Economic Analysis of Okra (Hibiscus Esculentus L.)
Production functions In Nineveh governorate for Year 2019

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Abstract
Vegetable production farms in general and okra growers in particular suffer from low production rates and productivity, which does not reflect the optimization in the use of available resources, and perhaps one of the most important reasons is the lack of use of scientific methods, as the farmers’ lack of technical and economic knowledge of the factors affects the production of okra crop. The research aims to estimate the production functions through which it is possible to analyze the production relations and the possibility of substitution between the various production elements, measure their substitution flexibility and find economic derivatives for them. Cross-sectional data were used according to a random sample that included 100 farms from Nineveh Governorate. The results of the estimation of the unrestricted production function showed that the function parameters are consistent with the logic of economic theory and statistical and standard tests. It was found that through the size of the function parameters, capital has a great importance in producing the crop compared to the labor element, since an increase of capital by 10% would lead increase production by 8.8%, due to the nature of vegetable crops production that needs increasing the capital, and it has been found that farmers produce in the rational economic stage. The substitution elasticity of the unrestricted production function was about 1.04, meaning that farmers produce according to the increasing returns to scale. We infer from the study that the economic resources used in the production process are optimally utilized, which led to higher production efficiency. The study recommends working to follow a production policy aimed at increasing economic efficiency and achieving the optimal use of the available resource combination, which is reflected in the increase in efficiency in the use of productive resources and improvement of efficiency.

Key word: Method Robust Least Squares, Cob-Douglas, Unrestricted Production Function.

1. Introduction
The okra (Hibiscus esculentus L.) belongs to the Malvaceae family, whose plants are spread in tropical and temperate regions, some of which are grown for fibers such as cotton, and others are grown for ornamental purposes. Among the vegetables in this family are okra and mallow. The ancient world is considered the original home of okra and it does not exist in nature in a wild form, and it was cultivated in Africa for the first time 4 thousand years ago as it was cultivated in ancient Egypt, and the Arabs transferred its cultivation to Europe in the thirteenth century AD and it is currently grown in many tropical and sub-tropical countries, and that is because of its fruits [1]. It is also grown for its fibers in India, the United States of America and some countries in Africa. Okra is a type of plant that belongs to the hibiscus plant family and is cultivated in order to finally obtain its green pods, which are cooked directly after harvesting or after a few periods of the harvest process. As for crops that are exported or transported over long distances, they can be preserved by freezing and canning [2]. About the benefits of okra plant for humans, we will find that it is many, as it contains a mucous substance that helps digestion and get rid of constipation, as it contains many vitamins, mineral salts and many nutritional values. From the above, we conclude that okra is one of the most important crops, and we must develop it, care for it, and even grow it in larger quantities. In the following, we will explain to those interested how to grow okra, from identifying the varieties suitable for cultivation until harvesting, and we will explain how to profit from the okra cultivation project. It is considered a warm weather crop, as it needs a certain temperature in order to give a good crop, so seed germination improves at a temperature between 21 -35 degrees Celsius, knowing that the germination process cannot be done at a temperature less than 15 degrees Celsius and more than 40 degrees Celsius where the speed of seed germination can be increased by soaking the seeds in water for a period of at least 8 hours and then grinding for 24 hours in a warm place, and it is necessary that the amount of soaking and bittersing the seeds does not exceed the mentioned period so as not to expose the seeds to damage and breakage. Plants when grown at a temperature between 25-35 ° C, so increasing the temperature leads to fruit spoilage, while lowering them leads to the
formation of irregular pods. Okra is an important summer vegetable crop in Iraq and many other countries, and it belongs to the marshmallow family. It grows in tropical and subtropical regions, and it is native to Africa [3]. It is characterized by the fact that its fruits are highly desirable to the Iraqi consumer. They are grown for their green pods, which are used either cooked, canned, frozen or dried [4]. Okra is a good source of some nutrients such as carbohydrates and proteins, and mineral elements such as calcium and phosphorous, and it also contains a proportion of vitamin Riboflavin, thiamin, vitamin C [5]. Okra cultivation occupies a large area in the production and marketing map in Iraq, so we find that its cultivation is spread in all the various governorates of Iraq. The total area planted in Iraq in 2010 reached about 78 thousand dunums, and the average yield per acre is about 1.9 tons, with a total production of 151219 tons [6]. The research aims to estimate the production functions through which it is possible to analyze the production relations and the substitution potential between the various production elements, measure their substitution flexibility and find economic derivatives for them. As vegetable production farms in general and okra growers in particular suffer from low rates of production and productivity, which does not reflect the optimization in the use of available resources, and perhaps one of the most important reasons is the non-use of scientific methods, which leads to an increase in costs and consequently reduced profits and expected returns from vegetable crops. Also, imported agricultural products affected the producers of vegetable crops, which led to the reluctance of some of them to cultivate some types of vegetable crops. Despite the economic importance of vegetable crops and the increasing demand for them, okra crop faces many problems, including the lack of accurate information on the factors affecting profit and how to determine the amount of production that farmers can produce that achieves the lowest possible cost, which requires further studies. Related to these problems, and the province of Nineveh was chosen as an application model for this study. The research assumes that the weakness of the technical level in the production function of okra crop is one of the most important factors that reduce the efficiency of performance of the farmers of this crop. It also assumes that there will be more appropriate production functions for analyzing and explaining the crop production that do not refer to the Cobb-Douglas production function. The importance of the research is that it is the first economic study concerned with studying the factors affecting the production functions of okra at the level of Nineveh Governorate. Informatics through which farmers can determine the quantity of production that they can produce that leads to lower production costs in the short term according to the market changes.

2. Materials and methods

The research adopts the quantitative method by conducting econometric analysis of the Cobb-Douglas production function, and the constrained Cobb-Douglas production function. The method will be relied on OLS using Eviews to estimate the functions, while the data were obtained from okra farmers, which were randomly collected from 100 farmers from the crop farmers in Nineveh Governorate for the year 2019.

3. Results and discussion:

One of the most important step that econometrics takes when studying any relationship between several variables is to formulate this relationship mathematically to obtain the best model that explains economic phenomena in an application, according to which it is evident that okra production is affected by a set of determinants and in this study the production has been linked from the volume of work and capital in the following form:

- The dependent variable: represents the quantity of okra production (kg.)
- The first independent variable (work): represents the total hours of family and rented work for the 2019 season.
- The second independent variable (capital): represents the total capital expenditures that are converted to output from the okra crop.

First: the Cobb-Douglas production function.

It is considered one of the most famous production functions in the agricultural sector. It is widely used to explain the relationship between inputs and outputs due to its ease. It is one of the most important tools of economic analysis that has appeared so far, as it is the tool that enabled economists to build models and discover other functions to address the problems that countries suffered from [7]. The standard application of this function is also very important because it helps in estimating economic and statistical indicators that help in drawing the necessary plans, it is a discretionary relationship that contributes to solving the problem of choosing between the appropriate technological combination [8]. The general formula of the okra production function can be described as follows[9,10]:

\[ Y = AL^{B_1}K^{B_2}e^{ui} \]

As:
- \( Y \): quantity of output (kg.)
- \( L \): work (hours)
- \( K \): Capital (Dinars)
- \( A \): The function constant.
- \( B_i \): the function parameters.
The above relationship between output and production factors, labor and capital, was estimated for the double logarithmic formula, using the least squares method, and with the help of the statistical program Avios, and the results were as fashionable in Table 1.

### Table 1. Okra crop production function.

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|----------|-------------|------------|-------------|-------|
| C        | -4.616392   | 0.405287   | -11.39043   | 0.0000|
| LNK      | 0.768556    | 0.056854   | 13.51814    | 0.0000|
| LNL      | 0.271270    | 0.072328   | 3.750570    | 0.003 |
| R-squared| 0.940185    |            |             | 8.24506|
| Adjusted R-squared| 0.938952 | S.D. dependent var | 0.600564 |
| S.E. of regression | 0.148387 | Akaike info criterion | -0.948441 |
| Sum squared resid | 2.135824 | Schwarz criterion | -0.870285 |
| Log likelihood | 50.42203 | Hannan-Quinn criter. | -0.916810 |
| F-statistic | 762.3313 | Durbin-Watson stat | 1.754543 |
| Prob(F-statistic) | 0.000000 |            |             |       |

Resource: prepared by the researcher depending on the statistical forecasting software EViews.

### Table 2. LM tests of okra yield function.

| Breusch-Godfrey Serial Correlation LM Test: |
|--------------------------------------------|
| F-statistic | 1.709319 | Prob. F(2,95) | 0.1865 |
| Obs*R-squared | 3.473568 | Prob. Chi-Square(2) | 0.1761 |

Test Equation:
Dependent Variable: RESID
Method: Least Squares
Date: 11/21/20 Time: 18:28
Sample: 1 100
Included observations: 100
Presample missing value lagged residuals set to zero.

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|----------|-------------|------------|-------------|-------|
| C        | -0.108020   | 0.408725   | -0.264285   | 0.7921|
| LNK      | 0.021143    | 0.058371   | 0.362220    | 0.7180|
| LNL      | -0.026497   | 0.074348   | -0.356387   | 0.7223|
| RESID(-1) | 0.114912  | 0.105177   | 1.092557    | 0.2774|
| RESID(-2) | 0.139060  | 0.102534   | 1.356238    | 0.1782|
| R-squared | 0.034736  | Mean dependent var | -1.26E-15 |
| Adjusted R-squared | -0.005907 | S.D. dependent var | 0.146881 |
| S.E. of regression | 0.147314 | Akaike info criterion | -0.943794 |
| Sum squared resid | 2.061635 | Schwarz criterion | -0.813535 |
| Log likelihood | 52.18970 | Hannan-Quinn criter. | -0.891076 |
| F-statistic | 0.854660 | Durbin-Watson stat | 2.028303 |
| Prob(F-statistic) | 0.494235 |            |             |       |

Resource: prepared by the researcher depending on the statistical forecasting software EViews.

### Table 3. ARCH tests of okra yield function.

| Heteroskedasticity Test: ARCH |
|--------------------------------|
| F-statistic | 2.244596 | Prob. F(1,97) | 0.1373 |
| Obs*R-squared | 2.239064 | Prob. Chi-Square(1) | 0.1346 |

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
It was found from the estimated model of the production function of okra yield, that the signal of all the variables is consistent with the logic of economic theory in terms of signal and size, and the significance of the parameters was proven according to the T-test, as well as the significance of the estimated model as a whole according to F-test. The coefficient of determination accounted for 94% of the fluctuations in the quantity produced. As for the standard tests, it has been shown that the estimated model is affected by the self-correlation problem according to the results of the LM test of the estimated model. Since the model was estimated in the logarithmic form, the model does not differ from the problem of multiple linear correlation, which is a problem that usually occurs when two or more independent variables are linked by a strong linear relationship that is difficult to separate from the dependent factor [11], so the independent variables are usually linked between them by different relationships and the existence of Such relationships are not a problem in and of themselves [12]. As for the problem of uniformity of variance, it was proven using White's test that the estimated model suffers from a problem of homogeneity instability, which is an expected result of the research's reliance on cross-sectional data[13], which usually shows the problem of homogeneity instability in this type of data. The function was estimated using the Robust Least Squares method to address the problem of homogeneity instability[14], and the new estimated function was obtained, and through the table below it was found that the function of the estimated okra yield production, all the parameters of the function came in accordance with the economic logic, and since the value of the parameter of the variable in the Cobb Douglas function The productivity elasticity of the factor represents the production, as the productivity elasticity of capital reached 0.888, which is a positive value, which is higher than the productivity elasticity of the labor resource, which amounted to about 0.158, which indicates that the production of the crop depends greatly on the provision of capital and this is consistent with the economic logic of vegetable farmers. The sample, as farmers use extensively the technological technologies represented by seeds, fertilizers, and pesticides. The productivity elasticity of the low labor resource is a clear indication of the low efficiency of the labor resource, due to the nature of the crop and the short production period for it, as well as the overlap of cultivation of various vegetable crops on one farm. In general, it can be inferred that there is a positive relationship between capital and labor for okra production, as increasing the capital by 1% will increase crop production by 0.88 by increasing the use of modern technologies, while increasing labor by 1% will lead to an increase in production by 0.15 when capital is stable. Average. As for the returns to capacity in the estimated production function, i.e., the total output elasticity (which is the sum of the production elasticities of the productive suppliers), they amounted to about 1.046, which is greater than the correct one, which indicates an increase in the return to capacity, meaning that an increase in resources by some percentage will lead to an increase in production by a percentage. It is greater than the total output, meaning that an increase in production suppliers (labor and capital) by 1% will lead to an increase in the total production of okra by 1.046, and this is evidence that there are increasing capacity returns and that farmers are working within the first stage of the production process, which is an indicator role However, the production of farmers in the studied area is going through a phase of increasing returns to scale, which enhances the possibility of expanding the cultivation of the crop in the studied area, as it is an indicator to measure the technical change in the function. And amounting to about 0.95, when you increase production by 10%, costs will increase by 9.5%. The fixed limit in the estimated function represents the efficiency factor, which amounted to about 0.003, as it represents the technology used by the sample farmers, which is greater than zero, conforming to the logic of economic theory, as it is evidence that confirms the impact of technology on the product, as its value can be increased by improving the quality of agricultural work as well as using improved varieties. Of seeds with high yield, as well as the use of fertilizers and pesticides. The statistical analysis has proven that all the parameters of the independent variables in the estimated function are significant at the level of 1% according to the T-test, as it was shown by the value of the coefficient of determination of the estimated function, that the fluctuations in the suppliers, work and capital were able to be explained by about 72% of those fluctuations in the quantity produced. Of the yield, and that there are other variables that affect the production function, perhaps the most important of which is the climate

3.1. Economic, statistical and standard analysis of the production function

| Variable          | Coefficient | Std. Error | t-Statistic | Prob. |
|-------------------|-------------|------------|-------------|-------|
| C                 | 0.018321    | 0.004283   | 4.278028    | 0.0000|
| RESID*2(-1)       | 0.150386    | 0.100378   | 1.498198    | 0.1373|
| R-squared         | 0.022617    | Mean dependent var | 0.021563 |
| Adjusted R-squared| 0.012541    | S.D. dependent var | 0.037001 |
| S.E. of regression| 0.036768    | Akaike info criterion | -3.748370 |
| Sum squared resid | 0.131135    | Schwarz criterion | -3.695943 |
| Log likelihood    | 187.5443    | Hannan-Quinn cr iter. | -3.727158 |
| F-statistic       | 2.244596    | Durbin-Watson stat | 2.005486 |
| Prob(F-statistic) | 0.137329    |             |             |       |

Resource: prepared by the researcher depending on the statistical forecasting software EViews.
and the nature of the soil, the dates of cultivation, fertilization, and disease and pest infestation, which explain about 28% of the fluctuations in the quantity of production, the effect of which absorbed the random factor. We would like to show that the high determination coefficient value is not necessarily evidence of the best model, so we must focus on the importance of the theory upon which the chosen model is based [15].

### Table 4. the new okra crop production function

| Dependent Variable: LNQ | Method: Robust Least Squares | Date: 11/12/20   Time: 16:18 |
|------------------------|------------------------------|-----------------------------|
|                        | Sample: 1 100               | Included observations: 100  |

| Method: M-estimation  | M settings: weight=Bisquare, tuning=4.685, scale=MAD (median centered) |

| Variable | Coefficient | Std. Error | z-Statistic | Prob. |
|----------|-------------|------------|-------------|-------|
| C        | -5.542198   | 0.261772   | -21.17183   | 0.0000 |
| LNK      | 0.888177    | 0.036721   | 24.18687    | 0.0000 |
| LNL      | 0.158405    | 0.046716   | 3.390820    | 0.0007 |

| Robust Statistics | | |
|-------------------|----------------|
| R-squared         | 0.724000       |
| Adjusted R-squared| 0.718309       |

| Akaike info criterion | Schwarz criterion | Deviance | Scale | 0.089860 |
|-----------------------|-------------------|----------|-------|----------|
| Rn-squared statistic  | 3938.154          | Prob(Rn-squared stat.) | 0.000000 |

| Non-robust Statistics | | |
|-----------------------|----------------|
| Mean dependent var    | 8.245006       |
| S.D. dependent var    | 0.600564       |
| S.E. of regression    | 0.159113       |
| Sum squared resid     | 2.455758       |

Resource: prepared by the researcher depending on the statistical forecasting software EViews.

### 3.2. Economic derivatives of the estimated production function

In order to arrive at economic derivatives, the estimated production function must be written in its exponential form, as follows:

\[
Q = 0.003 K^{0.888} L^{0.158}
\]

In order to derive the functions of the average product and the marginal product of the two suppliers separately, the other resource will be fixed at the arithmetic average, and through the table below, the results of the estimation of economic derivatives will be shown to us, as it becomes clear that the average productivity exceeds the marginal productivity of the production suppliers, since the production elasticity of each resource is less. The correct one, meaning that production increases at a decreasing rate, and that the resources used fall in the second stage, or the so-called rational economic phase, and if we assume certain levels of productive resources, the production phase can be clarified for the research sample, as Figure 1 shows. The average production and marginal product are constantly decreasing with the increase in the use of productive resources, and the marginal product curve appears below the average output curve, which confirms the occurrence of the estimated production function in the second stage of production, and this means that the percentage of additions of these resources is less than the percentage. The additions that are made to the total output and that production is going through a phase of diminishing returns.

### Table 5. economic derivatives of the estimated production function.

| Productive resource | AP            | MP             | Estimated production flexibility |
|---------------------|---------------|----------------|----------------------------------|
| K                   | \(AP_K = 0.0125 K^{-0.112}\) | \(MP_K = 0.011 K^{-0.112}\) | 0.888 |
| L                   | \(AP_L = 1354.7 L^{-0.842}\) | \(MP_L = 214.04 L^{-0.842}\) | 0.158 |

Source: prepared by researchers depending on the results obtained.
Figure 1. Marginal and average product of the capital.
Source: prepared by researchers depending on the results obtained.

Figure 2. Marginal and average product of the labour.
Source: prepared by researchers depending on the results obtained.

Table 6. Marginal and average production in certain levels for producers.

| L  | APL   | MPL   | K     | APK   | MPK   |
|----|-------|-------|-------|-------|-------|
| 10 | 194.92| 30.80 | 1000  | 0.0058| 0.0051|
| 20 | 108.74| 17.18 | 2000  | 0.0053| 0.0047|
| 30 | 77.29 | 12.21 | 3000  | 0.0051| 0.0045|
| 40 | 60.66 | 9.58  | 4000  | 0.0049| 0.0044|

Source: prepared by researchers depending on the results obtained

3.3. Substitution flexibility

The substitution elasticity is always positive in the Cobb-Douglas production function. The presence of great substitution flexibility is evidence of the existence of a large number of production combinations, which can then be chosen the appropriate production combination [16]. The elasticity of substitution in the estimated function reached 0.17, which is a small elasticity of substitution, which is evidence of the inability to intensify work at the capital account in the research sample, as Iraq is one of the developing countries that is characterized by an abundance of work element at the capital account, which applies to a sample Research, as family farms are spread in the study area, which always contains masked unemployment, which makes the process of replacing the labor resource with the capital resource impossible as it is a family business, whether the capital is intensified or mechanization is used, the family work spent on the farm will continue. By dividing the two parameters to know the intensity of labor and capital, it was revealed that production has a capital intensity, which means that it depends on the source of capital more than the resource of labor.

3.4. Share of productive resources

The share of the productive resource in production is obtained by dividing the value of the productive elasticity of that resource by the total elasticity of the estimated production function, so the share of capital in the estimated function is about 85% of income and about 15% of the labor share, and it appears that the share of capital is the largest share due to the fact that Capital participates in a greater proportion in most of the production processes.

The marginal rate of technical substitution

Finding the marginal rate of technical substitution is the first step in economic analysis to determine the nature of the relationship between the suppliers of production, labor and capital. The rate of technical substitution is obtained by dividing the marginal product of work by the marginal product of capital, as it shows the rational behavior of the producer in exploiting the ability of resources to substitute in quantitative production. Constant from the product. The rate of technical substitution in
the estimated function has reached 198.3, which means that increasing the labor resource by one unit requires a sacrifice of 198.3 units of capital. This decrease in the rate of substitution with the continuous substitution between productive resources has its importance to achieve the second condition of price efficiency, as this condition reflects the concavity of the isocost curve towards the point of origin, but it is faulted for being affected by the unit of measurement in which the production elements are measured, and this causes a difference in the value of the technical substitution rate according to the units of measurement used. Here, the importance of the flexibility of technical substitution appears between production elements that are not affected by units of measurement [17]. Hypothetical values of the production suppliers were used, as in the table below, to arrive at the shape and slope of the isotropic curve of the estimated function, which shows the combination of labor and capital.

Table 7. technical rate of producers in capital and labour.

| SERIA | K | L | MRTSL,K |
|-------|---|---|---------|
| 1     | 9 | 600| 113     |
| 2     | 7 | 700| 96      |
| 3     | 6 | 800| 85      |
| 4     | 5.5| 900| 76      |

Source: prepared by researchers depending on the results obtained

Second: the restricted Cobb Douglas production function

The constrained Cobb Douglas production function is estimated by assuming yield constant, meaning that elasticity is equal to the right one, and this assumption makes the production function restricted, and it shows that production takes place in the first stage. Therefore, it reflects the constant return to capacity, and is obtained by using the following formula:

\[
\ln Q = b_0 + b_1 \ln L + b_2 \ln K
\]

s.t: \( b_1 + b_2 = 1 \)

When estimating the restricted production function according to the study variables, we obtained the following results as shown in the table.

Table 8. restricted production function

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|----------|-------------|------------|-------------|-------|
| C        | -4.451582   | 0.383275   | -11.61460   | 0.0000|
| LN2K     | 0.786295    | 0.055118   | 14.26555    | 0.0000|
| R-squared| 0.674965    | Mean dependent var | 1.011921|
| Adjusted R-squared | 0.671648    | S.D. dependent var | 0.259617|
| S.E. of regression | 0.148766    | Akaike info criterion | -0.953092|
| Sum squared resid | 2.168859    | Schwarz criterion | -0.900982|
| Log likelihood | 49.65459    | Hannan-Quinn criter. | -0.932005|
| F-statistic | 203.5060    | Durbin-Watson stat | 1.717520|
| Prob(F-statistic) | 0.000000    |               |            |

Resource: prepared by the researcher depending on the statistical forecasting software EViews.

Table 9. LM tests of okra yield function

Breusch-Godfrey Serial Correlation LM Test:

| F-statistic | Prob. F(2.96) | 0.1578 |
|-------------|---------------|--------|
| Obs*R-squared | 3.773819    | Prob. Chi-Square(2) | 0.1515 |

Test Equation:

Dependent Variable: RESID
Method: Least Squares
Date: 11/21/20 Time: 18:38
Sample: 1 100
Included observations: 100
Presample missing value lagged residuals set to zero.

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|----------|-------------|------------|-------------|-------|
And after converting the function into an exponential form, we get:

\[ Q = 0.011 K_{0.786} L_{0.214} \]

According to the results obtained, it was found that in light of constant yields, the efficiency factor is identical to the economic logic as it came with a positive signal, and it came with a higher value than the efficiency factor in the unrestricted production function, which is evidence that the efficiency of the production elements in the bound function is higher than its counterpart in the unrestricted production function. Production will have an effect on capital in a broader and deeper way, allowing for an increase in the use of the labor component that is available and expended, whether there are restrictions or not, as the restrictions are effectively reflected in the limited capital. Because of the nature of the crop, which depends heavily in its production on capital, the partial elasticity of capital in the restricted production function reached 0.786, which is greater than the partial elasticity of labor in both cases. It is also noted that the increase in capital by 10% while keeping the work done at the average, production will increase by 7.8%, while production will increase by 2.1% when the work increases by 10%. Due to the assumption of the constraint, the overall elasticity of the function reached 1, and the significance of the parameters and the estimated function was fixed at the level of 1% according to the results of the T and F test. While the value of the determination factor was 67%, that is, the capital component, under the imposed restrictions, was able to explain a large proportion of the fluctuations in production, and this is evidence of the dependence of the crop production on the resource of capital very much, and the estimated model was tested several tests to detect standard problems. The results of the test showed that the model was free of standard problems of the second degree according to the LM test to detect the problem of self-correlation, and the ARCH test to detect the problem of homogeneity instability. Since the model was estimated in the logarithmic form, the model does not suffer from the problem of multiple linear correlation. The economic derivatives of the constrained production function.
In order to arrive at economic derivatives, the restricted production function must be written in its exponential form, as follows:

\[ Q = 0.003 K^{0.786} L^{0.214} \]

In order to derive the functions of the average product and the marginal product of the two suppliers separately, the other resource will be fixed at the arithmetic average, and through the table below, the results of the estimation of economic derivatives will be shown to us, as it becomes clear that the average productivity exceeds the marginal productivity of the production suppliers, since the production elasticity of each resource is less than the correct one, meaning that production increases at a decreasing rate, and that the resources used fall in the second stage, or the so-called rational economic phase, and if we assume certain levels of productive resources, the production phase of the research sample can be clarified, as Figure 3 shows. The average production and marginal product are constantly decreasing with the increase in the use of productive resources, and the average output curve is above the marginal product curve, which confirms the occurrence of the estimated production function in the second stage of production, and this means that the percentage of additions of these resources is less than the percentage of additions. Achieved in total output and that production is going through a phase of diminishing returns.

| Table 11. Economic derivatives of the restricted production function |
|---------------------------------------------------------------|
| Productive resource | AP | MP | Estimated production flexibility |
|---------------------|----|----|----------------------------------|
| K                   | APK = 0.0559 K - 0.214 | MPK = 0.044 K - 0.214 | 0.214 |
| L                   | APL = 926.5 L - 0.786 | MPL = 198.3 L - 0.786 | 0.786 |

Source: prepared by researchers depending on the results obtained.

**Figure 3.** Marginal and average product of the capital and restricted function.
Source: prepared by researchers depending on the results obtained.

**Figure 4.** Marginal and average product of the labour and restricted function.
Source: prepared by researchers depending on the results obtained.

| Table 12. Marginal production and average production in certain levels for producers in the restricted function |
|---------------------------------------------------------------|
| L | APL  | MPL  | K   | APK  | MPK  |
|----|------|------|-----|------|------|
| 10 | 151.65 | 32.45 | 1000 | 0.0127 | 0.0100 |
| 20 | 87.95  | 18.82 | 2000 | 0.0110 | 0.0086 |
| 30 | 63.95  | 13.68 | 3000 | 0.0101 | 0.0079 |
| 40 | 51.00  | 10.92 | 4000 | 0.0095 | 0.0074 |

Source: prepared by researchers depending on the results obtained.
are of. As well as increasing the efficiency of human labor in a way that resource. Also, the reliance of crop cultivation heavily on capital is a hindrance either to

8.6% of income and about 21.4% of labor share, and it appears that the share of

ng as

l, so the research recommends the necessity of providing the necessary support for

search sample, as Iraq is one of the developing countries that is

opening the way for introducing mechanization more broadly, and thus the efficiency of using the human labor resource in the

vegetable production projects if I do not want to increase the cultivated hours and thus production, which contributes to

due to the intensification of capita

expanding the areas cultivated with the crop, which is evident in vegetable production farms, which often cultivate small are

reducing waste in the other r

decisions the restrictions that may be imposed, which contribute to raising the efficiency of one resource at the expense of

restrictions contribute to increasing the efficiency of use Productive resources, this decrease in the rate of substi

the estimated function reached 303.4, which means that increasing the labor resource by one unit requires sacrificing about

the ability of resources to substitute in quantitative production. Constant from the product. The rate of technical substitut

the marginal product of work by the marginal product of capital, as it shows the rational behavior of the producer in exploi

relationship between the suppliers of production, labor and capital. The rate of technical substitution is obtained by divid

Finding the marginal rate of technical substitution is the first step in economic analysis to determine the nature of the

The entire rate of technical substitution in the estimated function was 0.27, which is a small elasticity of substitution, which is evidence of the inability to intensity work at the capital account in the research sample, as Iraq is one of the developing countries that is characterized by the presence of an abundance of work on the capital account, which applies to the research sample. As family farms are spread in the study area, which always contains masked unemployment, which makes the process of replacing the labor resource with the capital resource impossible as it is a family business, whether the capital is intensified or mechanization is used, the family work spent on the farm will continue. By dividing the two parameters to know the intensity of labor and capital, it was found that production has a capital intensity, which means that it depends on the resource of capital more than the resource of labor in the restricted function, which is the same result obtained from the unrestricted production function.

3.5. Substitution flexibility

The elasticity of substitution in the estimated function was 0.27, which is a small elasticity of substitution, which is evidence of the inability to intensity work at the capital account in the research sample, as Iraq is one of the developing countries that is characterized by the presence of an abundance of work on the capital account, which applies to the research sample. As family farms are spread in the study area, which always contains masked unemployment, which makes the process of replacing the labor resource with the capital resource impossible as it is a family business, whether the capital is intensified or mechanization is used, the family work spent on the farm will continue. By dividing the two parameters to know the intensity of labor and capital, it was found that production has a capital intensity, which means that it depends on the resource of capital more than the resource of labor in the restricted function, which is the same result obtained from the unrestricted production function.

3.6. Share of productive resources

The share of the productive resource of production is reached by dividing the value of the productive elasticity of that resource by the total elasticity of the estimated production function, and since the constraining function assumes that the total elasticity is equal to one, and therefore the partial elasticity will express the share of the productive resource, so the share of capital is in the estimated function. About 78.6% of income and about 21.4% of labor share, and it appears that the share of capital is the largest share as a result of the fact that the capital participates in a greater proportion in most production processes.

3.7. The marginal rate of technical substitution

Finding the marginal rate of technical substitution is the first step in economic analysis to determine the nature of the relationship between the suppliers of production, labor and capital. The rate of technical substitution is obtained by dividing the marginal product of work by the marginal product of capital, as it shows the rational behavior of the producer in exploiting the ability of resources to substitute in quantitative production. Constant from the product. The rate of technical substitution in the estimated function reached 303.4, which means that increasing the labor resource by one unit requires sacrificing about 303.4 units of capital, and it appears that the rate of technical substitution has increased in the restricted function, since the imposed restrictions contribute to increasing the efficiency of use Productive resources, this decrease in the rate of substitution with the continuous substitution between production resources is important to achieve the second condition of price efficiency, and default values for production suppliers have been used as in the table above, to arrive at the shape and slope of the equal product curve of the estimated function, which shows the combination of labor and capital. According to the results obtained, it can be concluded that okra is a vegetable crop that depends heavily on capital, and that restrictions placed on producers will contribute to raising the efficiency of labor use. Also, modern technological means, represented in the use of machines and machines, can contribute to increasing the production of the crop. It was found through the research sample that the form of most of the capital is used in the form of fertilizers, pesticides and seeds, while the use of modern mechanization can contribute to a surge in production quantities. As well as increasing the efficiency of human labor in a way that contributes to the elimination of the disguised unemployment prevalent in the agricultural sector, and the rate of technical substitution in the restricted function has shown the possibility and better options available to farmers in comparison with the unrestricted production function, as restrictions contribute to raising the efficiency of using a resource. Human labor, and reduce waste if found in the resource of capital, and accordingly, agricultural policy-makers must take into account in their decisions the restrictions that may be imposed, which contribute to raising the efficiency of one resource at the expense of reducing waste in the other resource. Also, the reliance of crop cultivation heavily on capital is a hindrance either to expanding the areas cultivated with the crop, which is evident in vegetable production farms, which often cultivate small areas due to the intensification of capital, so the research recommends the necessity of providing the necessary support for vegetable production projects if I do not want to increase the cultivated hours and thus production, which contributes to opening the way for introducing mechanization more broadly, and thus the efficiency of using the human labor resource in the

| Table13. technical rate between producers, labour, capital, and restricted function |
|------------------|---|---|---|
| SERIA | K   | L   | MRTSL,K |
| 1     | 9   | 600  | 47  |
| 2     | 7   | 700  | 40  |
| 3     | 6   | 800  | 35  |
| 4     | 5.5 | 900  | 31  |

Source: prepared by researchers depending on the results obtained
agricultural sector will increase. The research also recommends conducting studies on the use of other models and restrictions to demonstrate the effect of those restrictions imposed on the quantities produced.

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