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PRODUCTION ECONOMICS OF EGYPTIAN COTTON IN THE SALT-AFFECTED LAND

Abstract

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. The water management problem is currently increasing in the context of the on-going national transition from a government-controlled market with government intervention in the management of all activities to a free-market economy. Furthermore, due to the ambitious programs of desert agricultural development, the shortage of water supplies is becoming more serious after El Nahdda dam. Issues of equitable distribution of dwindling water supplies are becoming more serious and more is needed to assure fair access to water and more efficient use and allocation of it. On the other hand, accumulation of excessive salt in irrigated soils of Egypt negatively affects crop yields, reduce the effectiveness of irrigation, ruin soil structure, and affect other soil properties. High level of water table and shortage in irrigation 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 the half of corresponding averages at the national level. Cotton is the one of the main cultivated summer crops in the salt-affected land in Egypt. The main objective of the study is studying the production economics of cotton in the salt-affected land. The impacts of production factors used to produce cotton crop in salt-affected land will identify and measure. The various combinations of manure and irrigation water inputs which produce or yield equal production to cotton producers will derive and identify. The impacts of technical changes on the quantities produced of cotton and on the optimal and maximum-profit production levels will measure. The relationship between the quantity produced and the production costs of cotton crop will estimate and investigate. The levels of optimal and maximizing profits for the studied crop in the salt-affected land will identify and determine.

Keywords

cotton, production, salt-affected land

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. The water management problem is currently increasing in the context of the on-going national transition from a government-controlled market with government intervention in the management of all activities to a free-market economy. Furthermore, due to the ambitious programs of desert agricultural development, the shortage of water supplies is becoming more serious after El Nahdda dam.

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Issues of equitable distribution of dwindling water supplies are becoming more serious and more is needed to assure fair access to water and more efficient use and allocation of it. On the other hand, accumulation of excessive salt in irrigated soils of Egypt negatively affects crop yields, reduce the effectiveness of irrigation, ruin soil structure, and affect other soil properties. High level of water table and shortage in irrigation 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 the half of corresponding averages at the national level.

2. Methdological background

In economics, a production function relates physical output of a production process to physical inputs or factors of production. The production function is one of the key concepts of mainstream neoclassical theories, used to define marginal product and to distinguish allocative efficiency, the defining focus of economics. The primary purpose of the production function is to address allocative efficiency in the use of factor inputs in production and the resulting distribution of income to those factors, while abstracting away from the technological problems of achieving technical efficiency, as an engineer or professional manager might understand it. In general, economic output is not a (mathematical) function of input, because any given set of inputs can be used to produce a range of outputs. To satisfy the mathematical definition of a function, a production function is customarily assumed to specify the maximum output obtainable from a given set of inputs. The production function, therefore, describes a boundary or frontier representing the limit of output obtainable from each feasible combination of input. (Alternatively, a production function can be defined as the specification of the minimum input requirements needed to produce designated quantities of output, given available technology.) By assuming that the maximum output, which is technologically feasible, from a given set of inputs, is obtained, economists are abstracting away from technological, engineering and managerial problems associated with realizing such a technical maximum, to focus exclusively on the problem of allocative efficiency, associated with the economic choice of how much of a factor input to use, or the degree to which one factor may be substituted for another. In the production function, itself, the relationship of output to inputs is non-monetary; that is, a production function relates physical inputs to physical outputs, and prices and costs are not reflected in the function. In the decision frame of a firm making economic choices regarding production—how much of each factor input to use to produce how much output—and facing market prices for output and inputs, the production function represents the possibilities afforded by an exogenous technology. Under certain assumptions, the production function can be used to derive a marginal product for each factor. The profit-maximizing firm in perfect competition (taking output and input prices as given) will choose to add input right up to the point where the marginal cost of additional input matches the marginal product in additional output. This implies an ideal division of the income generated from output into an income due to each input factor of production, equal to the marginal product of each input. The inputs to the production function are commonly termed factors of production and may represent primary factors, which are stocks. Classically, the primary factors of production were Land, Labor and Capital. Primary factors do not become part of the output product, nor are the primary factors, themselves, transformed in the production process. The production function, as a theoretical construct, may be abstracting away from the secondary factors and intermediate products consumed in a production process. The production function is not a full model of the production process: it deliberately abstracts from inherent aspects of physical production processes that some would argue are essential, including error, entropy or waste, and the consumption of energy or the co-production of pollution. Moreover, production functions do not ordinarily model the business processes, either, ignoring the role of strategic and operational business management. (For a primer on the fundamental elements of microeconomic production theory, see production theory basics).

The production function is central to the marginalist focus of neoclassical economics, its definition of efficiency as allocative efficiency, its analysis of how market prices can govern the achievement of allocative efficiency in a decentralized economy, and an analysis of the distribution of income, which attributes factor income to the marginal product of factor input. The firm is assumed to be making allocative choices concerning how much of each input factor to use and how much output to produce, given the cost (purchase price) of each factor, the selling price of the output, and the technological determinants represented by the production function.

A production function can be expressed in a functional form as the right side of

$$Q = f(X_1, X_2, X_3, \ldots, X_n) \text{.................... (1)}$$

Where:
Q = Quantity of output
$X_1, X_2, X_3, \ldots, X_n =$ quantities of factor inputs (such as capital, labour, land or raw materials).

In economics, the Cobb–Douglas production function is a particular functional form of the production function. It is widely used to represent the technological relationship between the amounts of two or more inputs, particularly physical capital and labor, and the amount of output that can be produced by those inputs. The Cobb-Douglas form was developed and tested against statistical evidence by Charles Cobb and Paul Douglas during 1927–1947.

In its most standard form for production of a single good with two factors, the function is

$$Q = AL^{\beta}K^{\alpha} \text{ .... (2)}$$

Where:
Q = total production (the quantity produced in a year)
L = labor input (the total number of person-hours worked in a year)
K = capital input (the real value of all machinery, equipment, and buildings)
A = total factor productivity
α and β are the output elasticities of capital and labor, respectively. These values are constants determined by available technology.

Output elasticity measures the responsiveness of output to a change in levels of either labor or capital used in production, ceteris paribus. For example if $\alpha = 0.45$, a 1% increase in capital usage would lead to approximately a 0.45% increase in output.

Further, if $\alpha + \beta = 1$, the production function has constant returns to scale, meaning that doubling the usage of capital K and labor L will also double output Y. If $\alpha + \beta < 1$, returns to scale are decreasing, and if $\alpha + \beta > 1$, returns to scale are increasing. Assuming perfect competition and $\alpha + \beta = 1$, α and β can be shown to be capital's and labor's shares of output. The total, average, and marginal physical product curves mentioned above are just one way of showing production relationships. They express the quantity of output relative to the amount of variable input employed while holding fixed inputs constant. Because they depict a short run relationship, they are sometimes called short run production functions. If all inputs are allowed to be varied, then the diagram would express outputs relative to total inputs, and the function would be a long run production function. If the mix of inputs is held constant, then output would be expressed relative to inputs of a fixed composition, and the function would indicate long run economies of scale.

Rather than comparing inputs to outputs, it is also possible to assess the mix of inputs employed in production. An isoquant (see below) relates the quantities of one input to the quantities of another input. It indicates all possible combinations of inputs that are capable of producing a given level of output. An isoquant represents those combinations of inputs, which will be capable of producing an equal quantity of output; the producer would be indifferent between them. The isoquants are thus contour lines, which trace the loci of equal outputs. As the production remains the same on any point of this line, it is also called equal product curve. The Marginal Rate of Technical Substitution (MRTS) is the amount by which the quantity of one input has to be reduced when one extra or additional unit of another input is used, so that output remains constant. In other words, it shows the rate at which one input (e.g. nitrogen or water) may be substituted for another, while maintaining the same level of output. The MRTS can also be seen as the slope of an isoquant at the point in question. So it is diminishing. In economics, a cost curve is a graph of the costs of production as a function of total quantity produced. In a free market economy, productively efficient firms use these curves to find the optimal point of production (minimizing cost), and profit maximizing firms can use them to decide output quantities to achieve those aims. There are various types of cost curves, all related to each other, including total and average cost curves, and marginal ("for each additional unit") cost curves, which are equal to the differential of the total cost curves. Some are applicable to the short run, others to the long run. Assuming that factor prices are constant, the production function determines all cost functions. The variable cost curve is the inverted short-run production function or total product curve and its behavior and properties are determined by the production function. Because the production function determines the variable cost function it necessarily determines the shape and properties of marginal cost curve and the average cost curves. If the firm is a perfect competitor in all input markets, and thus the per-unit prices of all its inputs are unaffected by how much of the inputs the firm purchases, then it can be shown that at a particular level of output, the firm has economies of scale (i.e., is operating in a downward sloping region of the long-run average cost curve) if and only if it has increasing returns to scale. Likewise, it has diseconomies of scale (is operating in an upward sloping region of the long-run average cost curve) if and only if it has decreasing returns to scale, and has neither economies nor diseconomies of scale if it has constant returns to scale. In this case, with perfect competition in the output market the long-run market equilibrium will involve all firms operating at the minimum point of their long-run average cost curves (i.e., at the borderline between economies and diseconomies of scale).

Relationship between different costs curves:
- Total Cost = Fixed Costs (FC) + Variable Costs (VC)
- Marginal Cost (MC) = dC/dQ; MC equals the slope of the total cost function and of the variable cost function
- 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.

$$AC = \frac{TC}{Q}$$

In economics and finance, marginal cost is the change in the total cost that arises when the quantity produced changes by one unit. That is, it is the cost of producing one more unit of a good.[1] In general terms, marginal cost at each level of production includes any additional costs required to produce the next unit. For example, if producing additional vehicles requires building a new factory, the marginal cost of the extra vehicles includes the cost of the new factory. In practice, this analysis is segregated into short and long-run cases, so that over the longest run, all costs become marginal. At each level of production and time period being considered, marginal costs include all costs that vary with the level of production, whereas other costs that do not vary with production are considered fixed.

If the good being produced is infinitely divisible, so the size of a marginal cost will change with volume, as a non-linear and non-proportional cost function includes the following:
- variable terms dependent to volume,
- constant terms independent to volume and occurring with the respective lot size,
- jump fix cost increase or decrease dependent to steps of volume increase.

In practice the above definition of marginal cost as the change in total cost as a result of an increase in output of one unit is inconsistent with the differential definition of marginal cost for virtually all non-linear functions. This is as the definition finds the tangent to the total cost curve at the point q which assumes that costs increase at the same rate as they were at q. A new definition may be useful for marginal unit cost (MUC) using the current definition of the change in total cost as a result of an increase of one unit of output defined as: TC(q+1)-TC(q) and re-defining marginal cost to be the change in total as a result of an infinitesimally small increase in q which is consistent with its use in economic literature and can be calculated differentially. If the cost function is differentiable joining, the marginal cost is the cost of the next unit produced referring to the basic volume.

$$\frac{dC}{dQ}$$

3. Objectives of the study

Cotton is the one of the main cultivated summer crops in the salt-affected land in Egypt. The main objective of the study is studying the production economics of cotton in the salt-affected land. The impacts of production factors used to produce cotton crop in salt-affected land have been identified and measured. The various combinations of manure and irrigation water inputs which produce or yield equal production to cotton producers have been derived and identified. The impacts of technical changes on the quantities produced of cotton and on the optimal and maximum-profit production levels have been measured. The relationship between the quantity produced and the production costs of cotton crop is estimated and investigated. The levels of optimal and maximizing profits for the studied crop in the salt-affected land is identified and determined.

4. Emprical model and data sources

Field primary data concerning the inputs and outputs of cotton in the selected farms have been collected and conducted from five targeted villages in Sharkia Governorate. These villages are El Rewad, Tark Ben Ziad, El Ezdehar, El Salah and Khaleed Ben El Waleed. A random Stratified Cluster Sample Size of 150 holders from the five studied villages were targeted according the number of the population and the cultivated area in each village. Questionnaire sheets covering the inputs and outputs data have been used to collect the field primary data. The cotton production, total costs and average costs functions approach as well as the multiple regression models have been used to accomplish the main objectives of the study. In addition the isoquant production curve for the improved cotton varieties is used to estimate the impacts of technical changes on the quantities produced of cotton. As well as the averages total and marginal costs for the improved cotton varieties have been used to estimate the impacts of technical changes on the optimal and maximum production levels of cotton crop.

5. Results and discussion

5.1. Production Function of Cotton Crop

5.1.1. The Production Function

The Cobb–Douglas production function for cotton crop is estimated as follow:
Where:

$$Q_c = 0.014\ (\text{seed})^{0.474}\ (\text{manure})^{0.227}\ (\text{phosphorus})^{0.215}\ (\text{water})^{0.398} \ldots\ldots (1)$$
$$(12.9)^{**} \quad (12.3)^{**} \quad (13.5)^{**} \quad (9.93)^{**}$$

$$R\backslash 2 = 0.949 \qquad \text{F-ratio} = 208.9$$

LnQc = the natural logarithmic for the production quantity of cotton in kintar/feddan
LnSeedb = the natural logarithmic for the quantity used from cotton seed in kg/feddan
LnPhosphorusb = the natural logarithmic for the quantity used from phosphorus fertilizer in kg/feddan
LnManureb = the natural logarithmic for the quantity used from manure in cubic meter/feddan
LnWaterb = the natural logarithmic for the quantity used from irrigation water in cubic meter/feddan
The numbers between brackets are t-statistical values

The previous production function model indicates that: (i) The estimated parameters and the estimated model are statistically significant. The quantities used from seeds, manure, phosphorus and water have great statically effect on the production quantity of cotton in the salt-affected land. (ii) The production elasticities of seed, manure, phosphorus fertilizers and irrigation water are positive and less than one, i.e., the usage of those factors are in the second production stage or the economic production stage. (iii) the variations in the studied four factors explain 95% of the variations in the quantity produced of cotton in the salt-affected land. (iv) the returns to scale of the four studied factors in cotton production are increasing (i.e., 1.314). That means a 100% increase in the four factors usage would lead to approximately a 131% increase in the cotton output. (v) total factor productivity is positive and less than one (0.014).

An isoquant shows the extent to which the farm in question has the ability to substitute between the two different inputs (e.g., phosphorus fertilizers and irrigation water) at will in order to produce the same level of output. The isoquant curve for cotton represents those combinations of two inputs, which will be capable of producing an equal quantity of output; the producer would be indifferent between them. The cotton isoquant curve for the various combinations of phosphorus fertilizer and irrigation water (figure 1) can be derived from the functional form number (1) using the average quantity produced of cotton (6.13 kintar/feddan), average quantities used of seeds (37.35 kg/feddan) and manure (10.46 m3/feddan) as follows:

$$\text{Water} = \{45.825(\text{phosphorus})^{-0.215}\}^{(1/0.398)} \ldots\ldots\ldots\ldots\ldots\ldots (2)$$

Figure (1) shows that: (i) The Marginal Rate of Technical Substitution (MRTS) between phosphorus fertilizer and water is diminishing. On the other word, the amount by which the quantity of phosphorus input has to be reduced when one extra or additional unit of water input is used, so that output of cotton remains constant. (ii) the technological tradeoff between phosphorus and irrigation water in the cotton production function is decreasing marginal returns of both inputs. Adding one input while holding the other constant eventually leads to decreasing marginal output, and this is reflected in the shape of the isoquant.

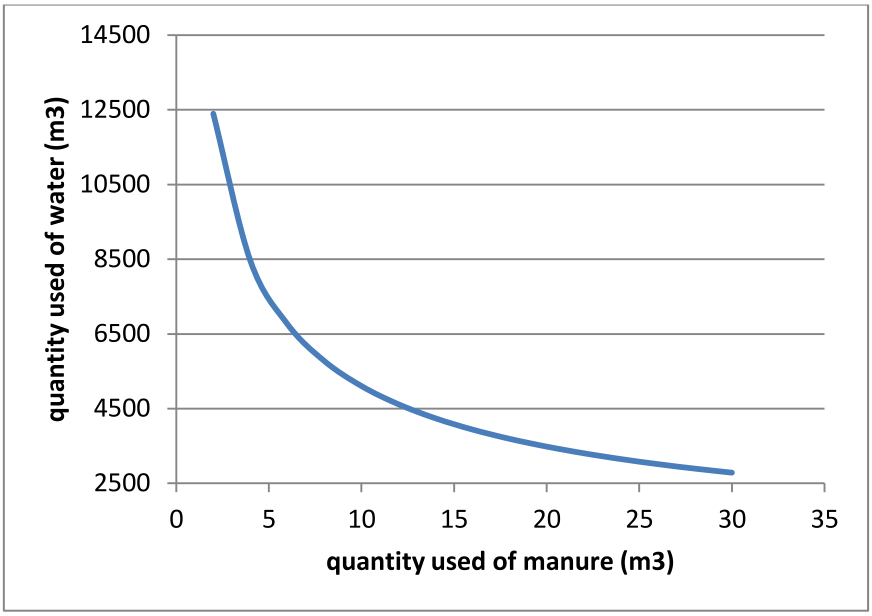

Figure 1. *The cotton isoquant curve for the various combinations of phosphorus fertilizer and irrigation water (Equation 2 and the Cotton field primary data, 2011)*

5.1.2. The Impacts of Technological Changes on Production Level

The impacts of technological changes on the cotton production using isoquant curves will investigate in this part of the study. The interviewed farmers indicate that the improved varieties of cotton increase the yield of cotton from 6.13 kintar/feddan to 7.36 kintar/feddan, i.e., an increase of 20%. Using this fact and recalculation the models number (1) and (2), the cotton isoquant curve can be derived in model number 3 as follows:

$$\text{Water} = \{54.99\ (\text{phosphorus})^{-0.215}\}^{(1/0.398)} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots (3)$$

Figure (2) shows that the farmers will produce high level of cotton output when they use improved varieties. The cotton isoquant curve for the improved varieties (Q\) is higher than the cotton isoquant curve for the old varieties (Q). Consequently the farmers can produce more output of cotton under the same quantity used of irrigation water and manure.

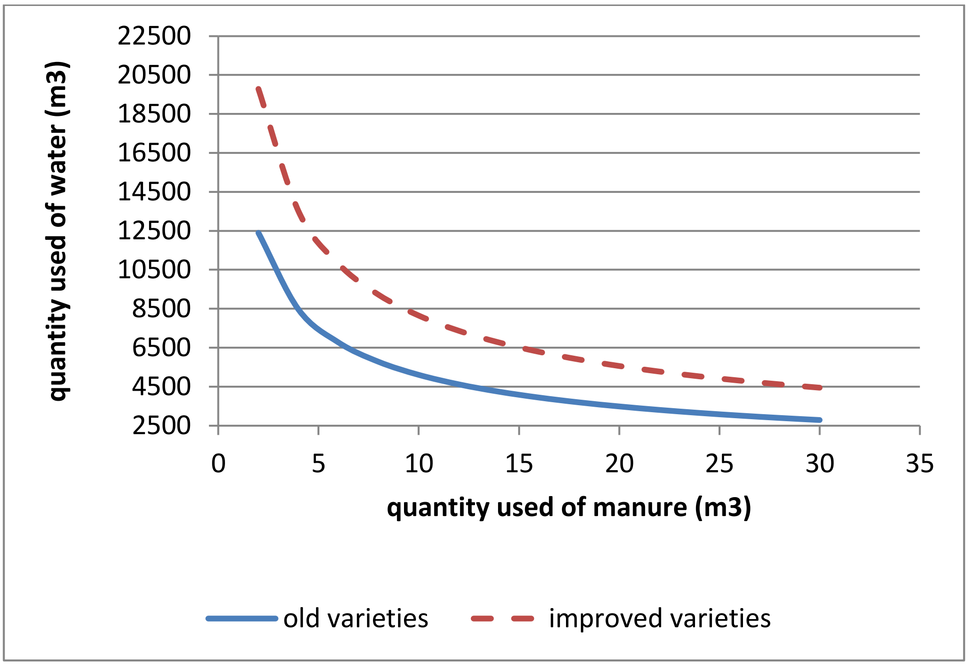

Figure 2. *The impacts of improved varieties on the cotton isoquant curve of cotton crop in salt-affected land (Equation 3 and the Cotton field primary data, 2011)*

5.2. The Production Cost Function of Cotton Crop

5.2.1. Total Cost Function

The total production cost function of cotton can be estimated as a cubic function, equation no. 4 and figure (3).

$$TC_c = 265.3 + 1531.9\,Q - 283.7\,Q^2 + 19.2\,Q^3 \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (4)$$
$$(3.3)^{**} \quad (5.6)^{**} \quad (-5.3)^{**} \quad (1.96)^{*}$$

$$\bar{R}^2 = 0.22 \qquad F \text{ ratio} = 3.2^{*}$$

Where:
TCc = the total production cost of cotton in LE/kintar
Q = the quantity produced from cotton in kintar/feddan

The previous production cost function Indicates that: (i) all estimated parameters and the model are statistically significant. (ii) the variation in the cotton yield (Q) explain 22% of the variation in total production costs. (iii) the cotton farmers will maximize their profits by producing about 9 kintar per feddan where the slopes of total cost curve and total return curve are equal. (iv) the total production costs of cotton at the maximum profit level is estimated at 5037 LE/feddan.

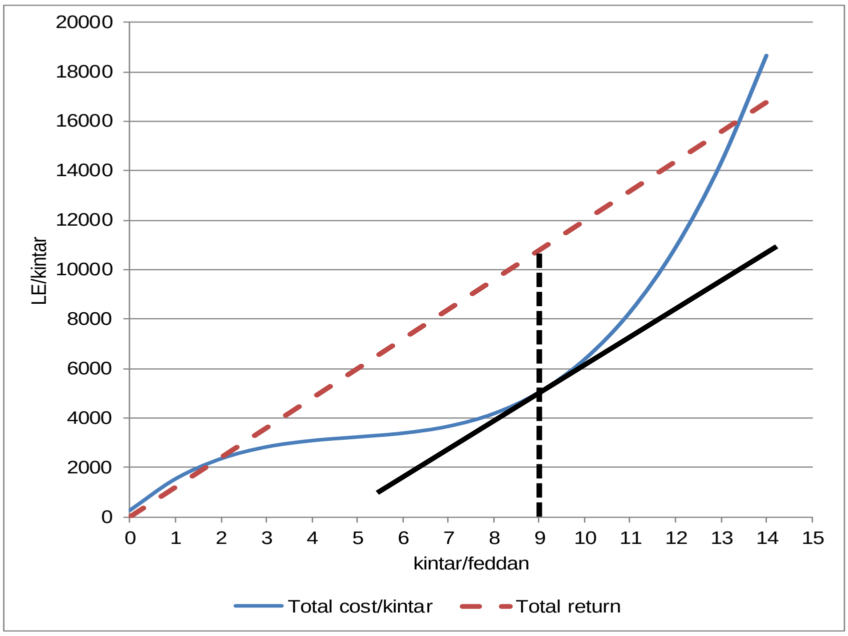

Figure 3. *the total production function of cotton crop in the salt-affected land (Equation 4 and the Cotton field primary data, 2011)*

5.2.2. The Averages Total Cost Function

The average total cost function of cotton can be estimated as a quadratic function, equation no. 5 and figure (4).

$$ATC_c = 1714.9 - 321.1\,Q + 21.5\,Q^2 \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (5)$$
$$(5.5)^{**} \quad (-2.8)^{**} \qquad (2.15)^{*}$$
$$R\backslash^2 = 0.34 \qquad\qquad \text{F-ratio} = 12.6$$

Where:

ATCc = the average total production cost of cotton in LE/kintar

Q = the quantity produced from cotton in kintar/feddan

The marginal cost (MCc) function of cotton can be derived from equation 5 as follows:

$$MCc = 1714.9 - 642.3\,Q + 64.6\,Q^2 \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (6)$$

The average total costs and marginal cost functions are presented in figure (4). The previous two functions indicate that: (i) all estimated parameters and the models are statistically significant. (ii) the variation in the quantity produced (Q) explain 34% of the variation in average production costs. Figure (4) present that: (i) both the average total cost and marginal cost curves take U shape (logically agree with the economic theory). (ii) the marginal cost curve intersects the average total cost curve at the minimum point. (iii) the cotton farmers will minimize their total costs by producing 7.5 kintar per feddan where the slopes of total cost curve and marginal cost curve are equal. The total production cost of cotton at the minimum level of costs is estimated at 518 LE/feddan. (iv) the cotton farmers will maximize their profit by producing 9 kintar/feddan. The total production cost of cotton at the maximum-profit level is estimated at 569 LE/feddan.

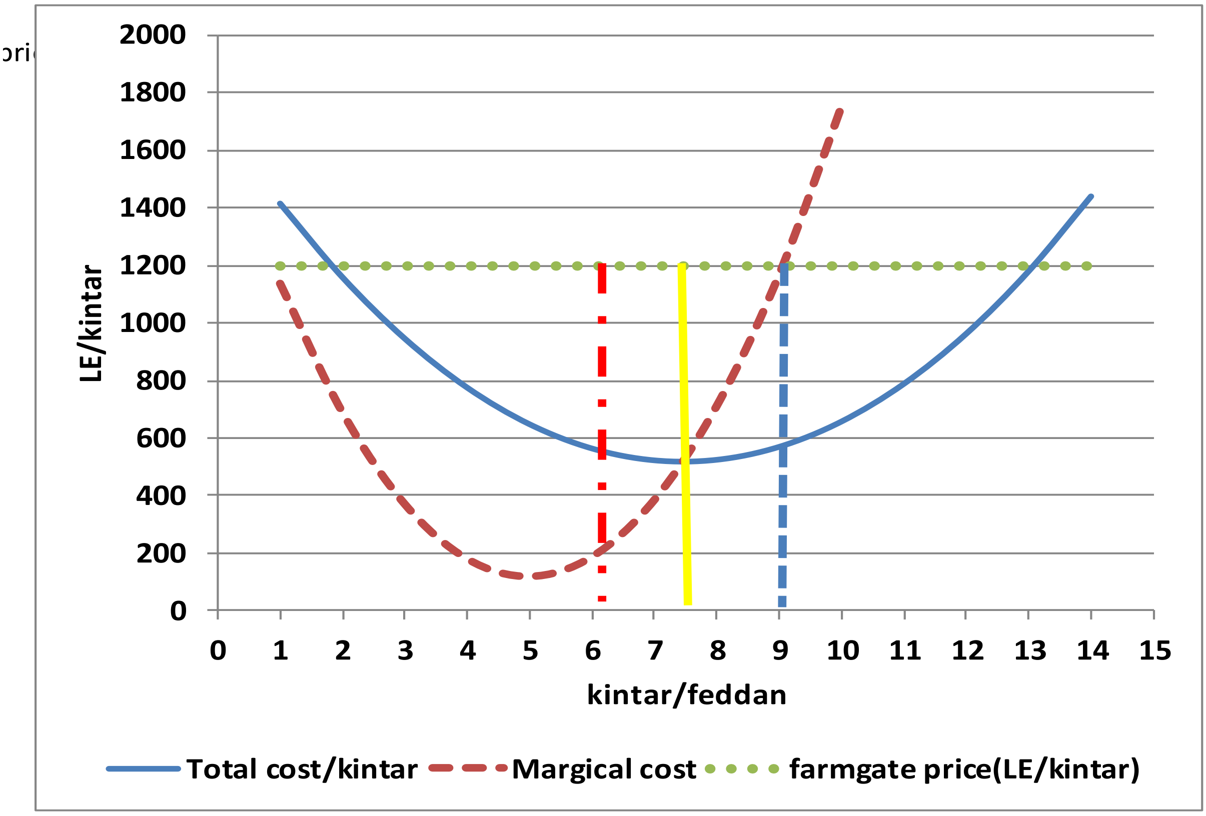

Figure 4. *The average production functions of cotton crop in the salt-affected land (Equations 5,6 and the Cotton field primary data, 2011)*

5.2.3. Income Forgone

The steps of calculation of income forgone for cotton farmers in the salt-affected land are presented in table (1). The results in the table indicate the following indicators: (i) the actual, optimal and maximizing-profit quantities produced of cotton are estimated at 6.13 kintar/feddan, 7.5 kintar/feddan and 9 kintar/feddan, respectively. The average farmgate price of cotton is estimated at 1198 LE/kintar. Thus, the actual, optimal and maximizing-profit total returns are estimated at 7344 LE/feddan, 8985 LE/feddan and 10782 LE/feddan, respectively. (ii) the average production costs at the actual, optimal and maximizing-profit production levels of cotton are 557 LE/kintar, 518 LE/kintar and 569 LE/kintar, respectively. Therefore, the total costs at the at the actual, optimal and maximizing-profit production levels of cotton are 3414 LE/feddan, 3885 LE/feddan and 5121 LE/feddan, respectively. (iii) the profit at the actual, optimal and maximizing-profit production levels of cotton are 3929 LE/feddan, 5100 LE/feddan and 5661 LE/feddan, respectively. Consequently the income forgone for cotton farmers at the optimal and maximizing-profit production levels are 1171 LE/feddan and 1732 LE/feddan, respectively.

Item	Unit	Actual production level	Optimal production level	Maximizing-profit production level
Production	kintar/feddan	6.13	7.5	9
farmgate price	LE/feddan	1198	1198	1198
total return	LE/feddan	7343.74	8985	10782
Average cost	LE/kintar	557	518	569
total costs	LE/feddan	3414.41	3885	5121
Profit	LE/feddan	3929.33	5100	5661
income forgone	LE/feddan		1171	1732

Table 1. *The actual, optimal and maximizing-profit productions, costs and returns for cotton farmers, 2012 (Figure 4 and the Cotton field primary data, 2011)*

5.2.4. The Impact of Technological Changes on the Average Production Costs Levels

As mentioned above the cotton farmers in the salt-affected land reveal that the improved varieties increase yield by 20% (i.e., from 6.13 kintar/feddan to 7.36 kintar/feddan). The average total cost functions of improved cotton varieties (ATC\c) can be estimated as a quadratic function, equation no. (7).

$$ATC\backslash_c = 1714.9 - 267.6\ Q + 14.96\ Q^2 \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (7)$$
$$(5.4)^{**} \quad (-2.8)^{**} \quad (2.1)^{*}$$
$$R\backslash^2 = 0.34 \qquad F\ ratio = 12.6$$

The marginal cost function of improved cotton varieties (MC\c) can be derived from equation (7) as follows, equation no. (8):

$$MC\backslash c = 1714.9 - 535.2\ Q + 44.87\ Q^2 \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots (8)$$

The average total cost and marginal cost functions of old varieties (equations 5 and 6) and the average total cost and marginal cost functions of improved varieties (equations 7 and 8) are presented in figure (5). the results can be concluded from the figure are: (i) 20% increase in the yield of cotton because of improved varieties cultivation leads to obvious moving the average total cost and marginal cost functions to the right. Therefore the production levels which minimize the total costs and maximize the profits of cotton farmers move to the right. (ii) The minimum points of averages costs and the maximum points of profits move obviously to right. The optimal production level of cost has been moved from 7.5 kintar/feddan for old cotton varieties to 9 kintar/feddan for improved cotton varieties. In addition the maximize-profit level has been moved from 9 kintar/feddan for old cotton varieties to 10.85 kintar/feddan for improved cotton varieties.

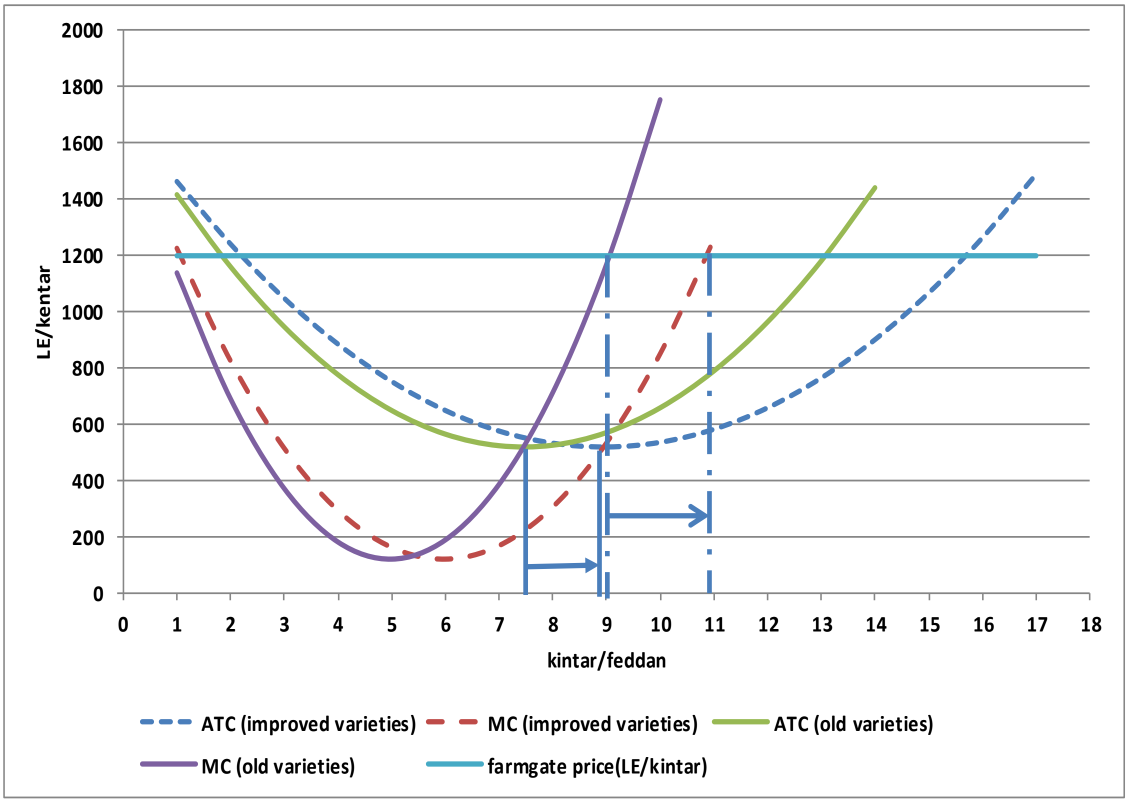

Figure 5. The impacts of improved varieties on the averages total and marginal costs of cotton crop in salt-affected land (Equations 7,8 and the Cotton field primary data, 2011)

6. Conclusions

The main results can be summarized as follows: (i) the relationship between the quantity produced of cotton and inputs used of seed, manure, phosphorus fertilizers and irrigation water are positive, less than one and statistically significant. In addition the returns to scale for cotton production are increased. (ii) The cotton isoquant curve for the improved varieties is higher than the cotton isoquant curve for the old varieties. Consequently the farmers can produce more output of cotton under the same quantity used of irrigation water and manure. (iii) the cotton farmers will minimize their total costs by producing 7.5 kintar per feddan where the slopes of total cost curve and marginal cost curve are equal. The total production cost of cotton at the minimum level of costs is estimated at 518 LE/feddan. (iv) the cotton farmers will maximize their profit by producing 9 kintar/feddan. The total production cost of cotton at the maximum-profit level is estimated at 569 LE/feddan.

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