The optimal size of wheat farms irrigated by supplementary irrigation of pivot sprinklers is 60 dunums in Salah al-Din Governorate / Tikrit district for the production season 2021/2022.

Maher Mustafa Shabib[1]
dr.maher.mostafa@tu.edu.iq
[1] *Agricultural Research Department, Natural Resources Research Center, Tikrit University Presidency, Tikrit, Iraq*

Abstract:

The research aims to study the reality of the costs of producing the wheat crop in Salah al-Din Governorate / Tikrit District using pivot sprinklers of 60 donum.. The cost function was estimated in the long run by introducing land area as an independent variable in the function in addition to production. The results showed that the optimal area of wheat that achieves economic efficiency and optimal production volumes for the sprinklers under study is (54,655) donum, in contrast, the optimum production was (1076.23) kg / donum. And the average cost per donum (284.405) thousand dinars / donum. Sprinklers also achieved economic efficiency (90%), while the maximum profit production reached (1006.868) kg /donum. Therefore, the study recommends using the optimal quantities of inputs in order to obtain the best production.

Keywords: optimum size, wheat, supplemental irrigation

Introduction:

Wheat is the most important staple food in the world. Up to 55% of the world's population depends on this crop for 20% of their caloric intake [2] The crop is widespread in temperate regions and is an important source of income for millions of small and medium farmers. The Iraqi agricultural sector was distinguished by the dominance of grain crops on most of the cultivated areas, and the wheat crop constituted the largest part of the grain crops. As there are slight increases in the areas used for agriculture that do not keep pace with the demand for it, as well as a decrease in the productivity of a dunam despite the increase in some cultivated volumes from the optimal size that the study reached, and for the purpose of meeting the needs of the Iraqi consumer, it was necessary to increase the yield of one dunam through The vertical expansion of its cultivation by using modern scientific means and methods such as sprinkler irrigation, the use of suitable agricultural areas and the use of scientific methods in control, in addition to the horizontal expansion in the cultivation of the crop. Due to the increasing demand for this crop being a major food crop, the need to use the sprinkler irrigation system was called for as it showed high efficiency. in increasing the productivity of this crop

Research problem:

The research problem is summarized in the low levels of production resulting from inefficiency in the use of resources, which requires studying and determining levels of efficiency and optimal sizes of areas and quantities produced from the wheat crop and knowing the extent of the farmer's deviation from these optimal sizes of areas and production for this crop, and thus the decrease in the net return that he obtains Farmers in the absence of support provided by the state.

Research Aims:

The research aims to study the reality of wheat production in Salah al-Din Governorate / Tikrit district by determining the optimal area, the optimal production quantity, the level

ISSN 2072-3857

of profit-maximizing production, and calculating cost elasticity.

Hypothesis:

The research assumes that farmers, despite their use of modern technologies, diverge to varying degrees from the optimal volumes of production, and many reasons, including misuse of available resources, which result in increased costs.

research importance:

The importance of the research lies in the wheat crop in terms of food for humans and fodder for animals and its entry into many industries, and for being one of the global strategic crops and its entry into the global economy market as a political weapon used by many countries. The dunam yield of the crop is so that it is close to the yield in the developed countries of the world by introducing an important ingredient that helps the farmer to use the resources available to him optimally and by scientific and economic methods such as sprinkler irrigation technology as one of the modern methods of growing strategic crops, which will maximize the profits achieved. Including crop farmers by raising their level of farm income, which contributes to improving their standard of living

Data collection:

The questionnaire was relied upon by which field data was collected from wheat farmers in Salah al-Din Governorate / Tikrit District for a random sample that included 80 sprinklers of (60) dunums, as a selected sample, and the quantitative method was used in analyzing the data to reach the results.

Theoretical framework:

Concept of Productive Cost Functions:

The production costs function means the relationship between the amount spent by the producer in exchange for obtaining the productive resources used in the production of a specific output, that is, the production costs are a function of the amount of the output [7]. The importance of production costs appears in the light of their impact on the supply of products in the market, and the project relies on them in making its decision to display the necessary quantities of its products in the market on the basis of the relationship between production revenues on the one hand and production costs on the one hand. Costs are related to the production process and the producer bears the costs of this process. The producer does not produce a commodity except after studying the costs he will incur and the revenue he is likely to obtain [1]

Production costs:

Production costs are defined as the amount of money incurred by projects in order to obtain the services of the factors of production necessary to achieve the production of a specific good or service during a specific period of time. When producers use a mixture of resources to produce a specific product,[8] they give up all alternative opportunities, so measuring the economic cost or opportunity cost of any economic resource used to produce a particular commodity is the value of that resource in the best use, and therefore the total costs of production are the sum of the explicit costs. and implicit costs [3]

A function of production costs in the long run

The long period represents that period of time during which the productive establishment can change all the elements of production it owns. During this period, all production costs become variable costs, and therefore there are no fixed costs [9]. It can be defined as the period of time that allows all the necessary and possible changes to be made in the size of the organization and in the production process, and therefore there will be no fixed costs, but the total costs will be, that is, all costs become variable [4]

Long-run total cost

Since the facility produces in the long run, there is no fixed production component in this case, and therefore there is no fixed cost

ISSN 2072-3857

(whether a fixed total cost or an average total cost). Therefore, the total cost of the long run is defined as the total cost of producing a certain quantity of a good or service, when the facility is able to change all elements of production [6]

Results and discussion:

Statistical estimate of the total cost function of the wheat crop in farms that use sprinklers (60 dunums).

The total cost function of the wheat crop was estimated in the short term for the production season (2021-2022), and multiple models were adopted in estimating the total cost function. In this analysis, three forms of cost functions were used (linear, quadratic, and cubic). It is the best and most suitable for the relationship in question. Based on the results of economic, statistical and standard tests [5].

According to economic theory the short-run cubic cost function (STRC) takes the following form.

STRC = b0 + b1 Q - b2 Q2 + b3 Q3 + Ui………………(1)

After substituting for the fixed cost b0 with the area factor A, we get the short-run cost function, as follows:

SRTC = b0 + b1 Q - b2 Q2 + b3 Q3 - b4 AQ + b5 A2 ………(2)

Since:

STRC = total cost (one thousand dinars).

Q = production quantity (kg).

A = farm area (dunums).

bi = regression coefficients (i = 1,2,3,……n).

The short-term total cost function was estimated for the 60-dunum sprinkler, and it was consistent with the economic logic and passed the statistical and standard tests and was as follows:

$$\mathbf{STRC = 296.475Q - 0.0174115\,Q^2 + 0.00001042\,Q^3 - 0.19754\,QA + 1.944612\,A^2}$$

Table (1) The short-term total cost function for the 60-dunum sprinkler plant.

calculated T	estimated parameters	independent variables
1.979	296.475	Q
-11.54213	-0.0174115	Q^2
3.241576	0.00001042	Q^3
-9.335412	0.19754 -	QA
2.01475	1.944612	A^2

R^2=0.941 R^{-2}=0.935 D.W = 2.713 F^*=114.2547

*The figures are significant at the 1% and 5% levels of significance.

statistical analysis :

By looking at the results of the t-test, it appeared that the estimated parameters were significant at a significant level (5%), and the F-test confirmed the significant significance of the function as a whole.) of those changes are due to other factors that were not included in the model and its effect was absorbed by the random factor (Ui).

Standard analysis

The problem of autocorrelation between random variables.

The results of the (D.W) test showed that there is no autocorrelation problem between the random variables in the model, and the reason is that the value of (D.W), which is (2.713), is located in the area of accepting the null hypothesis. No problem. And from the D.W table for the level of significance (5%), it was found that D.W lies between:

2.037 < 2.713 < 2.824 ie N-du < D.W < 4-du

And from it we conclude that there is no autocorrelation between the remainder, positive or negative, for the random variable.

The problem of instability of variance homogeneity

The results of Park's test showed that there is no problem of instability of variance homogeneity, as the results of the estimation of the regression equation function for the

ISSN 2072-3857

square of error with the output were not significant, as follows:
Log(ei)2 = a + b Log(Q)

= 4.152 + 0.218 Log Q
t (13.952) (0.644)
R^2 = 0.049 , D.W = 1.571 , F = 0.523
And since the estimated function is not significant under the 5% level of significance according to the F test, and the calculated t-value for the slope of the error regression coefficient is smaller than the tabular t-value at the 5% level of significance, this indicates that there is no problem of instability of variance.

The problem of multiple linear correlation between the independent factors.

Since the estimated function is a nonlinear function. Then I took into account production, its square and its cube, so the problem of linear correlation between the independent factors does not exist.

The optimal size for production and area for the sprinkler is 60 dunums.

For the purpose of calculating economies of scale in the production of the wheat crop, the function must be written in its implicit form and converted to the long run, as all production costs become variable costs in the long run. The estimated total cost function can be written as:

V= STRC= -296.475Q+ 0.0174115 Q2 - 0.00001042 Q3 + 0.19754 QA - 1.944612 A2=0

We take the first partial derivative with respect to the area A and set it equal to zero, we get the following:
$\partial V/\partial A$= 0.19754 Q –3.889224 A = 0
A = (0.19754 Q)/(3.889224)
A = 0.05079 Q…………………………1
And when replacing the value of (A) with its equal value in the original function, we get the cost function in the long run, as follows:
LRTC = 296.475Q – 0.017412 Q2 0.00001042 Q3 + 0.19754 QA - 1.944612 A^2=0
LRTC 296.475Q – 0.017412 Q^2+0.00001042Q^3 – 0.19754 Q(0.05079 Q) + 1.944612 (0.05079Q) 2
By summing up the terms of Q2, we get the long-run total cost function
LRTC= 296.475Q - 0.022429 Q2 + 0.00001042 Q3…………..2
The long-run average total cost (LRATC) function can be obtained by dividing (LRTC) by (Q) and the following is obtained:
LRATC = LRTC/Q = 296.475 – 0.022429 Q + 0.00001042Q2
In order to determine the amount of production that minimizes costs, the necessary condition for minimizing costs must be applied by taking the first partial derivative of average costs relative to output (Q) and equating it to zero, as follows:
∂LRTC/∂Q = - 0.022429 + 0.00002084Q = 0
:. Q = (0.05275)/(0.00002084) = 1076.23 kg/acre
This represents the optimal production quantity that reduces costs and maximizes profit in the long term for the 60-dunum class of sprinkler-irrigated wheat farms.
The graph of the long-run average total cost was drawn as shown in the following graph by compensating the different quantities of production, and then the function took the shape of a letter (U), as the function of the average costs is a function of the second degree.
As a result, the optimal quantities of production were determined, which is the quantity at which the lowest average cost is achieved in the long run, and the best net income (normal profit) is achieved.
In order to find out the lowest cost at which the optimal production and optimal area are achieved, by substituting the amount of optimal production achieved in the average total cost function, as follows:
LRATC = LRTC/Q = 296.475 - 0.022429 (1076.23) + 0.00001042 (1076.23)2
LRATC = 284.405 thousand dinars / donum
It is the cost of producing a donum that achieves optimal production and is the lowest level on the curve of average production costs,

ISSN 2072-3857

at which the optimal size of production and farm in the long term for the sprinkler is 60 donums.

long-run average cost curve

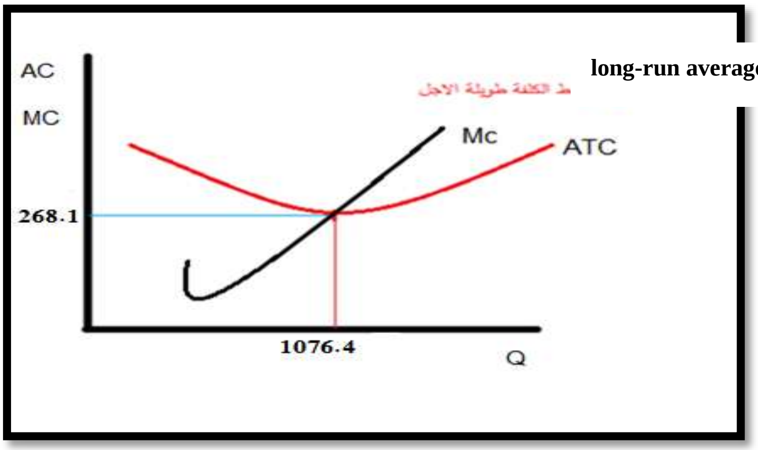

Figure (1) curve of the long-run average total cost.
Source: prepared by the researcher.

In order to obtain the area of the farm for the wheat crop, by substituting the value of the optimum production achieved (Q) in the equation for the area (A), then we will get the optimum to be cultivated by the farmers of the crop as follows:

A = 0.05079 (1076.09) = 54.655 acres

It is the optimal area for the farm to be exploited by the 60 dunums of irrigation farmers to obtain the ideal volume of production that lowers average costs in the long term and achieves the best net income in the long term.

Table (2) Areas and optimal and actual production quantities and efficiency of the wheat crop.

efficiency	Optimal level that lowers costs	actual production level	Paragraph
0.90	54.655	49.61	Area (dunums)
0.72	1076.09	770.142	output (tons)

Source: Calculated based on the questionnaire.

It appears from the results of the table () that the actually cultivated levels of area and production among the farmers of the research sample amounted to (49.61) dunums and (770.142) kg, respectively. By comparing these results with the optimal levels of production and area, we find that the actual output rates of the research sample amounted to (770.142 kg), which is less than the optimal production volume, which amounted to (1076.09 kg). The same applies to the area actually cultivated for the research sample, which amounted to (49.61 dunums), which is less than the optimal area of (54.655 dunums), while the crop efficiency in terms of area and production amounted to (0.90%, 0.81%), respectively. Optimum production of the wheat crop must increase the cultivated areas of the crop to take advantage of the economies of scale (Economics oF scale), (advantages of large production), which is the case in which the average costs decrease in the case of expanding the volume of production (Nicholson, Walter, 2011,83).

The profit-maximizing level of output in the long run

To achieve the producer's goal of maximizing profits, the marginal cost function is equated with the average price (MC = P), and this price represents the price at which farmers sold their production in the study area, which is about (850) thousand dinars / ton, as follows.

$$MC = 296.475 - 0.1055\,Q + 0.00007353\,Q^2 = 850$$

ISSN 2072-3857

$$0.00007353\,Q^2 - 0.1055\,Q - 190.192 = 0$$

By using the mathematical constitution law to solve the above equation the following is obtained

a= 0.00007353 , b= -0.1055 , c= -553.525

$$Q=\frac{-b\pm\sqrt{b^2}-4ac}{2a}$$

$$Q=\frac{-(-0.1055)\pm\sqrt{0.1055^2-4(0.00007353)*(-553.525)}}{2(-0.00007353)}$$

$$Q= = \frac{0.1055\pm\sqrt{0.0.016724177}}{0.000147}\ \frac{0.1055\pm0.146612}{0.000147}$$

As for:. Q = 1006.868 profit-maximizing output kg/dunum

:. Q = -427.921 It is neglected because the sign is negative

Cost flexibility

Cost elasticity (Ec) is calculated by dividing the long-run marginal costs by the long-run average costs according to the following formula:

$$EC=\frac{LRMC}{LRAC}$$

$$=\frac{296.475 - 0.1055\,Q + 0.00007353\,Q^2}{296.475 - 0.05275\,Q + 0.00002451\,Q^2}$$

After substituting the values of the levels of production in the above equation, it becomes clear that the values of cost elasticity are less than the correct one at the beginning. This means that production is subject to an increase in production yields, in the sense that we achieve a relative increase in production at a lower relative cost, and with an increase in the volume of production to the productive volume (1076.09) kg / dunum, the elasticity of costs at this size is equal to one whole (1), and this means that production is subject to constant yields, that is, we get a relative increase in production with the same increase in costs, but then the elasticity is greater than one, that is, if Production is subject to the law of diminishing returns, as the increase in production is accompanied by a greater increase in cost, and this indicates that the rate of increase in yield increases with the increase in the volume of production.

References

1. Judoo, Francis Oroha. Abdullah, Wathiq Abdul Qahar. Farhan, Muhammad Khaled. Madhi, Hussein Mahdi. Hadi, Muhammad Talib. Akkar, Muhammad Jassem. (2020). The role of the national program for multiplication of high-grade wheat seeds in improving the quality of seed production and raising the standard of living for farmers. Ministry Of Agriculture. The Republic of Iraq.

10. Anuj Kumar, Randhir Singh, Gyanendra Singh, R.K. Sharma, M.S. Saharan, R.S. Chhokar, B.S. Tyagi, Sendhil, R., Ramesh Chand and Indu Sharma, (2014), Wheat Cultivation in India Pocket Guide. ICAR - Directorate of Wheat Research Karnal-132 001, Haryana.

2. Nemat Allah, Ahmed Ramadan, Principles of Macroeconomics, University House Press, 2004.

3. Al saied, Sami. 2018. Principles of Economics. Faculty of Economics and Political Science. Cairo University .

4. Molokhia, Ahmed Fawzi, (2005), Microeconomics, Knowledge Grove Library, printing, publishing and distributing books, first edition. Egypt.

5. Kaseb, Sayed, and Ali, Mohamed Fahmy, (2009) Fundamentals of Administrative Economics, Deposit Number in the Egyptian Book House, First Edition. Cairo.

6. McConnel, D.J. , Dillon, J.L. (2009). Farm Management for Asia: A system approach, Rome, F.A.O.

7. Pindyck, Robert and Daniel, Rubifeld (2017) Micronomics, Ninth Edition, Pearsin Education, Inc, Upper Saddle Riverm New Jersey, 9781292213316, Prentice, Hall. Printed in United states of America.

8. Nicholson, Walter (2011). Microeconomic Theory- Basic principles and Extension.7/Ed. U.S.A

9. Krugman, Puan and Wells, Robin (2009), Economics Second (nd) Edition.