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The Estimation of production function of uncovered tomato crop for the season 2017 by dropping Irrigation in Qatha Al-Tarmia

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Abstract: *To increase the Production of any Crop required the optimum Use of resources of production process , The same as in this research of . Tomato crop . a random sample have been chosen consist of 34 from 500 farmers producing tomato crop in Qatha Al -Tarmia for season (2017) Using uncovered planting by dropping irrigation , the research aim to estimate and analysis the relationship between quantity of tomato Production the quantities used of both labor and Capital inputs using Cobb -Douglass function to proof the significant in explaining the relationship between both labor and Capital 57% from the change that happened in tomato's production the total elasticity of production function was (0.093) meaning degrease of return to the capacity , the amount of profitable Production of profit (151,28) ton the contribution ratio capital to output was (0,0000132%) and the contributed ratio capital to output was (52,21%) while production Value at broke even point was (5) ton for the studied sample .*
Keywords*: productionfunction, droppingirrigation, tomato crop.*

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I. Introduction

Tomato crop (Lycopesiconescculeutum Mill) is considered one of the important vegetable crops belonging to the eggplant family (solanacea). Which contains (Tomato , Pepper , Eggplant and Potato) this crop is known with its high nutritional value it contain , carb , protein and fats , as well as its medical importance and manufacture uses such Us Tomato paste and juice(1,2) . Tomato crop is important for individuals in their daily by optimal use of resources in production process, such as watering which is considered one of the main important influence factors in Tomato crop cultivation, due to water scarcity in many locations in Iraq modern irrigation technology became one of the mostly used big economic water irrigation[1]

By giving tiny drops of water to the roots (2-4-8-12) L/h in low water areas the yield is high for drip irrigation (85-95) % reducing the Spread of weed where moisturizing the root area only providing good covering within the roots reducing diseases and Poles fertilizers and pesticides with drip and irrigation provide fertilizer from (30-50) % .Drip irrigation is one of the most highest efficient ways which leads to the. Efficiency of utilization of chemical fertilizer added through irrigation water preserving the environment by preventing washing of fertilizer and their delivery to ground water and because of the non - deduction of the area of agricultural land in the work of irrigation and the provision of labor increase the productivity of the crop [2]

The use at drip irrigation method also improves the specifications of agricultural production, increase production provide irrigation water and plant nutrients in a specific, precise homogeneous manner at the same time and place. (Less working hours less water rationed) .And the process of service of the crop and reduce the pollution of the environment as a result of the addition of fertilizer by drip irrigation[3]

Research problem*:*

The crop of tomato suffers from many problems , including production and technical problems that directly or indirectly affect the low productivity on the one hand and the high costs on the other , which led to the inability of the farmer to achieve productive efficiency resulting in a decrease in the volume of profits achieved and economic returns as farmers may not be able to maximize their production and low costs without familiarity with the aspects of farm management and the development of technical method including reliance on modern irrigation methods , and the economic relations between the element of agricultural production , especially between the elements of human labor and capital besides of the nature demand for human element.

Research goals (aims)

1- Measuring the productive efficiency of tomato farm by estimating the production functions analyzing their economic derivatives.

2 - Estimation of the productive volumes of tomato crop at the break - even point the optimal production volume, the maximal production volumes of the profits and the optimal quantities of suppliers of labor and capital.
3- Estimating the function of demand for resources and knowledge of the nature current relationship between the elements of work capital and the extent of their contribution to the production process.

Research hypothesis:

The research assumes that farmers are unable to maximize their production levels that deviate from the level of production achieved for technical and economic efficiency the elasticity of production capital is greater than elasticity of labor production and the production function is increasing in yield.

Materials and Methods of work:

In order to achieve the objective of the research, a random sample was selected (34) of (500) farmers of the tomato crop in Tarmia district and under the conditions of open irrigated agriculture using drip irrigation method, the sample accounted for about 7% (2017), following the tabulation of the data, the mathematical model was determined and evaluated in the estimation and analysis of the production function
was computed according to Cobb - Douglas function[4]

Where the variable in the model are:

1- Y The dependent variable the amount of production of tomato crop (estimated in tons)
2- Independent variables included
L= Labor includes the total number of hours worked by the family and the lessor (hours)
k, Capital includes the total variable capital expenditure (seeds , fertilizer , pesticides , cost of irrigation water , fuel , oil grease , maintenance of machinery and agricultural pumps)
B1 = Elastic output for work
B2=Elasticity of production for capital
A = Technology

Therefore, the volume of production can be increased by three variables are increasing the size of the capital, increasing the volume of work or improving the technology used. The parameters of the function will be estimated using the (Eviews) program after converting it into a linear relationship by taking the natural logarithm (Ln) of the double production quantity (Y) , Labor (L) and capital (K) as follow

And then returned to the normal from Cobb _ Dongles function the average wage of the daily labor (15000 ID), and the average selling price of the crop was (500 ID), the interest rate for the production season was considered (0.09)

II. Results and Discussion

The parameters, of the model variable were estimated using a standard model the form of (Cobb Douglas). The result of the final analysis showed that the double logarithmic. Function is the most consistent with economic logic and representation of productive relationship especially passing the Statistical and standard test is according to the first and second test.

$LnY = 4.032 + 0.004\ LnL + 0.089\ LnK$
$T = 10.975 \quad 1.633 \quad 5.785$
$R2 = 0.57 \quad R^{-2} = 0.54 \quad DW = 1.730 \quad F = 20.594$

By taking the natural logarithm inverse, the function was converted to its normal form to reflect the relationship between production, labor

use and capital in the form.
$Y = 56.374^{L\ 0.004}\ K^{0.089}$
It's clear from the result of the statistical test that the function is statistically acceptable.

The value at F indicates that the independent factors in the function have a significant effect on the dependent factor a significant test also indicates the work factors (L) and capital (K) on the total output in the farm meaning the function parameter of B2 & B2 are different from zero a significant level , F 5% and 1% respectively ,we ensure that the problem of simple correlation is well as the lack of seriousness of the problem of multiple liner correlation (Multicollineorty) according to (Clein) test and the lack of seriousness of the problem of instability of variance (Heteroscedasticity) according to (park) test . The coefficient R (0.57) indicated that the independent variable represented by work (L) and Capital (K) accounted for 57% of fluctuations in total output and 43% for other factors not included in the estimated function[6]

(0.004) is the flexibility of labor a positive low value. This reflects the low level of knowledge of workers engaged in cultivating the tomato crop. The increase of labor supply by 10% leads to increase of tomato production by 0.04%. The elasticity of the capital resource is (0.089) which is greater than the value of the elasticity of the labor resource. This means that the production of the tomato crop depends primarily on the capital supplier following by the supplier work and when the capital resource is increased by 10% which increases the production of tomato crop about 89%. While the total elasticity of crop yield (B1 + B 2) was (0.093) less than one and greater than zero indicating that the farm is produced in the second half of the second stage which reflects (decreasing return to scale) [7] meaning that the percentage from suppliers of labor and capital is greater than the percentage of increase in the production of the maize crop of tomato.

Economic Derivatives :-

The product function includes some derivatives that cannot be dispensed with in the decision-making process of the addition or subtraction of the resource , and is very important in determine the range of efficient resources used in the production process are:-

- Average Production
- Marginal of Production
- Elasticity of Production
- Elasticity of substitution
- Marginal Rate of Technological substitution [8]

To find the conversion function of its logarithmic form:

$LnY = 4.032 + 0.004\ LnL + 0.089\ LnK$............. (1)

To The exponential formula (Cobb Douglass) becomes

$Y = 56.374\ L^{o.oo4}\ K^{0.089}$............. (2).

The total productively, marginality and the medium of Suppliers of labor and capital:

The total output of the labor resource (TP_L) was calculated by installing a resource capital of the average

K= 136318.765

$TP_L = 56.374\ L^{0.004} (136318.765)^{0.089}$

The total output equation of work

$TP_L = 161.455\ L^{0.04}$................ (3)

By taking the first derivative of the total output equation of work:-

$MP_L = 0.646\ L^{-0.996}$............... (4)

The equation of the marginal output of the work and the equation of the average output of work calculated by dividing the total equation of number (31 on the work the equation average output of work is :-

$AP_L = TP_L / L = 161.455\ L^{-0.996}$............ (5)

The total output of capital was calculated by stabilizing the labor resource at the mean

L= (6283.353)

$TP_k = 56.374\ (6283.353)^{0.004}\ K^{0.089}$

$TP_k = 58.403\ K^{0.089}$ .... (6)

The equation at total output of capital was calculated by calculating the equation of the marginal output of capital (MPk) by taking the first derivative of the equation of the total output of capital

$MP_K = 5.198\ K^{-0.911}$.......... (7)

While the equation of the average output of capital was calculated by dividing equation number 6 by the capital So the equation of the average output of Capital was

$AP_k = TP_k /K = 58.40\ K^{-0.911}$................ (8)

When calculating the marginal and intermediate productivity of the labor and capital elements , when stabilizing the other at the average it is found that the productivity decrease with the increase in the number of hours work and the amount of capital evidence of their occurrence in the second productive stage (Table1).

Table (1) total productivity medium and marginality of the work element

MP_k	AP_k	TP_k	K	MP_L	AP_L	TP_L	L
0.0001	**0.001**	**167.23**	**136000**	**0.0001**	**0.029**	**167.16**	**6000**
0.0001	**0.0011**	**168.29**	**146000**	**0.00009**	**0.025**	**167.27**	**7000**
0.0009	**0.0010**	**169.28**	**156000**	**0.00008**	**0.022**	**167.35**	**8000**
0.00009	**0.0010**	**170.22**	**166000**	**0.00007**	**0.019**	**167.43**	**9000**
0.00008	**0.0009**	**171.11**	**176000**	**0.00007**	**0.017**	**167.5**	**100000**

Source: - done by researchers depending on the equations 2,3,4,5,6,7,8

Marginal Rate of Technical Substitution (MRIS) :-

The rate of technical substitution is defined as the amount of the capital resource that the entity can waive by increasing the amount of work used by one unit so that will remain on the same production curve while mathematically , outside the division of the marginal product of labor on the marginal product of capital [9] ,the replacement of any production element with another for example replacing work hours for capital or vice versa (MRTS $_{\mathbf{k\ for\ L}}$) it will be according to the following equations :-

MRTS $_{\mathbf{L\ for\ k}}$ = MP_L / MP_k

MRTS $_{\mathbf{L\ for\ k}}$ = 0.004k / 0.089L

MRTS $_{\mathbf{k\ for\ L}}$ = MP_k/ MP_L

MRTS $_{\mathbf{k\ for\ L}}$ = 0.089L / 0.004K ……....(9)

According to MRTS equations we can say that the replacement rate decreases constantly when any other production resource is substituted for another resource this indicated by one of the characteristics of the experiential function (cobb-Douglas function) the output curve is convex to point of origin , meaning the marginal substitution rate between labor and capital suppliers decreases [10]. The higher working hours L by 0.004 is replaced by capital K about 0.089. The MRTS $_{\mathbf{k\ for\ L}}$ is continuously decreasing. But there are disadvantages on the rate of technical substitution between productive resources because it is affected by unity of measurement, the labor supplier, for example, can be measured by the number of working days and the difference in units of measurement lead to the difference in value according to standard used so the importance of studying the elasticity of substitution between the elements of production is not effected by units measurement [11].

Elasticity Substitution of factors :-

In this research we measure the elasticity of substitution between labor and capital

Es = MKS $_{\mathbf{L\ for}\ L/K}$ = 0.004L / 0.089K (L/K)

Es = 0.004 / 0.089 = 0.045

Es = 0.045

That means a10% of change in working hours leads to 0.045% change in capital it followers from the decrease in the elasticity of substitution between work and capital that. Production of tomato crop is produced by a small number , of workers and to know the share of each factor of the total product , by dividing the estimated parameter value for each factor by the sum of the estimated Parameters as in the following equation [12] (bi/b1 + b2).

When we apply the equation above we get the work estimated as the share of each productive resource of the total output, the capital comes in the first place followed by hours of work, it reflects 96% and 4% respectively, and this is a very large difference between work supplier and capital because it reflects the inefficient of work use in the production process and the non- use of technological techniques in agricultural process to increase work efficiency.

Equation of equivalent output :-

The equal output equation can be extracted from the Productivity function for tomato crop mathematically when production (Y) is stable on a certain level as follow.

Y= 56.374(L) $^{0.004}$ (L) $^{0.0889}$

$$L^{0.004} = \left[\frac{Y}{56.3741\ k^{0.089}}\right]$$

$$L = \left[\frac{Y}{56.3741\ k^{0.089}}\right]^{\frac{1}{0.004}}$$

$$L = \left[\frac{Y}{56.374\ k^{\ 0.089}}\right]^{250}$$ ………..(10)the equation of equivalent output of work supplier

For the capital resource (L)

$$K^{0.089} = \left[\frac{Y°}{56.374\ L^{0.004}}\right]$$

$$K = \left[\frac{Y°}{56.374\ L^{0.004}}\right]^{\frac{1}{0.089}}$$

$K = \left[\frac{Y^\circ}{56.374\ L^{0.004}}\right]^{11.236}$ …..(11) the equation of equivalent output of work capital supplier.

Expansion (ISO - cline) :-

It's the line that reaches the points of contact between the equal output curves the equal cost lines mathematically if we obtain the equalization of the marginal rate of substitution with the inverse price ratio of suppliers of labor and capital.

$MRTS_{KL} = W/r$

When W refers to price of work supplier

R refers to price of capital supplier

$MRS_{KL} = \frac{MP_K}{MP_L} = \frac{BAL^{a}\ K^{B-1}}{aAL^{a-1}K^{B}} = w/r$

$\frac{0.004k}{0.089L} = w/r$

$0.004Kr = 0.089Lw$

$K = 22.25L\ (w/r)$ ----------------- (12)

Equation (12) represents the relation between the path of production expansion which mixes the labor supplier and the capital supplier to obtain the highest productivity per acres for the tomato crop .

Derivatives demand function for work and capital supplier :-

This is done through equality of marginal output with wage rate where:-

W_L: Rate of workers' wages

Pw: price of tomato crop

The equation of demand on labor suppliers is as follows

$VMP_L = W_L$

$0.646\ L^{-0.996}\ (Pw) = W_L$

$L^{-0.996} = W_L / (0.646Pw)$

$L^{0.996} = 0.646\ Pw / W_L$

$L = [0.646\ Pw / W_L]^{1/0.996}$

$= [0.646\ Pw]^{1/0.996} / [W_L]^{1/0.996}$

$L = \left[(0.646\ Pw)^{1/0.99} \times (W_L)^{1/-0.996}\right]$…….(13)The equation demand on labor supplier

Capital supplier equation:-

This is done by the equal value of the marginal with the rate Interest

Where : R =Average rate Interest.

PW= the price of tomato crop .

The demand equation on Capital supplier is as follows:-

$VMP_k = R$

$5.198K^{-0.911}(Pw) = R$

$K^{-0.911} = R / (5.198Pw)$

$K^{0.911} = [5.198Pw / R]$

$K = 5.198Pw / R^{1/0.911}$

$K = [5.198Pw]^{1/0.911} / (R)^{1/0.911}$

$K = [5.198Pw]^{1/0.911} \times \left[(R)^{-1/0.911}\right]$ ….….. (14)Demand equation of capital supplier

profit Maximization:-

We can reach ideal value of labor Capital and production supplier the maximize profit by equality of marginal output supplier with its price[13] and when the marginal output supplier equation is applied with its price with the amount of labor supplier that maximizes profit we use labor wages(15000) ID/day selling price of crop (500) ID/kg as follow :-

$MP_L = 0.646L^{-0.996}$

$VMPL = w$

$(500)(0.646)\ L^{-0.996} = 1500$

$323\ L^{-0.996} = 15000$

$323 = 1500\ L^{0.996}$

$L^{0.996} = 323 / 1500$

$L = (0.02)^{1.004}$

$L = 0.02$

We conclude that farmer working hours in our sample study maximizes profit about (0.02) hour for each day equals one minute and two seconds to find capital that maximizes profit for each Acres we apply equation equality of marginal output for capital supplier with rate interest(0.09%)when average price of tomato crop is(1500)ID/kg as follow:-

$MP_K = 5.198\ K^{-0.911}$

$VMP = r$

$(500)\ (5.198)K^{-0.911} = 0.09$

$2599\ K^{-0.911} = 0.09$

$2599 = 0.09\ K^{0.911}$

$K^{0.911} = 2599 / 0.09$

$K^{0.911} = 28877.78$

$K = (28877.78)^{0.911}$

$K = 79013.1$

We conclude from that the capital used in our sample study that maximizes profit is about (79013.1)ID/Acres and when optimal quantity compensation of labor and capital supplier that maximizes profit in our sample as follow:

$Y = 56.374\ L^{0.004}\ K^{0.089}$

$Y = 56.374\ (0.02)^{0.004}\ (79013.1)^{0.089}$

$Y = 56.374\ (0.984)\ (2.728)$

$Y = 151.328$

We conclude that production quantity that maximizes profit is(151.328) ton The contribution rate has been reached both labor and capital supplier for production quantity maximizes profit the results are as the table (2)

Table (2)contribution rate for both labor and capital supplier in production Quantity.

Production Quantity Maximizes Profit / kg	Contribution rate labor supplier%	Contribution rate capital supplier%
151328	0.0000132	52.21

Source: - done by researchers

It's clear from this table that contribution of labor supplier to production quantity reached (0.0000132)which is small percentage so the effect of labor supplier to production. quantity is so low while the capital supplier contribution rate to production quantity was(52.21%) this rate shows there is impact and contribution for capital supplier on production quantity.

Production volume at break even point:-

We can find production volume at break even point by this equation:-

Production volume at break even point[14] $= \frac{\text{Production Quality} \times \text{fixed costs}}{\text{Production value} - \text{variable costs}} = \frac{987 \times 417.471}{113847 - 199922}$

$= \frac{411626 - 41}{86.76}$

= 5 Ton Productionvolume at break even point

The actual production volume is :-

$Y = 56.374\ L^{0.004}\ k^{0.089}$

$Y = 56.374\ (6283.353)^{0.004}\ (136318.765)^{0.089}$

$Y = 56.374\ (1.036)\ (2.864)$

$Y = 167.268$ Ton

By comparing production volume at break evenpoint with the actual production we can see there is an increase in actual production about (162) Ton with means the optimal production level should be reached is below the required level

III. Conclusions

The low values of both elasticity of (labor & capital suppliers) and the low value of the total elasticity of production which is less the (correct No .one) indicates that production is decreasing meaning there are possibilities to increase tomato production by reducing labor & capital supplier using low and constant quantities .

The contribution rate of capital supplier was greater than the contribution rate of labor supplier which indicates that labor supplier used into production wasn't optimum.

At the break evenpoint the profitable quantity and production volume were less than the actual production of tomato Crop which refers to the decrease in Agricultural Management of tomato crop farmer'sefficiency. Where they used production Methods that don't achieve optimal usage for resource which led to decrease in production volume of the break even point and the production quantity.

IV. Recommendations

The need to use production methods that leads to optimum used in labor Capital supplier while increasing the production of tomato crop.

Provide government support to the tomato farmers by providing them with production supplier prices.

The necessity of production the guiding instrument for their effective role in educating farmers and directing them to scientific and economic methods of production in manner that increases their competence in managing their farms.

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