184.4 LE/ardab.

Key words: Maize, traditional, modern, total costs.

1- INTRODUCTION

Maize is the third major field crop grown in the world after rice and wheat. In Egypt, maize, wheat and rice are also the three major grain crops with very similar annual tonnage and similar total values depending upon prices. The total value of the Egyptian wheat and maize crops are similar most years with the value of the rice crop being more variable. Maize is considered as one of the principal crops in Egypt, maize is planted on approximately 728,000 hectares of land, 75,000 hectares of which is devoted to yellow maize while the remainder is designated to white maize. Each year, 6.1 million tons of maize is produced domestically in Egypt. Moreover, 4.1 million tons of yellow maize is imported annually, valued at 1.3 billion US$. Recently, Egypt became the first country in the Arab world to commercialize biotech maize crops.

2- OBJECTIVES OF THE STUDY

Maize is the one of the main cultivated summer crops in Sharkia Governorate and in Egypt. The main objective of the study is estimating the impacts of technical changes on the optimal and maximum-profit production levels for maize in Sharkia Governorate. Therefore the total cost and average cost curves for the cultivated traditional and modern maize varieties have been estimated and investigated. The relationship between the production costs, the optimal and maximum-profit production levels for

traditional and modern maize varieties in Sharkia Governorate have been identified and measured. In addition the shifts in the averages total costs because of the modern maize varieties have been estimated. The study depends on three hypotheses

FIRST HYPOTHESIS

Farms which are applying the modern verities of maize are producing at optimal level and maximizing the profit thus realizing production level that is higher than those farms which are applying the traditional verities.

SECOND HYPOTHESIS

Average total cost for the profit maximizing level of production of those farms which are applying the modern verities is less than those farms which are applying the traditional verities.

THIRD HYPOTHESIS

The maximum profit at the optimal level of production in the farms which are applying the modern verities is higher than the maximum profit at the optimal level of production at the farms which are applying the traditional verities.

3- DATA BASE

The secondary and primary field data have used to accomplish the previous objectives. The primary field data for inputs and outputs prices and quantities of tradition and modern maize varieties have been conducted from maize farms at four villages in Sharkia Governorate; Sanhout, Shalshalamoun, El Azaziah and Bani Helal.

The previous primary field data have been collected from 80 maize farms cultivating traditional varieties and 80 maize farms cultivating modern varieties; 20 maize farms per each village. Questionnaire sheets have been designed to collect the field data from the maize farmers by using the personal meetings.

4- METHODOLOGY

The total cost and average cost functions approach have been used to achieve the main objectives of the study. The total costs and averages cost functions for the traditional and modern maize varieties have been estimated to measure the impacts of technical changes on the optimal and maximum-profit production levels for maize in Sharkia Governorate. The relationship among the different costs curves can be summarized as follows:

- Total Cost (TC) = Fixed Costs (FC) + Variable Costs (VC)
- Marginal Cost (MC) = dTC/dQ; MC equals the slope of the total cost function and of the variable cost function. Q is the level of the quantity produced.
- Average Total Cost (ATC) = Total Cost/Q
- Average Fixed Cost (AFC) = FC/Q
- Average Variable Cost = VC/Q.
- ATC = AFC + AVC
- The MC curve is related to the shape of the ATC and AVC curves:
  - At a level of Q at which the MC curve is above the average total cost or average variable cost curve, the latter curve is rising.
  - If MC is below average total cost or average variable cost, then the latter curve is falling.
  - If MC equals average total cost, then average total cost is at its minimum value.
  - If MC equals average variable cost, then average variable cost is at its minimum value.

In economics, average cost or unit cost is equal to total cost divided by the number of goods produced (the output quantity, Q). It is also equal to the sum of average variable costs (total variable costs divided by Q) plus average fixed costs (total fixed costs divided by Q). Average costs may be dependent on the time period considered (increasing production may be

expensive or impossible in the short term, for example). Average costs affect the supply curve and are a fundamental component of supply and demand.

5- RESULTS AND DISCUSSION

5.1 TREND OF MAIZE PRODUCTION

At the national level the data shown in table (1) indicate that the averages of cultivated area, yield, the total production, the total production value and the profit are estimated at 1769 thousand feddan, 24.2 Ardab/feddan, 42827 thousand ardab, 4634.9 LE/feddan and 1711 LE/feddan, respectively. (ii) the annual growth rate of cultivated area, yield, the total production, the total production value and the profit are estimated at 0.2%, -0.01%, 0.2%, 9.5% and 10.4%, respectively.

Table (1) The averages and annual growth rates of the total cultivated area, yield total production and profit for the maize crop at national level, 2000 - 2013

Year	Cultivated area	Yield	Total Production	Total production Value	Profit
	(000 feddans[1])	Ardab[2] / feddan	(000 Ardab)	LE[3]/feddan	LE/ feddan
2000	1679.5	24.03	40355.98	2193	762.9
2001	1773.5	24.54	43519.24	2224.1	752.2
2002	1668.5	24.3	40544.55	2304	824
2003	1657.8	24.48	40582.94	2565	855
2004	1684.9	24.76	41718.12	3781	855
2005	1940.3	25.28	49043.2	3876	1821
2006	1708	25.72	43929.76	4087	1327
2007	1781.8	24.62	43867.92	5675	2051
2008	1860.4	24.21	45040.28	5050	1753
2009	1977.6	24	47462.4	4914	1615
2010	1998.2	22.43	44819.63	6140	2430
2011	1482.2	24.23	35913.71	6740	2658
2012	1839	22.54	41446.67	7566	3220
2013	1724	23.98	41338	7773	3038
Average	1769.69	24.22	42827.31	4634.86	1711.58
Annual Growth Rate	0.2%	-0.01%	0.2%	9.5%	10.4%

1 one feddan=4200 square meter. 2 one ardab=150 kilogram 3 LE equal almost 0.125 US$.

Source: Ministry of Agriculture, Central Administration of Agricultural Economics.

For Sharkia Governorate the data shown in table (2) indicate that the averages of cultivated area, yield, the total production, the total production value and the profit are estimated at 213 thousand feddan, 24.12 Ardab/feddan, 5285 ardab, 4613.7 LE/feddan and 1377 LE/feddan, respectively.. (ii) the annual growth rate of of cultivated area, yield, the total production, the total production value and the profit are estimated at 0.7%, -0.39%, 2.7%, 12.5% and 26.1%, respectively.

Table (2) The averages and annual growth rates of the total cultivated area, yield total production and profit for the maize crop at Sharkia Governorate, 2000 - 2013

Year	Cultivated area	Yield	Total Production	Total production Value	Profit
	(000 feddan)	Ardab/feddan	(Ardab)	LE/feddan	LE/feddan
2000	202.1	25	5052.5	1642.5	116.5
2001	199.8	24.7	4935.06	1786.4	138.9
2002	161.9	23.9	3869.41	2868	1197.5
2003	205.8	24.1	4959.78	2651	524
2004	213.1	25.6	5455.36	3060	877
2005	247.2	26.3	6501.36	3592	1098
2006	172.96	22.8	3943.49	3932	1557
2007	217.2	26.6	5777.52	5328	1639
2008	193.39	25.9	5008.8	4533	3279
2009	220.94	21.6	4772.3	4180	648
2010	280.33	21.28	5965.42	5407	1018
2011	240.9	20.77	5003.54	6804	1284
2012	211.4	25.4	5369.56	7688	2890
2013	221.34	23.67	7381.62	8572	3011
Average	213.45	24.12	5285.41	4431.71	1376.99
Annual Growth Rate	0.7%	-0.39%	2.7%	12.5%	26.1%

Source: Ministry of Agriculture, Central Administration of Agricultural Economics.

5-2 MAXIMIZATION OF TOTAL RETURNS OF THE MAIZE FARMERS USING THE AVERAGE COST CURVES

Using the field primary data for the quantities and prices of maize inputs and outputs, the averages costs function and curves have been estimated and figured.

5-2-1 TRADITIONAL MAIZE VARIETIES

The field primary data for the quantities and prices of the inputs and outputs of the traditional maize varieties have been used to estimate the averages total costs function (equation 1) as follows:

$$\mathbf{ATC_{tr} = 494.88 - 23.91\ X_{tr} + 0.487\ X_{tr}^2 \ldots\ldots\ldots\ldots\ldots\ldots\ (1)}$$

$$\mathbf{(5.37)^{**}\quad (-2.66)^{**}\quad (2.25)^{*}}$$

$$\mathbf{R\backslash^2 = 0.31 \qquad F - ratio = 18.52^{**}}$$

Where:

ATC_{tr} = the average total costs of traditional maize varieties (LE/feddan).

X_{tr} = the quantity produced of traditional maize varieties (Ardab/feddan).

* is significant at $\alpha \leq 0.05$ and ** is significant at $\alpha \leq 0.01$

The marginal costs function of the traditional maize varieties has been derived from the previous function (equation 1) as follows:

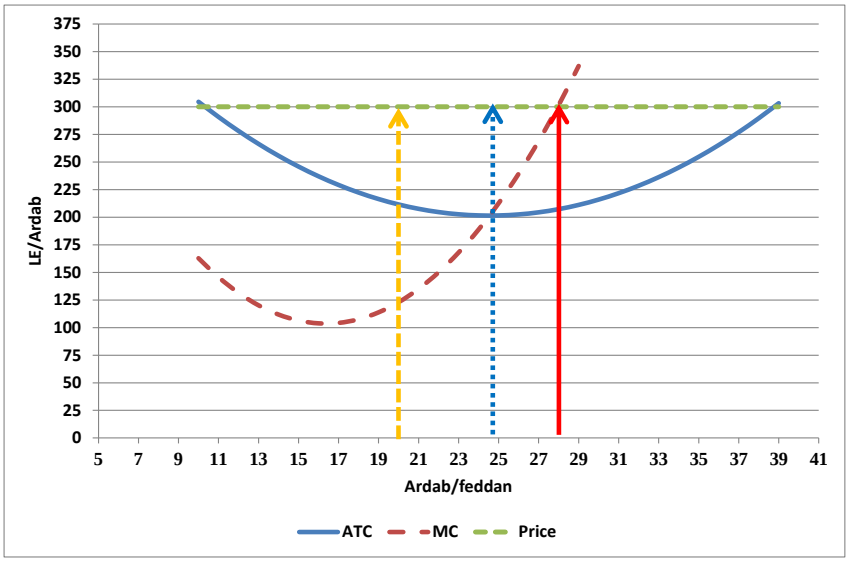
$$\mathbf{MC_{tr} = 494.88 - 47.82\ X_{tr} + 1.46\ X_{tr}^2 \ldots\ldots\ldots\ldots\ldots\ (2)}$$

Where: $\mathbf{MC_{tr}}$ = the marginal cost of traditional maize varieties (LE/feddan).

The statistical measures indicate that the previous models and their parameters are statistically significant. The determination coefficient indicates that the variations in maize yield explain 31% of the variations in the average total costs per ardab of traditional maize varieties. The previous average total costs and marginal cost of traditional maize varieties are shaped in figure (1). The following results can be summarized from figure (1): (i) both the average total costs and marginal cost curves take the U

shape (logically agree with the economic theory). Consequently the U shape of the average total costs curve reveals that the average total costs per ardab of traditional maize varieties decreases as the quantity produced of the traditional maize increases until the minimum point (i.e., 24.5 ardab) because the inputs used in the production process are efficient. After the previous minimum point the average total costs per ardab of traditional maize varieties increases as the quantity produced of the traditional maize increases because the inputs used in the production process are inefficient. (ii) the marginal cost curve intersects the average total cost curve at the minimum point (i.e., 24.5 ardab). Therefore the farmers of the traditional maize varieties can be minimized the average total cost per ardab by producing 24.5 ardab per feddan where the slopes of average total cost curve and marginal cost curve are equal. The average total production cost of traditional varieties at the minimum level is estimated at 201 LE/ardab. (iii) the farmers of the traditional varieties can be maximized their profit by producing 28 ardab/feddan where the marginal cost curve intersects the farmgate price (i.e., 300 LE/ardab). The total production cost of traditional maize at the maximum-profit level is estimated at 207.3 LE/ardab. (iv) the actual level of the traditional maize yield is estimated at 20 ardab/feddan and the average total costs are 211.5 LE/ardab.

Figure (1): The average total cost and marginal cost functions for the traditional maize varieties



Source: compiled and computed from the Maize field primary data, 2013.

5-2-2 MODERN MAIZE VARIETIES

The field primary data for the quantities and prices of the inputs and outputs of the modern maize varieties have been used to estimate the averages total costs function (equation 3) as follows:

$$\mathbf{ATC_{te} = 510.12 - 25.25\ X_{te} + 0.478\ X_{te}^{2} \ldots\ldots\ldots\ldots\ldots\ldots\ (3)}$$

$$\mathbf{(4.8)^{**} \quad (-2.7)^{**} \quad (2.29)^{*}}$$

$$\mathbf{R\backslash^{2} = 0.31 \qquad F - ratio = 18.51^{**}}$$

Where:

ATC_{te} = the average total costs of modern maize varieties (LE/feddan).

X_{te} = the quantity produced of modern maize varieties (Ardab/feddan).

* is significant at $\alpha \leq 0.05$ and ** is significant at $\alpha \leq 0.01$

The marginal costs function of the modern maize varieties has been derived from the previous function (equation 1) as follows:

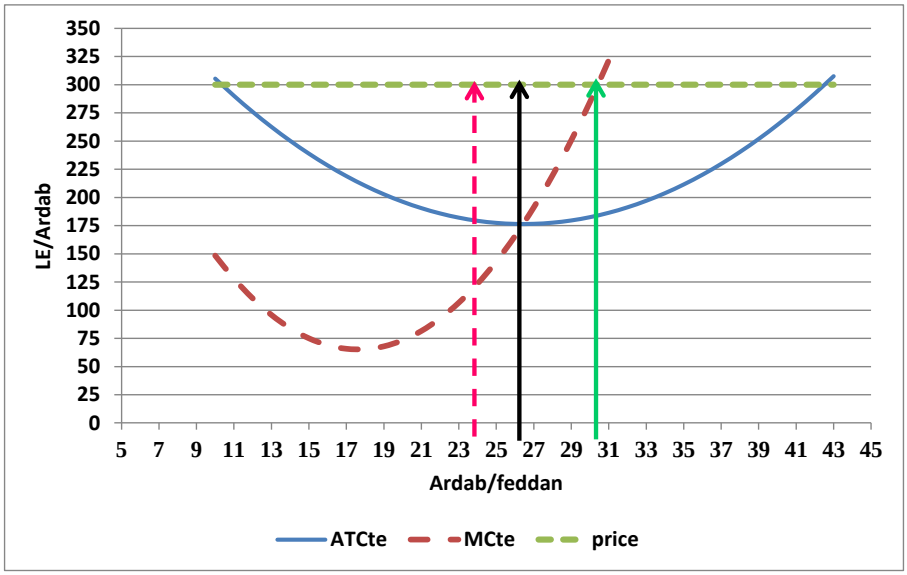
$$MC_{te} = 510.12 - 50.5\ X_{te} + 1.433\ X_{te}^{2} \ldots\ldots\ldots\ldots\ldots\ldots (4)$$

Where: MC_{te} = the marginal cost of modern maize varieties (LE/feddan).

The statistical measures indicate that the previous models and their parameters are statistically significant. The determination coefficient indicates that the variations in maize yield explain 31% of the variations in the average total costs per ardab of modern maize varieties. The previous average total costs and marginal cost of modern maize varieties are shaped in figure (2).

The following results can be summarized from figure (2): (i) both the average total costs and marginal cost curves take the U shape. Consequently the U shape of the average total costs curve reveals that the average total costs per ardab of modern maize varieties decreases as the quantity produced of the modern maize increases until the minimum point (i.e., 26.5 ardab) because the inputs used in the production process are efficient. After the previous minimum point the average total costs per ardab of modern maize varieties increases as the quantity produced of the modern maize increases because the inputs used in the production process are inefficient. (ii) the marginal cost curve intersects the average total cost curve at the minimum point (i.e., 26.5 ardab). Therefore the farmers of the modern maize varieties can be minimized the average total cost per ardab by producing 26.5 ardab per feddan where the slopes of average total cost curve and marginal cost curve are equal. The average total production cost of modern varieties at the minimum level is estimated at 176.5 LE/ardab. (iii) the farmers of the modern varieties can be maximized their profit by producing 30 ardab/feddan where the marginal cost curve intersects the farmgate price (i.e., 300 LE/ardab). The average total production cost of modern maize at the maximum-profit level is estimated at 184.4 LE/ardab. (iv) the actual level of the modern maize yield is estimated at 24.5 ardab/feddan and the average total costs are 178.2 LE/ardab.

Figure (2): The average total cost and marginal cost functions for the modern maize varieties



Source: compiled and computed from the Maize field primary data, 2013.

5-2-3 AT THE SAMPLE LEVEL

The field primary data for the quantities and prices of the inputs and outputs for both traditional and modern maize varieties have been used to estimate the averages total costs function (equation 5) as follows:

$$ATC_t = 526.98 - 25.66\ X_t + 0.487\ X_t^2 \quad \text{..... (5)}$$

$$(4.8)^{**} \qquad (-2.6)^{**} \qquad (2.25)^{*}$$

$$R\backslash^2 = 0.31 \qquad F - ratio = 18.52^{**}$$

Where:

ATC_t = the average total costs of traditional and modern maize varieties (LE/ feddan).

X_t=the quantity produced of traditional and modern maize varieties (Ardab/ feddan).

* is significant at $\alpha \leq 0.05$ and ** is significant at $\alpha \leq 0.01$

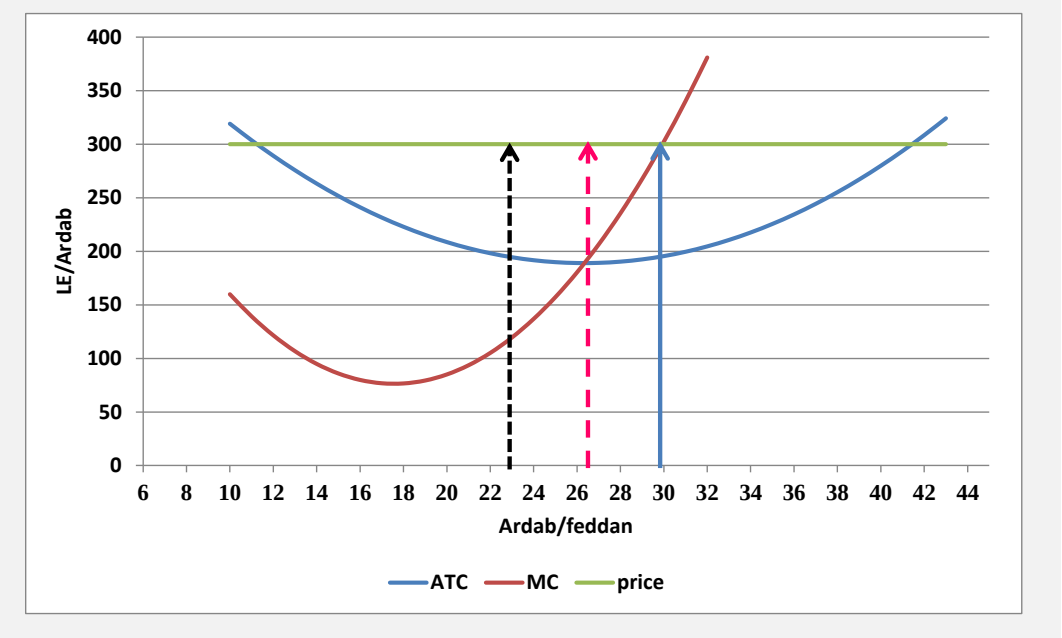
The marginal costs function of both maize varieties has been derived from the previous function (equation 5) as follows:

$$\mathbf{MC_t = 510.12 - 50.5\ X_t + 1.433\ X_t^2 \ldots\ldots\ldots\ldots\ldots\ (6)}$$

Where: $\mathbf{MC_t}$ = the marginal cost of both maize varieties (LE/feddan).

The statistical measures indicate that the previous models and their parameters are statistically significant. The determination coefficient indicates that the variations in maize yield explain 31% of the variations in the average total costs per ardab of modern maize varieties. The previous average total costs and marginal cost of traditional and modern maize varieties are shaped in figure (3). The following results can be summarized from figure (3): (i) both the average total costs and marginal cost curves take the U shape. Consequently the U shape of the average total costs curve reveals that the average total costs per ardab of both maize varieties decreases as the quantity produced of the modern maize increases until the minimum point (i.e., 26.4 ardab) because the inputs used in the production process are efficient. After the previous minimum point the average total costs per ardab of both maize varieties increases as the quantity produced of the maize increases because the inputs used in the production process are inefficient. (ii) the marginal cost curve intersects the average total cost curve at the minimum point (i.e., 26.4 ardab). Therefore the farmers of the maize varieties can be minimized the average total cost per ardab by producing 26.4 ardab per feddan where the slopes of average total cost curve and marginal cost curve are equal. The average total production cost of maize varieties at the minimum level is estimated at 189.2 LE/ardab. (iii) the farmers of the maize varieties can be maximized their profit by producing 29.9 ardab/feddan where the marginal cost curve intersects the farmgate price (i.e., 300 LE/ardab). The total production cost of maize at the maximum-profit level is estimated at 195.2 LE/ardab. (iv) the actual level of the modern maize yield is estimated at 22.7 ardab/feddan and the average total costs are 195.5 LE/ardab

Figure (3): The average total cost and marginal cost functions for the maize varieties



Source: compiled and computed from the Maize field primary data, 2013.

5-3 MAXIMIZATION OF TOTAL RETURNS OF THE MAIZE FARMERS USING THE TOTAL COST CURVES

The total costs functions of maize varieties are derived from the previous corresponding average total costs of maize varieties. The total return functions of maize are derived from the average farmgate price (i.e., 300 LE/ardab) and the quantity produced from maize varieties.

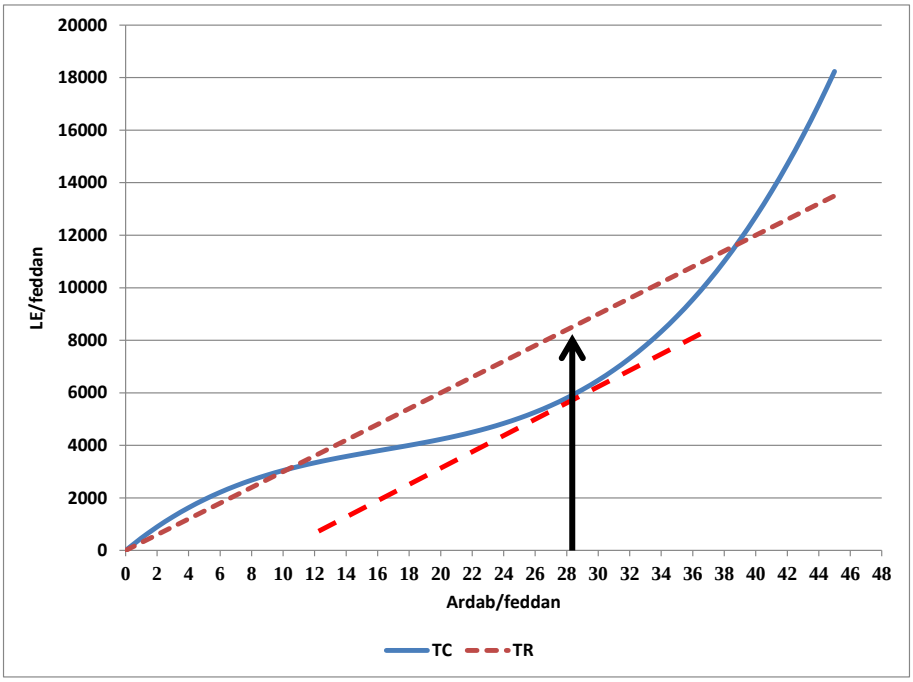
5-3-1 TRADITIONAL MAIZE VARIETIES

The total costs functions of traditional maize varieties are derived from the average total costs of traditional maize varieties (equation 1) as follows:

$$TC_{tr} = 494.88\ X_{tr} - 23.91\ X^2_{tr} + 0.487\ X^3_{tr} \quad \text{..... (7)}$$

The previous total costs and total revenue of traditional maize varieties are shaped in figure (4). The following results can be summarized from figure (4): (i) both the total costs and total revenue curves take the common shapes. (ii) the farmers of the traditional maize varieties can be maximized their profit by producing 28 ardab/feddan where the slope of the total cost curve (i.e., marginal cost curve) equal the slope of total revenue (i.e., marginal revenue or the farmgate price = 300 LE/ardab). The total production cost of traditional maize at the maximum-profit level is estimated at 5804 LE/ardab.

Figure (4): The total cost and total revenue functions for the traditional maize varieties



Source: compiled and computed from the Maize field primary data, 2013.

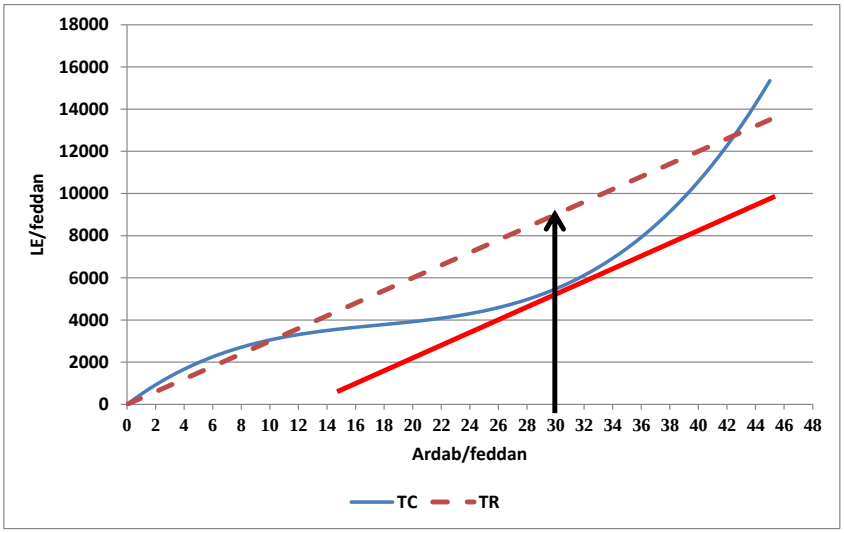
5-3-2 MODERN MAIZE VARIETIES

The total costs functions of modern maize varieties are derived from the average total costs of modern maize varieties (equation 3) as follows:

$$TC_{te} = 510.12\ X_{te} - 25.25\ X^2_{te} + 0.478\ X^3_{te} \quad \text{..... (8)}$$

The previous total cost and total revenue of modern maize varieties are shaped in figure (5). The following results can be summarized from figure (5): (i) both the total costs and total revenue curves take the common shapes. (ii) the farmers of the modern maize varieties can be maximized their profit by producing 30 ardab/feddan where the slope of the total cost curve (i.e., marginal cost curve) equal the slope of total revenue (i.e., marginal revenue or the farmgate price = 300 LE/ardab). The total production cost of modern maize at the maximum-profit level is estimated at 5532 LE/ardab.

Figure (5): The total cost and total revenue functions for the modern maize varieties



Source: compiled and computed from the Maize field primary data, 2013.

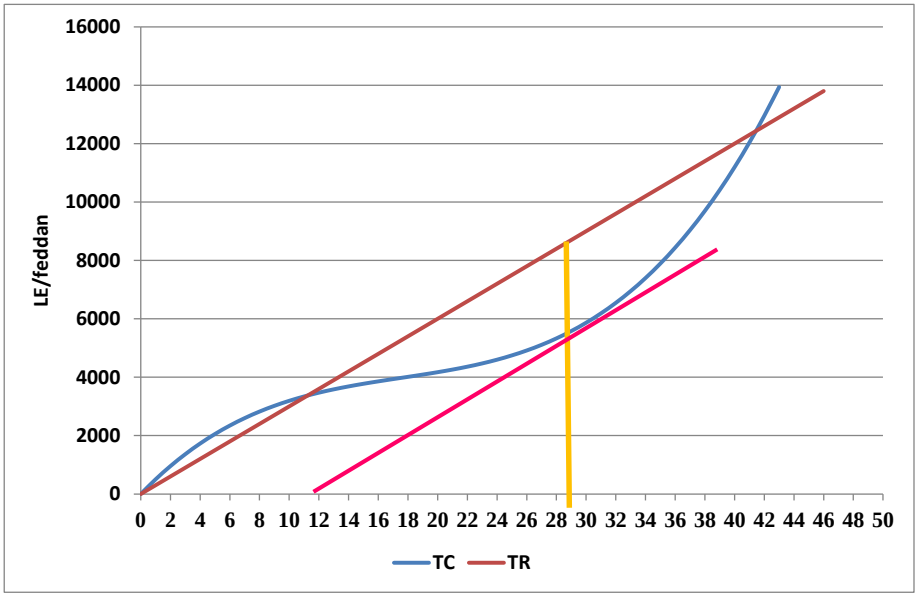
5-3-3 AT THE SAMPLE LEVEL

The total costs functions of modern maize varieties are derived from the average total costs of modern maize varieties (equation 5) as follows:

TC_t =526.98 X_t – 25.66 X^2_t + 0.487 X^3_t …….…….. (9)

The previous total costs and total revenue of maize varieties are shaped in figure (6). The following results can be summarized from figure (6): (i) both the total costs and total revenue curves take the common shapes. (ii) the farmers of the maize varieties can be maximized their profit by producing 29.9 ardab/feddan where the slope of the total cost curve (i.e., marginal cost curve) equal the slope of total revenue (i.e., marginal revenue or the farmgate price = 300 LE/ardab). The total production cost of modern maize at the maximum-profit level is estimated at 5837 LE/ardab.

Figure (6): The total cost and total revenue functions for the maize varieties



Source: compiled and computed from the Maize field primary data, 2013.

5-4 FORGONE INCOME

The revenues and profits for maize farmers are compared at three production levels; (i) actual production levels, (ii) optimal production levels (i.e., minimization – costs production levels) and (iii) profit- maximization production levels. The foregone revenue is the deviation among the actual revenue, revenue at the minimum-costs production level and the revenue at the maximum-profit production level.

5-4-1 TRADITIONAL MAIZE VARIETIES

The structure of the maize yield, total revenue, total costs and profits of traditional varieties according to the previous three production levels are presented in table (1). The results shown in the table can be summarized as follows: (i) the actual production, the minimum-costs production and maximum-production levels are estimated at 20 ardab/feddan, 24.5 ardab/feddan and 28 ardab/feddan, respectively. (ii) the total revenues of maize farmers at the actual, minimum-costs and maximization-profit production levels are estimated at 6000 LE/feddan, 7350 LE/feddan and 8400 LE/feddan, respectively. (iii) the total costs of maize farmers at the actual, minimum-costs and maximization-profit production levels are estimated at 4230 LE/feddan, 4924.5 LE/feddan and 5804 LE/feddan, respectively. (iv) the profits of maize farmers at the actual, minimum-costs and maximization-profit production levels are estimated at 1770 LE/feddan, 2425.5 LE/feddan and 2595.6 LE/feddan, respectively. (v) the foregone revenues of the maize farmers at the minimum-costs and maximization-profit production levels are estimated at 1350 LE/feddan and 2400 LE/feddan, respectively. (vi) the foregone profits of the maize farmers at the minimum-costs and maximization-profit production levels are estimated at 655.5 LE/feddan and 825.6 LE/feddan, respectively. The inefficient utilizations of the farming inputs are the main reason beyond these foregone revenues and profits of the maize farmers.

Table (1): The foregone revenues and profits for the traditional maize varieties

Items	Unit	actual production	minimum costs level	maximum profit level
Yield	Ardab	20	24.5	28
farmgate price	LE/ardab	300	300	300
total revenue	LE/feddan	6000	7350	8400
average total costs	LE/ardab	211.5	201	207.3
total costs	LE/feddan	4230	4924.5	5804.4
profit /feddan	LE/feddan	1770	2425.5	2595.6
foregone revenue	LE/feddan		1350	2400
foregone profit	LE/feddan		655.5	825.6

Source: compiled and computed from the Maize field primary data, 2013.

5-4-2 MODERN MAIZE VARIETIES

The structure of the maize yield, total revenue, total costs and profits of modern varieties according to the previous three production levels are presented in table (2). The results shown in the table can be summarized as follows: (i) the actual production, the minimum-costs production and maximum-production levels are estimated at 24.5 ardab/feddan, 26.5 ardab/feddan and 30 ardab/feddan, respectively. (ii) the total revenues of maize farmers at the actual, minimum-costs and maximization-profit production levels are estimated at 7350 LE/feddan, 7950 LE/feddan and 9000 LE/feddan, respectively. (iii) the total costs of maize farmers at the actual, minimum-costs and maximization-profit production levels are estimated at 4365.9 LE/feddan, 4677.3 LE/feddan and 5532 LE/feddan, respectively. (iv) the profits of maize farmers at the actual, minimum-costs

and maximization-profit production levels are estimated at 2984 LE/feddan, 3273 LE/feddan and 3468 LE/feddan, respectively. (v) the foregone revenues of the maize farmers at the minimum-costs and maximization-profit production levels are estimated at 600 LE/feddan and 1650 LE/feddan, respectively. (vi) the foregone profits of the maize farmers at the minimum-costs and maximization-profit production levels are estimated at 288.7 LE/feddan and 483.9 LE/feddan, respectively. The inefficient utilizations of the farming inputs are the main reason beyond these foregone revenues and profits of the maize farmers.

Table (2): The foregone revenues and profits for the modern maize varieties

Items	Unit	Actual production	Minimum costs level	Maximum profit level
Yield	Ardab	24.5	26.5	30
farmgate price	LE/ardab	300	300	300
total revenue	LE/feddan	7350	7950	9000
average total costs	LE/ardab	178.2	176.5	184.4
total costs	LE/feddan	4365.9	4677.25	5532
profit /feddan	LE/feddan	2984.1	3272.75	3468
foregone revenue	LE/feddan		600	1650
foregone profit	LE/feddan		288.65	483.9

Source: compiled and computed from the Maize field primary data, 2013.

5-4-3 MAIZE VARIETIES AT SAMPLE LEVEL

The structure of the maize yield, total revenue, total costs and profits of maize varieties at the sample level according to the previous three production levels are presented in table (3). The results shown in the table can be summarized as follows: (i) the actual production, the minimum-costs

production and maximum-production levels are estimated at 22.7 ardab/feddan, 26.4 ardab/feddan and 29.9 ardab/feddan, respectively. (ii) the total revenues of maize farmers at the actual, minimum-costs and maximization-profit production levels are estimated at 6810 LE/feddan, 7920 LE/feddan and 8970 LE/feddan, respectively. (iii) the total costs of maize farmers at the actual, minimum-costs and maximization-profit production levels are estimated at 4438 LE/feddan, 4995 LE/feddan and 5836 LE/feddan, respectively. (iv) the profits of maize farmers at the actual, minimum-costs and maximization-profit production levels are estimated at 2372 LE/feddan, 2925 LE/feddan and 3134 LE/feddan, respectively. (v) the foregone revenues of the maize farmers at the minimum-costs and maximization-profit production levels are estimated at 1110 LE/feddan and 2160 LE/feddan, respectively. (vi) the foregone profits of the maize farmers at the minimum-costs and maximization-profit production levels are estimated at 553 LE/feddan and 761 LE/feddan, respectively. The inefficient utilizations of the farming inputs are the main reason beyond these foregone revenues and profits of the maize farmers.

Table (3): The foregone revenues and profits for the maize varieties at the sample level

Items	Unit	Actual production	Minimum costs level	Maximum profit level
Yield	Ardab	22.7	26.4	29.9
farmgate price	LE/ardab	300	300	300
total revenue	LE/feddan	6810	7920	8970
average total costs	LE/ardab	195.5	189.2	195.2
total costs	LE/feddan	4437.85	4994.88	5836.48
profit /feddan	LE/feddan	2372.15	2925.12	3133.52
foregone revenue	LE/feddan		1110	2160
foregone profit	LE/feddan		552.97	761.37

Source: compiled and computed from the Maize field primary data, 2013.

5-5 THE IMPACTS OF TECHNICAL CHANGES

The production levels, total revenue, total cost and profit per feddan at the actual levels, minimum- costs production and maximum- profit production levels for the traditional and modern maize varieties have been compared to measure the impacts of technical changes. The results shown in Table (4) and figure (7) can be summarized as follows: (i) at the actual production level, the production level increases from 20 ardab/feddan for the traditional varieties to 24.5 ardab/feddan for the modern varieties. In addition the average total costs decreases from 211.5 LE/ardab for the traditional varieties to 178.2 LE/ardab for the modern varieties. Consequently the average total costs curve has been shifted to *the down and the right* because of the modern varieties (figure 4). (ii) at the minimum-costs production level, the production level increases from 24.5 ardab/feddan for the traditional varieties to 26.5 ardab/feddan for the modern varieties. In addition the average total costs decreases from 201 LE/ardab for the traditional varieties to 176.5 LE/ardab for the modern varieties. Therefore the average total costs curve has been shifted to *the down and the right* because of the modern varieties (figure 4). (iii) at the maximum-profit production level, the production level increases from 28 ardab/feddan for the traditional varieties to 30 ardab/feddan for the modern varieties. In addition the average total costs decreases from 207.3 LE/ardab for the traditional varieties to 184.4 LE/ardab for the modern varieties.

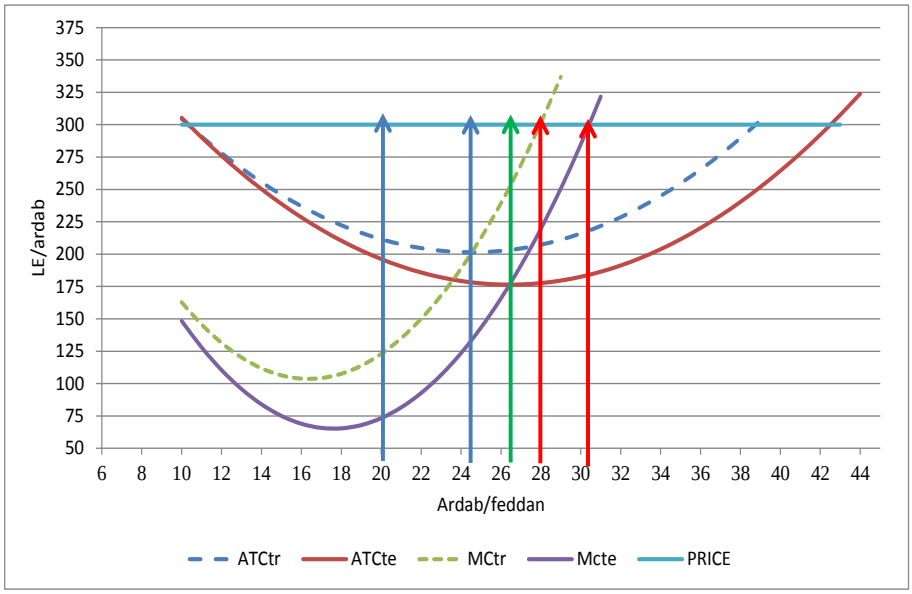
Therefore the average total costs curve has been shifted to *the down and the right* because of the modern varieties (figure 4). Finally, at the previous three production levels the profits per feddan have been increased for the modern varieties.

Table (4): The production levels, total revenues, total costs and profit per feddan at the actual levels, minimum- costs production and maximum- profit production levels

Items	actual production level		minimum-costs production level		maximum-profit production level	
	traditional	modern	traditional	Modern	traditional	modern
Yield	20	24.5	24.5	26.5	28	30
farmgate price	300	300	300	300	300	300
total revenue	6000	7350	7350	7950	8400	9000
average total costs	211.5	178.2	201	176.5	207.3	184.4
total costs	4230	4365.9	4924.5	4677.25	5804.4	5532
profit /feddan	1770	2984.1	2425.5	3272.75	2595.6	3468

Source: compiled and computed from the Maize field primary data, 2013.

Figure (7): The shift in average total costs curves for traditional and modern maize varieties



Source: compiled and computed from the Maize field primary data, 2013.

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الأثار المترتبة على التغيرات التكنولوجية على الاحجام الاقتصادية لمحصول الذرة المصري

ملخص البحث

محصول الذرة هو المحصول الثالث من المحاصيل الحقلية المزروعة على مستوى العالم بعد محصولي الارز والقمح ،ويمثل احد محاصيل الحبوب الرئيسية الثلاث في مصر والتي تحقق اهمية سنوية متشابهة جدا من حيث كمية الانتاج وقيمته بالاعتماد على مستوى الاسعار.

ويتمثل الهدف الرئيسي للدراسة في تقدير اثار التغيرات التكنولوجية على مستويات الانتاج المثلى والمعظمة للأرباح لمحصول الذرة في محافظة الشرقية. ولذلك فقد تم تقدير وفحص منحنيات التكاليف الكلية ومتوسط التكاليف الكلية لأصناف الذرة التقليدية والحديثة التي يتم زراعتها.

وتم تحديد وقياس العلاقة بين تكاليف الانتاج ومستويات الانتاج المثلى والمعظمة للأرباح لأصناف محصول الذرة التقليدية والحديثة في محافظة الشرقية. وتم استخدام البيانات الميدانية الاولية والثانوية لتحقيق الاهداف السابقة، وفيما يتعلق بالبيانات الاولية لأسعار وكميات المدخلات والمخرجات من الاصناف التقليدية والحديثة فقد تم الحصول عليها من مزارع الذرة وتحليلها.

وقد تم استخدام منهج دوال التكاليف الكلية ودوال متوسط التكاليف لتحقيق الاهداف الرئيسية للدراسة، وتم تقديرها لأصناف الذرة التقليدية والحديثة لقياس اثار التغيرات التكنولوجية على مستويات الانتاج المثلى والمعظمة للأرباح لمحصول الذرة في محافظة الشرقية. والنتائج الرئيسية للدراسة يمكن تلخيصها كما يلي:-

أ- يمكن لمزارعي الذرة من الاصناف التقليدية تعظيم ارباحهم عند انتاج ٢٨ اردب للفدان ،نظرا لأن منحنى التكلفة الحدية يتقاطع مع سعر التسليم في المزرعة وذلك عند مستوى ٣٠٠ جنيه للأردب، وتقدر التكلفة الكلية من اصناف الذرة التقليدية عند الحد الاقصى للأرباح بمقدار ٢٠٧,٣ جنيه للأردب.

ب- يمكن لمزارعي الذرة من الاصناف الحديثة تعظيم ارباحهم عند انتاج ٣٠ اردب للفدان ،نظرا لأن منحنى التكلفة الحدية يتقاطع مع سعر التسليم في المزرعة وذلك عند مستوى ٣٠٠ جنيه للأردب، وتقدر التكلفة الكلية من اصناف الذرة الحديثة عند الحد الاقصى للأرباح بمقدار ١٨٤,٤ جنيه للأردب.

الكلمات المفتاحية: الذرة، التقليدية ، الحديثة ،التكلفة الكلية.