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AN ECONOMIC STUDY TO DETERMINE THE OPTIMAL RESOURCE COMBINATIONS FOR OLIVE GROWERS IN BASHIQA DISTRICT FOR THE 2021 PRODUCTION SEASON

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Abstract

The olive tree is one of the blessed trees known to man since ancient times, and one of the food security crops for many countries. Among them, the research aimed to determine the optimal resource combinations for olive growers in the Bashiqa district for the season 2021, where it is the most area in Iraq that cultivates olives. The production function was estimated as Cobb-type Douglas and in the long run. As the optimal amounts of profit-maximizing and cost-saving resources were reached and compared to the actual reality, as well as finding multiple combinations of resources at different levels of production through isoquant curves and measuring the distributional efficiency in the use of resources, through data collected by means of a questionnaire prepared for this purpose for a random sample of fruitful farms consisting of 58 farms, It constituted 10% of the study population, its area was one hectare or more. Among the most important findings of the research is that the production volume of the bulk of the profits amounted to 1624 kg / dunum, and profits amounted to (611107) dinars / dunum, compared to the actual production of 1505 kg / dunum, and profits amounted to (533757) dinars / dunum, While the profits when costs were reduced amounted to (577857) dinars / dunum, in the light of these results, the study recommends olive growers to use the optimal quantities of resources, whether maximizing profits or civic costs, in order to increase their profits.

Keywords: Cobb-Douglas function, profit maximization, cost minimization, resource combination, production.

Introduction:

The olive (Olea europea L.) is one of the evergreen and perennial subtropical fruits for hundreds of years and belongs to the olive family (Oleaceae) (Vossen, 2007, 1093). mediterranean basin,Also, the greatest credit goes to the Arabs who carried this tree in their Islamic conquests, east and west, to areas that it did not reach (Al-Witness, 2021, 197). Olive cultivation and olive oil production requires a healthy environment and a stable society because the tree remains productive for very long years (Malclom & Vera, 2014).),The olive tree grows in a wild environment in different regions of the world such as (Algeria, Morocco, India, Iraq, Syria, and the Canary Islands). Latitude (15-44) and includes 20-29 genera. The number of fruit trees in Iraq in the year 2021 is (1,329,882) trees, while the production volume reached approximately (34) thousand tons of fruits out of the total fruit trees, and the tree's production rate is about (26) kg, with an area of more than (26) thousand dunums (central statistical organization , 2021), and its cultivation is mostly spread in the northern region, especially in Nineveh and Dohuk, in addition to the existence

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of areas in the governorates of Baghdad, Anbar, Kirkuk, Salah al-Din, Diyala, and Babylon, As the cultivated area in Nineveh provainc amounted to nearly a third of the area planted in Iraq with olives, as it was estimated at about (7000) dunams in 2020, according to the statistics of the Nineveh Directorate of Agriculture, with a production level of (9695) tons, and the number of trees that reached approximately (400) thousand fruit trees.Among the most famous cultivated varieties are (Al-Ashrasi, Al-Bashiqi, Dakl, and Khastawi) and some other foreign varieties. Among them, the local variety (Al-Bashiqi) is characterized by its high oil content (12-15%) and good specifications in terms of fruit quality, weight, and size.

Research problem:

Despite the fact that this crop provides consumer needs in Nineveh Governorate, the quantities produced remain short of covering the market's need for it, as the problem is the lack of awareness among most farmers of adopting the cultivation of this important food, logistical and export crop.As well as the distance of those who grow it from using the optimal quantities of productive resources due to the high production costs as a result of the decrease or lack of support for production requirements, which leads to an increase in their prices, which is significantly reflected in the decrease in the net yield of a dunam.Which leads to the reluctance of some producers to continue producing this crop and shift to the cultivation of other crops that are less expensive and more profitable, or to move to other sources of income and move away from agriculture.

Research aims:

The research aimed to estimate the production function of the Cobb-Douglas type in the long run and equal output curves, and to know and determine the optimal resource combinations that maximize profits and civil costs, using what is employed by microeconomic theory and mathematical and econometric economics to reach the optimal volumes in the use of resources and compare them with the actual reality. As well as measuring the allocative efficiency of the available resources.

Research hypothesis:

The research relied on the hypothesis that the production of the olive crop in Iraq in general and in Nineveh Governorate in particular does not meet the needs of the market, as a result of the lack of optimal utilization and the best scientific allocation of the available economic resources, which negatively affects the productivity of dunums, which leads to poor adoption by farmers of cultivating this crop because they are unable to reach the size The profit-maximizing production that achieves a rewarding net income helps in increasing the cultivated area and increasing the adoption of the cultivation of this crop, and the research seeks to know the validity of this hypothesis or not.

Research method:

The research relied on two methods, the first is descriptive, based on the concepts of economic theory and the reference presentation of the studies that preceded this study.Through the multiple regression analysis model using the OLS method, the long-run Cobb Douglas production function was estimated in its double logarithmic linear form, and the volume of profit-maximizing and civil-

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production was determined, and the optimal resource combinations and the maximum profit were determined.

Reference view:

Given the importance of previous studies and research, we must shed light on some of these studies, research and results that could be reached. Mudhi and Al-Samarrai (2011) conducted a research on the optimal combinations for the production of citrus trees in Salah al-Din Governorate. The Cobb-Douglas function was used in estimating the production function to know the capacity returns and the flexibility of total production achieved from labor and capital, as well as analyzing the relationship between inputs and outputs by placing a constraint on both costs and production to reach the optimal combinations that achieve the best levels of production at the lowest possible cost through Using Lagrange's equation, The contribution ratio of labor and capital suppliers was calculated using the (Tyler expansion) equation approximated to the Cobb-Douglas function. Stillitano & et al (2016) In a study on evaluating the economic profitability of olive cultivation systems in the Mediterranean region in the Calabria region in the province of Catanzaro in southern Italy, the study aimed at how to use the optimal production factors in order to increase production and productivity .The study found high production costs, offset by low productivity due to the aging of some olive farms, offset by high productivity of other farms using new and innovative production systems. In the year (2017), both Hussein and a young man completed a research on the production determinants of the olive crop in Nineveh Governorate, Bashiqa district, as a model for the 2010 season.The research aimed to estimate the functions of production and costs and to know the size of the maximizing profits, as the Cobb-Douglas production function was estimated using the OLS method to represent the functional relationship between the dependent variable, the amount of production of the olive crop (kg/dunum) and between the factors of production, labor (day/worker) and capital (JD).) and determining the economic derivatives, for three categories according to the cultivated area, and determining the optimal profit-maximizing size for each category.In the year (2019), Al-Jarhi conducted an economic study of the production of the olive crop in South Sinai Governorate, and the study aimed to study the economics of producing the olive crop and the factors affecting its production and determining the optimal and maximum profit size. The study concluded that there is a significant direct relationship between the amount of production in tons and each of the human work And the amount of organic, nitrogen and phosphate fertilizers, and that 72% of the sample farmers achieved the maximum amount of profit and civil costs.Likewise, Kalthoum and others carried out a research this year (2019) entitled The Economics of Olive Production in the Salamiyah Region (Syria). And 3510.3 kg / dunum for irrigated olive and rain-fed, respectively, while the actual production reached 3454.4 and 3578.8 kg/dunum for irrigated and rain-fed olives, respectively, and by comparing these volumes with the average actual production, it was found to be much less than the profit-maximizing volume and relatively less than the optimal volume. In (2019) Barakat and others conducted a study on the optimal size of mango farms in Ismailia. The study aimed, in general, to estimate the polynomial production function at the level of the total sample through the use of a number of independent variables, which are human labor, organic fertilizer, phosphate fertilizer, potassium fertilizer, and herbicides. Dividing and analyzing its results, whether the production function, into three possession categories. The first category is less than 5 acres, the second is from 5 to less than 10 acres, and the third category is 10 acres or more. As for Mohamed et al. (2021), they conducted a research on the standard analysis of the production of mango and orange crops in Ismailia Governorate, Egypt. The research aimed to estimate the optimal and civil resource combinations of costs from the production inputs, which are the most statistically significant and significant, which are nitrogenous and organic fertilizers, through the derivation of the output curve Iso quant of the Cobb-Douglas function and the derivation of the expansion path function (the least cost combination line) through the equality of the technical substitution rate with the inverse of the ratio The price of the two production factors.Through the aforementioned presentation of the above studies, this research came as an extension of it by calculating the optimal quantities of resources, whether maximizing profits or civil costs, using the Cobb-Douglas type production function with three variables, and from which the optimal resource combinations are determined for maximizing profits and civil costs.

The Cobb-Douglas production function

It is one of the most important tools of economic analysis that have appeared so far, as it enabled economists to build models and derive other production functions, which led to significant progress in the field of economic analysis (Al-Ruwais, 2009, 167).The function assumes the stability of the productive elasticity of resources regardless of the amount of inputs used (Debertin, 2012, 175) and its general formula:

$$Y = A\, x_1^{b1}\, x_2^{b2}$$

Since Y: the quantity of production, A is the coefficient of the function or the technological variable, and each of (b_1, b_2) represents the productive flexibility of the resources X_1 and X_2 (labor and capital), and their values range between zero and one, and as a result, the returns (capacity returns) or yields are determined the size.The Cobb-Douglas function has several properties, including that it is homogeneous of degree ($b_1 + b_2$), where the degree of homogeneity and the determination of capacitance returns are determined by the sum of elasticities (total elasticity E), as $E = b_1 + b_2$ (Lodewijks & Monadjemi, 2016, 40). And the value of b_1 and b_2 ranges between zero and one (Debertin, 2012, 174- 175), and the production curves for both the labor and capital components shift when one of them increases and the other remains constant, as well as the ease of calculating their parameters by converting them into the logarithmic formula of the base (10) or the natural logarithm For the base (ex), since e = (2.71828), then take the following formula:

$$\text{Ln } Y = \text{Ln } A + b_1 \text{ Ln } X_1 + b_2 \text{ Ln } X_2$$

The Cobb-Douglas function can also take more than two inputs, like the following formula
Its double logarithmic form would be:

$$Y = A\, X_1^{b1}\, X_2^{b2}\, X_3^{b3}$$

$$\text{LnY} = \text{Ln } A + b_1\text{LnX}_1 + b_2\text{LnX}_2 + b_3\text{LnX}_3$$

Since: Y: the quantity of production, A: the technical factor (function proportional coefficient)

X_3, X_2, X_1: quantities of production elements (labor, capital, and a third resource such as area, field capacity, number of trees, etc.)
b_3 , b_2 , b_1 : input parameters (input elasticities, because the function is double logarithmic).
Description of the template used:

The data was analyzed and the results obtained were interpreted for a random sample of olive farms in Bashiqa district in Nineveh Governorate, which numbered (58) farms, with an area of (1) hectares or more, representing approximately 10% of the sample population, as the Cobb-Douglas type production function was estimated Using the usual least squares method (OLS) and using the statistical program (Eviews.10), and the double logarithmic formula was adopted because it is the best formula to represent the embodied model of the relationship between Y production, which was estimated on the basis of the donum yield for the production season 2021 as a dependent variable, and between production elements on the other hand as variables an influential explanatory variable on the dependent variable, namely:

• L work (man/day) per dunam, and represents the human labor component, consisting of family work and rented work, and it was estimated per dunam for the 2021 production season, such as carrying out all agricultural operations needed by olives, such as hoeing, weeding, pruning, fertilizing, spraying pesticides, watering, harvesting...etc.
• Capital K represents all capital costs that are converted into production such as (fertilizers, pesticides, electricity wages, fuel, oils, maintenance of equipment and pumps, wages for mechanical work, irrigation costs, etc.) during the agricultural season 2021 (dinars/dunums)
• Number of olive trees planted per dunam, N (tree/dunum).

The mathematical model was formulated to study the relationship between production and its elements above, as follows:

$Ln\ Y = Lnb_0 + b_1\ Ln\ L + b_2\ Ln\ K + b_3\ Ln\ N$

Since: Y production (kg), L: labor (man/day), K: capital (dinar/dunum), N: number of trees (tree/dunum)
bo : function constant (technical level)
b1, b2, b3 parameters of the variables (since the function is logarithmic, they represent the productive elasticities of the variables)

Table (1) Data analysis results for olive farms

Dependent Variable: LNY
Method: Least Squares
Date: 11/26/22 Time: 12:43
Sample: 1 58
Included observations: 58

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	2.702297	0.534781	5.053090	0.0000
LNL	0.240370	0.066708	3.603336	0.0007
LNK	0.267138	0.055332	4.827946	0.0000
LNN	0.222434	0.046140	4.820790	0.0000

R-squared	0.852011	Mean dependent var	7.311914
Adjusted R-squared	0.843789	S.D. dependent var	0.094237
S.E. of regression	0.037246	Akaike info criterion	-3.676090
Sum squared resid	0.074911	Schwarz criterion	-3.533991
Log likelihood	110.6066	Hannan-Quinn criter.	-3.620740
F-statistic	103.6306	Durbin-Watson stat	1.990101
Prob(F-statistic)	0.000000		

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Source: prepared by the researcher based on the data of the questionnaire using the Eviews.10 program

The equation below represents the estimated production function for farms, which was obtained from the results of Table (1) by using multiple linear regression and according to the method of ordinary least squares (OLS), as follows:

$$\text{Ln } Y = 2.702 + 0.24 \text{ L} + 0.267 \text{ K} + 0.222 \text{ N}$$

A- Statistical analysis: The results of the (t) test showed through Table (1) the significance of the estimated parameters of the economic variables included in the model under the level of significance of 0.01, and the coefficient of determination (R2 = 0.852) explains that 85.2% of the changes that occur in the dependent variable (production) is due to the (independent) explanatory variables which are (N, K, L) and that (14.8%)Attributable to other variables that were not included in the model, and finally, the F test, which had a value of 103.6, indicating the significance of the function as a whole when compared to its tabular value at a significant level of 0.01.

B- Standard analysis: The value of the D.W test of (1.99) showed that there was no autocorrelation problem between random variables (random error) at a significant level of 0.05, as the tabular du values were 1.68 for three explanatory variables and 85 observations. Therefore, the calculated D.W value will fall in the acceptance region of the absence of a problem (du < D.W < du-4, that is, 1.68 < 1.99 < 2.32. Park analysis also proved the absence of the problem of heteroscedasticity, which often appears with cross-sectional data (Cross-Section data) (Attia, 2000, 439), and to test this problem, the Park test is used to detect it (Gujarati, 2004, 411). Using the statistical program Eviews.10, the natural logarithm of the explanatory variables was tested separately with the natural logarithm of the square of the residuals. (Lnei2) as a dependent variable and as follows:

Table (2) Park's test for the problem of variance instability

test F	coefficient of determination R^2	Square test Select error with explanatory variables	variants
1.126	0.019	$Lnei^2 = 3.012 - 3.789 \text{ Ln L}$ t (0.285) (-1.06)	The number of workers is LnL
1.49	0.026	$Lnei^2 = 29.32 - 3.25 \text{ Ln K}$ t (0.95) (-1.22)	LnK capital
1.78	0.03	$Lnei^2 = 2.5 - 2.71 \text{ Ln N}$ t (0.311) (-1.33)	Number of trees LnN

Source: Prepared by the researcher based on the sample data and the results and outputs of the Eviews.10 program

Table (2) above shows the non-significance of the parameters of the explanatory variables through the t-test under the level of significance of 0.05, as it was found that their calculated values are less than the tabular ones.The F test also showed the non-significance of the functions estimated above, as the calculated value of F is less than the tabular one, which indicates that the test does not have a problem of heterogeneity of variance.With regard to the multicollinearity problem, Klien's test is used (Maddala, 1988, 45), by comparing the square root of the coefficient of determination of (0.923) with the values of the simple correlation coefficient between the explanatory variables in the simple correlation matrix in a table (3) It turns out that this problem does not exist.

Table (3) Simple Correlation Matrix

Correlation			
A	B	C	D
	LNK	LNL	LNN
LNK	1.000000	0.570754	0.734277
LNL	0.570754	1.000000	0.657562
LNN	0.734277	0.657562	1.000000

Source: Prepared by the researcher based on the sample data and the results and outputs of the Eviews.10 program

- Economic analysis of the production function:

Ln Y = 2.702 + 0.24 L + 0.267 K + 0.222 N   logarithmic formula

$Y = 14.91\, L^{0.24}\, K^{0.267}\, N^{0.222}$ Exponential form

The results of the statistical estimation of the parameters of the olive production function indicate the direct relationship between the explanatory variables (labor L, capital K, number of trees N) and the dependent variable Y, and this is consistent with the logic of economic theory. The possibility of increasing the amount of output by the parameter of each of (L, K, N) if their use increased by 1%, and since the values of the flexibility of the variables are between zero and one, this means that the resources work in the second stage of the yield stages, and from the production function it is clear that the sum of the production elasticities For (L, K, N) it amounted to (0.729), which is less than the correct one, which means that the olive production function reflects a state of decreasing capacity returns, which indicates that production is increasing in a decreasing manner. As for the percentage of the contribution of each resource in production, it is extracted by dividing the resource's flexibility On the total elasticities of production multiplied by 100, as it was found that the resource of capital was in the first place, followed by the number of workers and then the number of trees, with percentages amounting to (36.6%, 32.9%, 30.5%), respectively. The optimal combination of resources that achieve the volume of production that maximizes profits

To reach the optimal resource combination of productive elements (labor, capital, and number of trees) that achieve the profit-maximizing production volume, this is done through the estimated production function and the cost constraint to obtain the aim function (the normal profit function π) (Zanzel and Muhammad, 2020: 16- 18) and as follows:

Ln Y = 2.702 + 0.24 L + 0.267 K + 0.222 N

$Y = 14.91\, L^{0.24}\, K^{0.267}\, N^{0.222} - - - - 1$

$\pi = P_y\,.(AL^{b1}K^{b2}N^{b3}) - \lambda(wL + rK + aN - \bar{C})$ aim equation for profit

$\pi = 650(15.33L^{0.24}K^{0.267}N^{0.222}) - \lambda(11000L + 1.08K + 2500N - 444493)$

Since: π: the normal profit function, Py: the price of output (the average price of olives is 650 dinars / kg).
A: technical factor, L, K, N: production factors (labor, capital, and number of trees)
w: labor wage (as the average wage for workers in olive farms is 11,000 dinars per man/day)
r: interest rate for capital (the average interest rate is 0.08, so the return on one dinar is 1.08)
a: the price of the tree (the average price of olive seedlings, mangroves, vines, etc. is 2500 dinars, or the opportunity cost and the cost of caring for the planted trees), b3, b2, b1: function parameters (partial elasticities of production factors)
$\bar{C}$: the actual cost (the average cost of a dunam is 444,493 dinars), λ: the Landa (the Lakrangian multiple)
By applying the profit maximization condition from the profit function (VMPx = Px), it is necessary to derive the profit function for the factors of production and the lands (L, K, N, λ) as follows:

$$\frac{\partial \pi}{\partial L} = (650(14.91)(0.24)L^{0.24-1}K^{0.267}N^{0.222}) - 11000\,\lambda = 0$$

$$= (2325.96\,L^{-0.76}K^{0.267}N^{0.222}) = 11000\,\lambda ----\mathbf{2}$$

$$\frac{\partial \pi}{\partial K} = (650(14.91)(0.267)L^{0.24}K^{0.267-1}N^{0.222}) - 1.08\,\lambda = 0$$

$$= (2587.63\,L^{0.24}K^{-0.733}N^{0.222}) = 1.08\,\lambda ------\mathbf{3}$$

$$\frac{\partial \pi}{\partial N} = (650(14.91)(0.222)L^{0.24}K^{0.267}N^{0.222-1}) - 2500\,\lambda = 0$$

$$= (2151.51\,L^{0.24}K^{0.267}N^{-0.778}) = 2500\,\lambda ------\mathbf{4}$$

$$\frac{\partial \pi}{\partial \lambda} = (11000\,L + 1.08\,K + 2500\,N - 444493) = 0 ---\mathbf{5}$$

Dividing Equation 2 by Equation 3, we get the expansion path equation between L and K

$$= \frac{(2325.96\,L^{-0.76}K^{0.267}N^{0.222})}{(2587.63\,L^{0.24}K^{-0.733}N^{0.222})} = \frac{11000\,\lambda}{1.08\,\lambda}$$

$$= \frac{(2325.96K)}{(2587.63L)} = \frac{11000\,\lambda}{1.08\,\lambda} \Rightarrow 2512.037\,K = 28463930\,L \quad \textit{expansion path equation}$$

L = 0.000088253 K ------------- 6

Dividing Equation 3 by Equation 4, we get the expansion path equation between N and K

$$= \frac{(2587.63\,L^{0.24}K^{-0.733}N^{0.222})}{(2151.51\,L^{0.24}K^{0.267}N^{-0.778})} = \frac{1.08\,\lambda}{2500\,\lambda}$$

$$= \frac{(2587.63\,N)}{(2151.51\,K)} = \frac{1.08\,\lambda}{2500\,\lambda} \Rightarrow 6469075N = 2323.631K \quad \textit{expansion path equation}$$

N = 0.00035919 K ------------- 7

Substituting Equation 6 and Equation 7 into Equation 5, we obtain the optimal amount of capital:

11000 (0.000088253 K) + 1.08 K + 2500 (0.00035919 K) – 444493 = 0

0.97078 K + 1.08 K + 0.89797 K = 444493 ⇒ 2.94875 K = 444493

)optimal capital maximizing profits) $K = \frac{444493}{2.94875} = 150739 \text{ Dinar}$

We substitute the value of the optimal capital (150739) into Equation 6 to find the optimal amount of work and into Equation 7 to find the optimal number of trees:

L = 0.000088253 (150,739) = 13.3 man-day (optimum profit-maximizing number of workers(

N = 0.00035919 (150,739) = 54.14 trees/dunum (profit-maximizing number of trees(

We substitute the optimal amounts of resources obtained into the estimated production function 1 to obtain the optimal amount of profit-maximizing production, as follows:

$Y = 14.91 (13.3)^{0.24} (150739)^{0.267} (54.14)^{0.222}$

Y = 14.91 (1.8609) (24.1316) (2.4257) = 1624 Kg / dunam (production volume of profits)

The optimal civil resource combination for costs:

Profits can be maximized by minimizing costs as little as possible. If the production is given (restricted) $\bar{Y}$ and the prices of the inputs are given, then costs are minimized through the contact of the lower costs line than the costs lines far from the origin point of the given isoquant curve (Hussein, 2005). , 10) In order to reach the optimal combination of productive resources (labor, capital and number of trees) that achieve the lowest possible cost, this is done by restricting production to obtain the aim function, as follows:

$C = 11000 L + 1.08 K + 2500 N$, $Y = 14.91 L^{0.24} K^{0.267} N^{0.222}$

And since the actual production volume $\bar{Y}$ was on average 1505 kg / dunam, then we will form the objective function ϕ by placing the constraint on the production function through the use of the Lacarangian multiplier θ as follows:

ϕ = (w L + r K + a N) + θ ($\bar{Y}$-14.91 L^0.24 K^0.267 N^0.222) aim equation

ϕ = (11000 L + 1.08 K + 2500 N) + θ (1505 – 14.91 L0.24 K0.267 N0.222)--- (1)

From objective function (1) we take the first partial derivative of L, K, N, and θ

$$\frac{\partial \phi}{\partial L} = 11000 - \theta\, 14.91\, (0.24) L^{0.24-1} K^{0.267} N^{0.222} = 0$$

$$11000 = \theta\, 3.5784\, L^{-0.76} K^{0.267} N^{0.222} - - - - - (2)$$

$$\frac{\partial \phi}{\partial K} = 1.08 - \theta\, 14.91\, (0.267) L^{0.24} K^{0.267-1} N^{0.222} = 0$$

$$1.08 = \theta\, 3.98097\, L^{0.24} K^{-0.733} N^{0.222} - - - - - (3)$$

$$\frac{\partial \phi}{\partial N} = 2500 - \theta\, 14.91\, (0.222) L^{0.24} K^{0.267} N^{0.222-1} = 0$$

$$2500 = \theta\, 3.31\, L^{0.24} K^{0.267} N^{-0.778} - - - - - - (4)$$

$$\frac{\partial \phi}{\partial \theta} = 1505 - 14.91\, L^{0.24} K^{0.267} N^{0.222} = 0 - - - - - (5)$$

From objective function (1) we take the first partial derivative of L, K, N, and θ

$$\frac{\partial\phi}{\partial L} = 11000 - \theta\, 14.91\,(0.24) L^{0.24-1} K^{0.267} N^{0.222} = 0$$

$$11000 = \theta\, 3.5784\, L^{-0.76} K^{0.267} N^{0.222} ------(2)$$

$$\frac{\partial\phi}{\partial K} = 1.08 - \theta\, 14.91\,(0.267) L^{0.24} K^{0.267-1} N^{0.222} = 0$$

$$1.08 = \theta\, 3.98097\, L^{0.24} K^{-0.733} N^{0.222} ------(3)$$

$$\frac{\partial\phi}{\partial N} = 2500 - \theta\, 14.91\,(0.222) L^{0.24} K^{0.267} N^{0.222-1} = 0$$

$$2500 = \theta\, 3.31\, L^{0.24} K^{0.267} N^{-0.778} ------(4)$$

$$\frac{\partial\phi}{\partial\theta} = 1505 - 14.91\, L^{0.24} K^{0.267} N^{0.222} = 0 ------(5)$$

We divide Equation 2 by Equation 3 to find the expansion path between L and K

$$\frac{11000}{1.08} = \frac{\theta\, 3.5784\, L^{-0.76} K^{0.267} N^{0.222}}{\theta\, 3.98097\, L^{0.24} K^{-0.733} N^{0.222}}$$

$$\frac{11000}{1.08} = \frac{3.5784\, K}{3.98097\, L} \Rightarrow 43790.7\, L = 3.86467\, K \text{ Expansion Path Equation}$$

$$L = 0.000088253\, K ------(6)$$

We divide Equation 3 by Equation 4 to find the expansion path between K and N

$$\frac{1.08}{2500} = \frac{\theta\, 3.98097\, L^{0.24} K^{-0.733} N^{0.222}}{\theta\, 3.31\, L^{0.24} K^{0.267} N^{-0.778}}$$

$$\frac{1.08}{2500} = \frac{3.98097\, N}{3.31\, K} \Rightarrow 3.5748\, K = 9952.425\, N \text{ Expansion Path Equation}$$

$$N = 0.00035919\, K ------(7)$$

We substitute equations 6 and 7 into the constraint function (the derivative of θ) to find the optimal K for civil costs $1505 - 14.91\,(0.000088253\, K)^{0.24} (1.08)^{0.267} (0.00035919\, K)^{0.222} = 0$

$$1505 = 14.91\,(0.106408) K^{0.24} K^{0.267} (0.1719) K^{0.222}$$

$$1505 = 0.272727\, K^{0.729} \Rightarrow K^{0.729} = \frac{1505}{0.272727}$$

We substitute equations 6 and 7 into the constraint function (the derivative of θ) to find the optimal K for civil costs

$$N = 0.00035919\, K ------(7)$$

We substitute equations 6 and 7 into the constraint function (the derivative of θ) to find the optimal K for civil costs $1505 - 14.91\,(0.000088253\, K)^{0.24} (1.08)^{0.267} (0.00035919\, K)^{0.222} = 0$

$$1505 = 14.91\,(0.106408) K^{0.24} K^{0.267} (0.1719) K^{0.222}$$

$$1505 = 0.272727\, K^{0.729} \Rightarrow K^{0.729} = \frac{1505}{0.272727}$$

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K = (5518.34)^1.3717 = 135718 dinars (capital value of civil costs)

We substitute the civil capital value for the costs in Equation 6 to find the number of civil workers for the costs and in Equation 7 to find the number of civil trees for the costs, as follows:

L = 0.000088253 (135,718) = 12 man/day number of civilian workers for costs))
N = 0.00035919 (135,718) = 48.75 trees/dunum (Number of urban trees for costs)
We substitute the civil quantities for the costs in the restricted production function, we get the restricted actual production volume, and in the cost function we get the lowest possible costs most of the profits at the restricted production volume, as follows:
Y=14.91 (12)^0.24 (135718)^0.267 (48.75)^0.222
Y=14.91 (1.8155) (23.4646) (2.37)=1505 dunums/kg
C=11000 (12)+1.08 (135718)+2500 (48.75)
C=132000+146575+121875=400450 dinars (lower cost possible)

The isoquant curve.

It is an engineering locus for different combinations of the two production elements used in the production process that gives the same level of production assuming the stabilization of other production elements (Debertin, 2012, 86). We can derive the isoquant equation for the olive production function estimated by taking three or four levels of production as follows:
• We find the equal output curve between L and K by fixing N at its arithmetic mean and changing K, at different levels of production (1400, 1500, 1600, 1700) and at optimal quantities as well, so at a production volume of 1400, for example, and a capital of 90,000,

And fixing the number of trees at its arithmetic mean is 53, we will get a quantity of work of 13 men / day. Thus, if we repeat the process at different levels of capital and different levels of production, we will get corresponding labor quantities, as in Table (4) and Figure (1), and thus we can draw Curves of indifference between the elements of labor and capital with the constant number of trees or any other resource, as follows:

•

$$Y = 14.91\, L^{0.24}\, K^{0.267}\, N^{0.222}$$

$$L^{0.24} = \frac{Y}{14.91\, K^{0.267}\, N^{0.222}} \Rightarrow L = \left(\frac{1400}{14.91\, K^{0.267}\, N^{0.222}}\right)^{4.1666}$$

$$L = \left(\frac{1400}{14.91\,(90000)^{0.267}\,(53)^{0.222}}\right)^{4.1666} \Rightarrow L = \left(\frac{1400}{14.91\,(21.027)(2.4143)}\right)^{4.25532}$$

$$\text{man/day}\quad L = \left(\frac{1400}{756.913}\right)^{4.1666} \Rightarrow L = 12.966$$

And when using the optimal combination of capital suppliers, number of trees, and profit-maximizing production, we will get the optimal size of profit-maximizing work, as follows:

$$L = \left(\frac{1624}{14.91\,(150739)^{0.267}\,(54.14)^{0.222}}\right)^{4.1666} \Rightarrow L = \left(\frac{1624}{14.91\,(24.1316)(2.4257)}\right)^{4.1666}$$

)The optimal number of jobs(man/day $L = (\frac{1624}{872.772})^{4.1666} \Rightarrow L = 13.3$

As for when using the optimal combination of capital resources, the number of trees, and civil production costs, we will get the optimal size of civil work for costs, as follows:

$$L = (\frac{1505}{14.91\ (135718)^{0.267}\ (48.75)^{0.222}})^{4.1666} \Rightarrow L = (\frac{1505}{829.14})^{4.1666} \Rightarrow L = 12$$

Table (4) The isoquant curve between K and L by fixing N at its average for a number of production levels

1700	**1600**	**1500**	**1400**	**Production levels (kg/dunum)**	
L work (man/day)				**Number of trees N**	**Capital K (IQD)**
29.12	22.62	17.28	12.97	53	90000
25.90	20.12	15.37	11.53	53	100000
23.29	18.09	13.83	10.37	53	110000
21.14	16.42	12.55	9.41	53	120000
19.34	15.02	11.48	8.61	53	130000
17.81	13.83	10.57	7.93	53	140000
16.49	12.81	9.79	7.35	53	150000
15.35	11.92	9.11	6.84	53	160000

Source: prepared by the researcher based on the results of the production function and the questionnaire.

Thus, if we repeat the mathematical operations above regarding the relationship between N and K with a constant of L at its arithmetic mean (18) man, we will get the results of Table (5), and if we repeat the mathematical operations regarding the relationship between L and N and fix K at its arithmetic mean (105546) dinars, we will get Table results (6)

Table (5) The isoquant curve between N and K by fixing L at its average for a number of production levels

1700	**1600**	**1500**	**1400**	**Production levels (kg/dunum)**	
Capital K (IQ D(				**L work (man/day)**	**Number of trees N**
175227	139634	109652	84683	18	40
158881	126608	99423	76783	18	45
145554	115989	91083	70343	18	50
134465	107152	84144	64983	18	55
125081	99674	78272	60448	18	60

117027	93256	73232	56556	18	65
110034	87683	68856	53176	18	70

Source: prepared by the researcher based on the results of the production function and the questionnaire.

Table (6) The isoquant curve between L and N by fixing K at its average for a number of production levels

1700	**1600**	**1500**	**1400**	**Production levels (kg/dunum)**	
Capital K (IQ D(				**L work (man/day)**	**Number of trees N**
175227	139634	109652	84683	18	40
158881	126608	99423	76783	18	45
145554	115989	91083	70343	18	50
134465	107152	84144	64983	18	55
125081	99674	78272	60448	18	60
117027	93256	73232	56556	18	65
110034	87683	68856	53176	18	70

Source: prepared by the researcher based on the results of the production function and the questionnaire.

Table (6) The isoquant curve between L and N by fixing K at its average for a number of production levels

1700	**1600**	**1500**	**1400**	**Production levels (kg/dunum)**	
Number of trees, N (tree/dunum)				**Capital K (IQD)**	**L work (man/day)**
138.9	105.7	79.1	57.9	105546	10
104.6	79.6	59.5	43.6	105546	13
83.6	63.6	47.6	34.9	105546	16
69.4	52.8	39.5	29.0	105546	19
59.2	45.1	33.7	24.7	105546	22
51.6	39.3	29.4	21.5	105546	25

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Source: prepared by the researcher based on the results of the production function and the questionnaire.

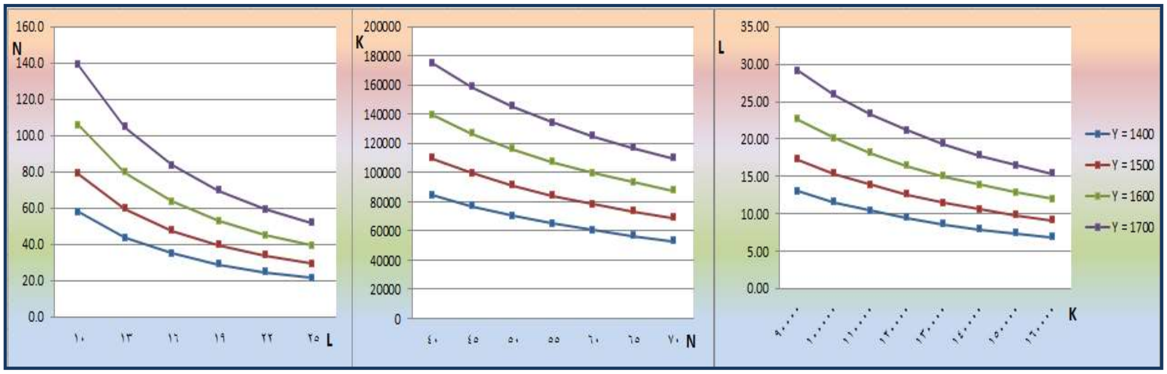

Figure (1) Equal output curves between production elements for different levels of production

Source: Prepared by the researcher based on the data of tables (4), (5) and (6).

The net profit of optimal supplier combinations maximizing profits and minimizing costs

• We can calculate the profits achieved at the profit-maximizing production volume using the profit function by substituting the profit-maximizing resource amounts into the aggregate cost function as follows:

Y = 14.91 L0.24 K0.267 N0.222 , PY = 650 JD/kg , TC = 11000 * 13.3 + 1.08 * 150739 + 2500 * 54.14 , π = TR – TC , TR = PY * Y, Y = 1624 kg /dunum

π = 650 (1624) – (11000 * 13.3 + 1.08 * 150739 + 2500 * 54.14) ∴

π = 1055600 – 444448 = 611152 dinars (the greatest profit)

As for the profits achieved through cost reduction, we will obtain them by substituting the amounts of civil resources for the costs in the aggregate cost function, as follows:

Y = 14.91 L0.24 K0.267 N0.222 , TC = 11000 * 12 + 1.08 * 135718 + 2500 * 48.57

Table (7) The optimal resource combinations that maximize profits and reduce costs

Net revenue (profit) dinars / dunam	Total costs dinars / dunum	Total Revenue (Dinar/dunum)	The price of the product is dinars / kg	The number of trees is a tree/dunum	Capital (IQD)	The number of workers per day	Production volume kg / Dunum	
533757	444493	978250	650	53	105546	18	1505	actual sample
611107	444493	1055600	650	54.14	150739	13.3	1624	At the volume of production

								most of the profits
577800	400393	978250	650	48.75	135718	12	1505	Minimizing costs

Source: The table prepared by the researcher based on the profit functions estimated for olive growers

It is clear from table (7) that the optimal combination of resources at the volume of production that maximizes profits amounted to (13.3) working days and (150739) dinars of capital and (54) trees per dunam giving a production volume of (1624) kg, and a net profit of (611107) dinars/dunum, while the amounts of civil resources for costs were (12) working days, (135718) dinars of capital, (48.57) trees/dunum, and a net profit of (577857) dinars/dunum. From the foregoing, it is clear that the profit achieved when the volume of production maximizes profits or the profit achieved from minimizing costs is higher than the actual profits, as this requires a reduction in the use of the labor component with an increase in the use of capital and the number of trees because of its importance in increasing the amount of production. In reducing costs, it is necessary to reduce the number of workers as well as the number of trees with an increase in capital, and thus reach maximizing the profits of farmers.

Allocative efficiency of resources:

The closer the distributive efficiency of the resource is to the correct unit, that is, the marginal product is equal to the marginal cost of the resource, and thus the efficient use of the resource is reached. But if it is greater than one, this means that the marginal product is greater than the marginal cost of the resource, but if it is less than one, then the case is reversed, which means the distributive inefficiency of the resource (Debertin, 2012, 57-58). Efficiency is calculated for each resource as follows:

1- Calculate the value of the marginal product for the labor resource L by entering the average number of workers in the marginal product equation for the number of workers and multiplying it by the product price of 650 dinars / kg to obtain the value of the marginal product for the worker

MPL = 189.555 L-0.76 ⇒ MPL = 189.555 (18)-0.76 = 21.07

VMPL = MPL * Py ⇒ VMPL = 21.07 * 650 = 13695 JD (the value of the marginal product of labour)

2- Calculating the value of the marginal product of the capital resource K by substituting the value of the average sample capital into the marginal product equation of capital, multiplying it by the price of the product and obtaining the value of the marginal product of capital

MPK = 19.2224 K-0.733 ⇒ MPK = 19.2224 (105546)-0.733 = 0.00399

VMPK = MPK * Py ⇒ VMPK = 0.00399 * 650 = 2.59 JOD

3- Calculate the value of the marginal product of the tree N by substituting the average number of trees into the marginal product equation for the number of trees, and multiplying it by the product price to get the value of the tree's marginal product

MPN = 145.251 N-0.778 ⇒ MPN = 145.251 (53)-0.778 = 6.6

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VMPN = MPN * Py ⇒ VMPN = 6.6 * 650 = 4290 JD (the value of the marginal product of the tree)

Calculating the distributional efficiency of resources according to Table (8)

Table (8) Distributive efficiency in the use of resources

AE	MFC) Dinar(	VMP (Dinar)	resource
1.24	11000	13695	L workers
2.39	1.08	2.59	K capital
1.71	2500	4290	N number of trees

Source: prepared by the researcher based on the estimated production function.

Table (8) shows that the labor resource is close to achieving efficiency due to its proximity to the correct unit. As for the resource of capital and the number of trees, the value of their marginal product was high, which led to a high distributional efficiency and its distance from the correct unit, which means the possibility of increasing the use of these resources, especially head Money, which leads to increased production and profits.

Conclusions and recommendations:

Through the results of the research, we conclude, through the production function of the Cobb-Douglas type, and extract the optimal quantities of labor, capital, and number of trees, whether in the case of restricting costs or production in order to maximize profits, the possibility of reducing the number of workers and the number of trees per unit area with an increase in the use of capital for what It has an important role in increasing the level of production and reducing costs and thus maximizing the profits of farmers, and the possibility of obtaining different resource combinations from the equation of equal output curves at different levels of production, as well as reaching the optimal sizes of resources that maximize profits and civil costs.The distributive efficiency of the use of labor resource, capital and the number of trees in olive production indicates the possibility of reducing the number of workers due to waste in use, with the possibility of increasing the use of capital in place of wasted labor because of its importance in increasing productivity compared to the labor resource, with the close number of trees. of the number achieved for distributional efficiency. Accordingly, the research recommends the need to increase the use of capital, such as fertilizers, pesticides, machinery, and machinery, within the optimal quantities recommended by specialists, and in return, reduce the use of human labor, and this in turn leads to a reduction in costs in general, and thus an increase in farmers' profits by increasing their production or reducing their costs, which achieves price efficiency for this. Resource and it turns out that there is a deficit in the use of this resource. As well as assisting farmers in all possible ways to reach them to achieve the optimal quantities of resources achieved to maximize their profits and achieve distributional efficiency in the use of resources and exploit the element of space available to them in maximizing their profits.

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