Estimating the Optimal Production Size and the Maximum Profit Size for Yellow Corn Crop in the 2023 Production Season in Salah al-Din, Al-Ishaqi Subdistrict: An Applied Model

Safaa Hafedh Saleh1*, Yousra Tarek Bakr 2
University of Tikrit College of Agriculture, Science in Economic and Extension - Agricultural Economics

*Corresponding author's email: safaa.h.salih789@tu.edu.iq
Email addresses of coauthors: Usraa_Traiq@tu.edu.iq

Abstract
Yellow corn is considered one of the important economic crops, as it ranks fourth in terms of relative importance of area after wheat, barley, and rice, and second after rice in terms of area and production. Where the study aimed to estimate the optimal size of production and area using the marginal method according to the long-term cost function. The data were obtained through the design of a questionnaire specifically prepared for this purpose and collected in the field. This sample consisted of (100) farms that represented the entire study community. The optimal size of corn crop production was determined in the research sample and based on the cubic cost function, which passed all statistical, standard and economic tests. The optimal size of production was (4024) kg, which maximizes profits and low costs, while the optimal area achieved was (50.3) dunums. The study concluded that in light of the application of the criteria for evaluating financial performance, it was found that all projects achieved rewarding returns, but large category projects exceeding 56 dunums are the best category in achieving economic efficiency by achieving the best results when using the studied criteria, adding them well. The results of this, study recommended giving the role of agricultural extension system by educating farmers and training them to adopt modern irrigation technis.

Keywords: costs, Agricultural Economics, corn, the Optimal Production Size.

Introduction:

Yellow corn is one of the important economic crops, as it occupies the fourth place in terms of relative importance of the area after wheat, barley and rice crops, and the second place after rice in terms of area and production. The corn crop is considered one of the important strategic food grains crops, if it is used in many food and industrial uses (its seeds are used in the production of starch because it contains(70% : 80%) of carbohydrates, and the production of oils whose seeds contain(4%) of liquid oil, and an amount of calories of about (360) calories, as well as for fodder uses. The importance of this crop has increased with the increase in the expansion of livestock projects in general and poultry in particular. Yellow corn constitutes a large percentage of the components of concentrated relations, which led to an increase in demand for it, but the increasing demand was accompanied by a lack of production represented in the low level of donum yield

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and the oscillation of cultivated areas, and to address this deficit requires an increase in agricultural production. Saladin Governorate, especially in Ishaqi, is one of the rich agricultural areas that depend heavily on the cultivation of this vital crop. In light of the agricultural challenges facing the region, such as climate change, water scarcity, and the deterioration of soil fertility, and because we believe that the level of efficiency in use is low, it has become necessary to study this important activity and identify economic efficiency and its components as the most important measure of the efficiency of economic performance, and then identify the amount of economic efficiency achieved by yellow corn crop farmers. This study comes to estimate the efficiency of yellow corn crop farms in Salah al-Din, Ishaqi, for the season 2024.

Objectives of the Research

Estimating the optimal production volumes and area of the crop under study.

Estimating the ratio of economies of scale achieved for crop farmers by calculating the elasticity of the average cost function and the coefficient of the function and thus calculating economic efficiency by the marginal analysis method.

Research Problem

Many farmers in the Ishaqi sub-district, especially yellow corn farmers, suffer from many problems in crop production. This is due to the underdevelopment of methods of cultivation and the dependence of farmers on the cultivation of local and synthetic varieties and low productivity, as well as the underdevelopment of methods of control of agricultural pests and diseases and the weakness of its transport and marketing. This leads to low productivity due to the low agricultural resources used and the lack of experience of most farmers, which is reflected in productivity and high production costs because farmers are not equipped with resources on time. This requires farmers to buy from the local black market, which is reflected in the increase in production costs and the failure to achieve production volumes that approach the optimal volumes of production and area, at which the lowest production costs and the greatest profit possible in the farms of the study sample. Therefore, the study to assess the efficiency of yellow corn crop farms will provide the best solutions for decision makers. The rest of rationalizing the use of various resources to achieve an increase in production in order to keep pace with the increasing demand for it.

Study Importance

The importance of the research lies in the importance of the crop and the importance of the study, as yellow corn is one of the main crops in the world in general and in Iraq in particular, and its importance comes because it contains the main food components that enter human food directly or indirectly.The economic importance of the crop is steadily increasing due to the increase in demand for meat because it is an essential element in the bush of various animals, as well as the increase in demand for edible oil. The agricultural sector, in particular, aims to achieve economic efficiency and optimize the exploitation of resources. This criterion is one of the main criteria for achieving economic efficiency, which calls for the importance of studying the sources of production growth of the crop under study and the most important factors affecting it and seeking to increase the global yield, which leads to providing indicators for decision-makers in agricultural policy-making and efficient management of

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production resources. Knowing the performance of maize crop production projects is important for supervisors of the agricultural sector in Iraq to identify the most important obstacles that hinder these projects .

Research hypothesis

The economic reality indicates that the yield of yellow corn for farmers in Salah al-Din governorate is low and the majority of them do not achieve the optimal production volumes and the current level is inversely proportional to the size of the farm and their inability to achieve economic efficiency.

Study Method:

The research relied on two approaches, which are descriptive analysis based on studies that dealt with the subject of the study or close to it and the second quantitative economic analysis based on the quantities obtained from a questionnaire and in line with the concepts and foundations of economic theory and using the program (Eviews 10) to estimate the cost function in cubic form and the use of Excel in the arrangement and classification of data.

Conceptual Framework

Production costs and economies of scale of the farm

Production costs

It is the expenses and expenses incurred by the farm as a result of agricultural production, including a type that does not change with the change of farm production, which are fixed costs, and another type that changes with the change of production, which are variable costs (1). Production costs are also defined as the amount of money that projects bear in order to obtain the services of the production elements necessary to achieve the production of a specific commodity or service during a certain period of time (2).

Cost function:

The cost function is defined as the relationship between production costs and the quantity of production, that is, production costs are a function of the volume of production (3), and the cost function can be expressed in the short term in the following formula:

$TC = f(Y) + FC$

Economic derivatives of the cost function.

1. Average total costs

It is the amount of total costs per unit produced, and is obtained mathematically by dividing the total production costs by the amount of production, or by adding the average fixed and variable costs.

$SRATC = SRTC/Y = bo/Y + b1 – b2\ Y + b3\ Y2$

2-Average Fixed Costs

It is the amount of fixed costs per unit produced, (4) mathematically obtained from the division of fixed costs at the level of the quantity of production

$AFC = TFC/Y = b\_0/Y$

3-Average Variable Costs

It is the amount of variable costs per unit produced, (5), and we get mathematically from dividing the variable costs by the number of units produced (level of production)

$AVC = TVC/Y = b1 – b2\ Y + b3\ Y2$

Marginal Costs

It is the amount of change in total costs as a result of the change in production by one unit, (6) and we obtain it mathematically through the first derivative of the function of total costs or variable costs

$MC = \partial SRTC/\partial Y = b1 – 2b2Y + 3b3Y2 = 0$

Optimum volume of production

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Optimization has an important role in economic analysis because it is one of the specific indicators of product behavior in taking the appropriate decision to continue production or stop depending on the commissioning functions, as the optimal volume of production is defined as that volume in which the average cost of production per unit reaches its minimum (7).

Optimum size

The level of production at which the average total costs are as low as possible is the production that determines the optimal size of the project in the long term. At this size, marginal costs are equal to the average total costs. The share of the production unit of the average costs is less than possible. At this level of production, the efficiency of production factors is as high as possible. The optimal size can also be defined as the size that achieves the largest capacity savings, the lowest possible cost, or the highest net return for the production unit. The variation in determining the optimal size of the farm is due to differences in the nature of agriculture, environmental conditions, the level of technology adopted in agriculture, the degree of risk and uncertainty, the nature of possession and the level of inflation. The long-term cost function can be derived by adopting short-term cost functions in the following general formula:(8)

Economies of scale

The economics of optimal volume of production is one of the main determinants and tools of production policy at the project level, and therefore the economics of optimal volume tell us that the optimal volume of production(the project) is that level at which marginal revenue is equal to marginal cost. The economic theory considers that the rule of equality of marginal revenue with marginal cost, at which the optimal volume of production is achieved in a fully competitive market.(9).

Cost Flexibility:

It is the relative change in total production costs divided by the relative change in the quantity produced, or the degree of response of total costs to the change in the volume of production(10)

Results and Discussion

$Tc = b1Q - b2Q2 + b3Q3 - b4AQ + b5A2$………. (1)

Whereas:

TC: Represents the total cost (thousand dinars/acre)

Q: Represents the quantity of production (kg/acre)

A: Representing the size of the farm(acres)

Bi; Regression coefficients (I= 1,2,3…….n)

Ui; Representing the random variable

The short-term cost function was estimated to be consistent with economic logic and passed statistical and standard tests, as follows:

$SRTc = 41743.251\ Q - 3.\ 501Q2 + 0.000435Q3 - 0.000450AQ + 0.0179A2$

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Table (1) Short-term cost function in the research sample farms

Independent Variables	**Estimated Parameters**	**Calculated T**
Q	41743	711
Q^2	3.501523-	.742
Q^3	000435	.431**
AQ	0.000	3, 86-109.
A^2	0.0179521	297

R2 = 0.77 ² = 0.76 D.w = 2.001 F* = 63.712

* Morale at 1%

* * Morale at 5%

Source: Calculated by the researcher using the statistical program Eviews 10 based on the questionnaire data

When writing the estimated function in its implicit form, we get:

V = Tc –41743.251Q + 3. 501Q2 – 0. 000435Q3 + 0. 000450AQ – 0.0179A2= 0

By taking the partial derivative of it relative to A and equating it to zero, we get:

∂V/∂A= 0

= 0. 000450Q – 0.0358A = 0

A = 0.000450Q/0.0358 = 0.0125Q…………. (2)

When we substitute the value of A equal to the original function, we obtain the following long-term cost function:

LRTc = 41743.251Q – 3.501Q2 + 0.000435Q3 – 0.000453(0.0125Q) Q + 0.0179(0.0125Q)2

= 41743.251Q – 3.501Q2 + 0.000435Q3 – 0.00000566Q2 + 0.00000279Q2

Adding the Q2 terms gives:

LRTc = 41743.251Q - 3.501Q 2 + 0.000435Q 3……………. (3)

It is a function of total cost in the long run.

Economic Analysis

Determine the optimal size of production:

From the extent of studying the economics of volume, it is necessary to identify the long-term average cost equation LRATC, and since all production costs are considered variable costs in the long term, so the average cost equation was derived from the total cost equation by dividing it by the output (1):

LRTc =41743.251Q – 3.501Q2 + 0.000435Q3

The total cost function in the long run.

To obtain the long-term average total cost function, we divide LRATc by Q as follows:

LRATc (LRTc)/Q =41743.251 – 3.501Q + 0.000435Q2

In order to determine the optimal size of production that reduces costs, the necessary condition must be applied to minimize costs by taking the partial derivative of it relative to Q and equating it to zero, so you get:

(∂ATc)/∂Q= – 3.501 + 0.00087Q = 0

Q = 3.501/0.00087 =4024 kg

Optimal production quantity that minimizes costs and maximizes profit.

By replacing the value of Q in Equation No. (2), you get:

A = 0.0126Q

= 0.0125 (4024) = 50.3 dunums

The optimal space that can be exploited by crop farmers to obtain the optimal volume of production that reduces costs and maximizes profit.

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Table (2) The actual volume and the optimal volume of maize crop production in the research sample farms

Actual volume of production (1) Dunum	Optimum volume of production (2) Dunum	of efficiency 1/2
3200	4024	79.52

Source: Calculated by the researcher based on the questionnaire data

Table (2) shows that the optimal volume of production came at a rate that exceeds the actual rate of the yellow corn crop in the research sample, as the optimal volume of production reached (4024) kg/acre, and since the optimal volume of production exceeds the actual volume, wheat crop farmers in the research sample must increase their production by (824) kg/acre.

Figure (1) The actual volume and the optimal volume of maize crop production in the research sample farms

Source: Prepared by the researcher based on the table data (2(

Economies of size and cost elasticities of the falcon corn crop in the research sample farms

Table No. (3) Volumetric categories of the maize crop in the research sample farms.

Volumetric categories (acres)	**Farmers number**	Percentage of Contribution%	**Materiality**.
21 October	10	10	**Increasing capacity = 47**
22:33	15	15	
34-44	22	22	
45-55	19	19	Optimum size
56-66	16	16	**Decreasing capacity = 34**
67.77	14	14	
¡ >=80	4	4	

Source: Calculated by the researcher based on the questionnaire form.

Table (3) shows that the maize crop farms in Salah al-Din Governorate – Ishaqi sub-district for the productive season 2024 were divided into seven volumetric categories, as each volumetric category showed the economies of scale achieved through the results reached using the previous formula to obtain the economies of scale achieved, which showed that flexibility is negative for production levels below the optimal production level (4024) kg, indicating the inverse relationship between the results and the average cost in the savings area. This is due to the fact that the marginal cost is below the average total cost. As for the optimal size of production, the value of cost elasticity reached (0) in about (19%) of maize farms, as they produce production levels that approach the optimal size. While the elasticities of the cost function take the positive signal at production levels that exceed the optimal level, indicating the direct relationship between the output and the average cost for production levels that exceed the optimal size.

The coefficient of function in Table (4) showed that its value is positive and greater than the correct one for production levels less than the optimal volume, as its value increases with the increase in the volume of production , that is, the rate of increase in the volume of production exceeds the rate of increase in costs, which reflects the first stage of production (the stage of increased yield), and when its value becomes equal to the correct one, the optimal volume of production is achieved.

As for the achieved economies of scale, they increase with the increase in the volume of production and reach their maximum value at the optimum volume of production 100%, but by increasing the volume of production from the optimum volume, the proportion of economies of scale begins to decrease in increasing proportions, as farms operating within the area of economies accounted for (34%) of the total number, while farms operating within the area of capacity savings amounted to (47%). As for farms operating at the optimum volume, which are within the area of capacity savings, they amounted to (19%), as shown in tables(3(and(4.(

Table (4) Percentage of achieved economies of scale, flexibility and coefficient of function at the level of production achieved for the different categories of volume in the research sample farms.

Capacity Returns	scale of economies	Elasticity of an average cost function	Function Coefficient	Expected marginal cost at the level of production achieved	Average total cost at achieved production level	Level of production achieved (kg/acre)
Economies	29.1	-0.056	1.072	36046.251	38677.251	1000
Economies	68.2	072	1.106	32959.251	36481	2000
Economies	91.8	0.038-	1.082	32482.251	35155.251	3000
Economies	100	0.0000	1.000	34698.514	34698.997	4024

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Dis Economies	92.6	0.182	0.892	39358.251	35113.251	5000
Dis Economies	69.7	0.355	0.779	46711.251	36397.251	6000
Dis Economies	31.3	0.603	0.680	56674.251	38551.251	7000

Source: Calculated by the researcher based on the questionnaire form, the average total cost function, the marginal cost function, the equation of the coefficient of the function, and the cost flexibility.

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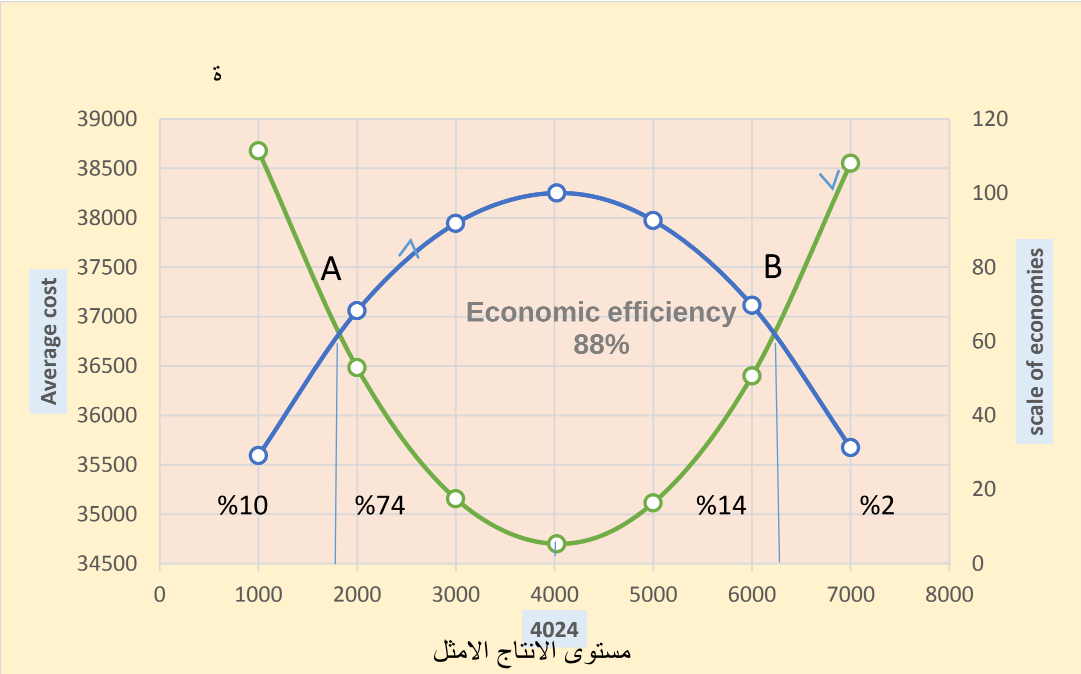

Figure (2) The average total cost curve and the economies of scale curve achieved for yellow corn crop farmers in the research sample farms

Source: Prepared by the researcher based on the table data (4(

Figure (2) shows the relationship between the expected long-term average total cost curve and the economies of scale curve at the different production levels shown in Table (4). The two curves intersect at point (A), which represents the level of production (1900) kg, and point (B), which represents the level of production (6200) kg. The ratio of economies of scale achieved between points (A) and(B) represents the highest achieved ratios between other output levels, which crosses the levels that achieve economic efficiency. The percentage of maize crop farmers who produce between (1900-6200) kg was about (88%) of the total crop farmers.

As for the farmers who produce between point (A) and the optimum level of production, their percentage reached (74%), and thus they produce below the optimum size as capacity savings are achieved with the increase of output, while the farmers who produce below the economic efficiency zone, that is, below point (A), their percentage reached (10%.(

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About (16%) of farmers produce between point (B) and the optimal volume level of production, that is, with production levels that exceed the optimal volume. Thus, there are no economies of capacity as the level of production increases and they move far away from the optimal volume of production. As for farmers who produce above the economic efficiency zone, that is, above point (B), their percentage reached (2%.(

Conclusions and Recommendations

Based on the findings reached in this study, the most important conclusions reached can be summarized as follows:

.1 The results of the questionnaire showed that the total variable costs (TVC) of wheat crop farms in the research sample accounted for the largest part of the total TC costs compared to the total total fixed costs (TFC), as the contribution percentage of variable costs amounted to about (62%) of the total costs. As for fixed costs, they accounted for (38%) of the total costs. We conclude from this that the farmers of the maize crop in the research sample bore a large part of the variable costs (TVC) as production costs and expenses that were paid in order to provide production elements and supplies for the maize crop, especially in the absence of government intervention represented by not providing the necessary support for production requirements, even at the minimum.

.2 In the light of the questionnaire, the study found that government support is weak if it is no longer sufficient, especially with regard to production requirements, which included seeds, fertilizers, pesticides, stimulants and maintenance costs if the cost of production requirements reaches (54%) of the total production costs

.3 The optimal size of maize crop production was determined in the research sample according to the marginal method and based on the cubic cost function, where it reached (4024 kg), while the optimal area of crop production reached (50.3) acres, and the

.4 We recommend that the agricultural extension system should be given a role in educating and training farmers to adopt modern techniques in irrigation and directing them to use the optimal quantities of economic resources to reach optimal production that maximizes profits and reduces costs.

.5 Enabling farmers to use the optimal quantities of production inputs in addition to the optimal quantities of irrigation water, which leads to increasing the productivity of elements and thus increasing production and achieving optimal sizes that achieve efficiency by increasing the size of cultivated areas to reach the optimal areas reached by the study.

.6 We recommend that we should rely on the experiences of efficient farm owners, and benefit from their experiences by employing them in inefficient farms to reach full efficiency levels. Inefficient farms should study the reasons that led to achieving full efficiency in some farms and use them to know the sites of imbalance in their farms and take them as practical models to reach full efficiency.

.7 Paying attention to marketing policy by opening marketing centers that receive project products

.8 researcher concluded that the optimal volume of production exceeds the actual

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volume of production (3200) kg/acre and a deviation of (824) kg/acre.

.9 The results of estimating the economies of scale in the marginal way and based on the cubic cost function showed that the percentage of farms in the research sample that work under increasing yields (economies of scale) before the economic efficiency zone of the wheat crop reached (64.1%), and the percentage of farms that work under decreasing yields (not economies of scale) after the economic efficiency zone reached (17.2%), thus concluding that most of the sample farms work under increasing yields.

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