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Estimation of Economic Efficiency and the Production Function of Alfalfa Crop in Diyala Governorate.

Mhana Abdullah Mahmood
Assistant lecturer College of agriculture – univ.of Diyala
Corresponding Author: Mhana Abdullah Mahmood

Abstract: *The objective of this research was to study the economic efficiency and the production function of alfalfa crop in Diyala Governorate to determine the factors which affect the production of alfalfa, as well as the identification of the optimal quantities that achieve economic efficiency. And assessment of economic efficiency and its components Technical efficiency, efficiency of the allocation and knowledge of capacity efficiency and yield size using a questionnaire distributed to 30 alfalfa farmers in different areas DiyalaGovernorate randomly. The quantitative method was used to estimate the factors affecting the production of the alfalfa crop using evewis.9. while the economic efficiency and its technical and customized sections were estimated using the method of Data Envelopment Analysis using DEAP program. In the analysis of multiple regression in the Ordinary Least Squares (OLS) method, the productionlogarithmic function was estimated, which shows the relationship between the total production of the variable dependent (production quantity) and the independent variables of labor and capital.The economic analysis shows that the sign of all parameters is consistent with the economic, statistical and standard logic. The parameter value of the variable in the double logarithmic function represents the production flexibility of this variable. We observe from the results of the estimated function that the flexibility of the capital is 1.259 which was positive value, and higher than its equivalent, this mean, it is more influential than the other variables. This means that the increase of capital by 1% leads to increase of production by 1.259% with assuming the stability of other factors. The total production flexibility reflected an increase in returns to scale of 1.45% in the case of a 1% increase in production resources leading to an increase of 1.45% in alfalfa production. Meaning that they provide the possibility of increasing total production increasingly when resources are used at a fixed rate. By statistical analysis, the test F showed the significance of the function, indicating the realism of the function and the importance of the variables factors. The t-test showed a capital significance at 1% and the work was not significant. coefficient of determination R-2 was 0.83%. The technical efficiency measured with the change in the return of capacity was about 0.821%, while the return of the capacity with capacity return stability of the of was about 0.748%.The decrease of technical efficiency of these farms is due to the small cultivated areas and the poor management and organization of farms. The results showed that the efficiency of the allocation capacity ranged between 0.24 and one with mean reached 0.577. This ratio is relatively low and indicates the potential for this crop farmers to increase their production. This means that the redistribution of economic resources will provide 0.423 of the production cost and maintaining the current production level. The production factors are used within the second stage and increasing them leads to increase of production by a larger percentage. The study recommends the development of agricultural plans and price policies for this crop and the opening of many marketing routes to reduce the burden on farmers and protect them and reduce the reluctance of farmers to grow this important crop.*

Keyword: *efficiency of the allocation, production mean, marginal rate of substitution.*

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I. Introduction

The cultivation of alfalfa crop was transferred to Greece from Iran in 490 BC and then spread to Italy and other European countries. then entered in Central and South America through Spanish explorers and then entered in United States in 1851 when entered to California from the Republic of Chile where it began growing as a crop Since then, the first information obtained by the explorers of this plant has been found in one of the books of the Chinese Empire in 2939 BC, as it was called (king of food) by the Arabs in ancient times, by feeding their horses with alfalfa crop to get energy and fast movement (Alkhashan et al, 1980). The crop of alfalfa has a great importance in many European countries and United States. The total area planted in the world is estimated at 30 million hectares, mostly in the United States and Argentina (Gash et al., 2009). With world production which reaching 436 million tons in 2006 (FAO, 2006). The productivity of this crop in Iraq was estimated at 907 thousand tons, or 64.5% of the total forage crop production as a whole (Central Statistical Organization, 2010). The importance of alfalfa crop is not limited as a forage yield, but has many medical

benefits for humans, including treatment of rheumatism, arthritis, heart problems, help to reduce the diseases of old age, breast feeding period, symptoms of tooth decay and other diseases (coarse and others, 1980).

Research problem :

There is a reluctance to cultivate the alfalfa crop in Diyala Governorate due to technical problems and productivity suffered by the farmers of the crop, which led to a decline in economic efficiency and pushed away from the required level.

Research objective :

The research aims to

1- Diagnosis of the factors affecting the production of the Jet by estimating the production function. And to identify the optimum quantities achieved for economic efficiency.
2- determination of economic efficiency and its components, both technical efficiency and specialization efficiency. And know the efficiency of capacity and yield size.

II. Materials and Methods

The data were obtained from a random sample of the alfalfa farmers in Diyala governorate using a questionnaire prepared for this purpose. The number of farmers reached 30 farmers. The quantitative method will be used to estimate the factors affecting the production of this cropand using the evewis.9 program. The economic efficiency and its technical and customized sections were estimated using the method of analyzing the envelope data and relying on the DEAP program.

III. Results and discussion

First: Estimation of the production function of alfalfa crop:

Characterization and formulation of mathematical model

The characterization and formulation of the economic and mathematical model depends on the economic theory and any other information related to the phenomenon in this study. The description phase is one of the most important stages of research. It is the weak point in standard applications and research. Especially if the model is incorrectly described, The most important steps that the standard economic start with are (Alkaisi, 2009), (Koutsoyiannis ,1977).:

1- When studying any relationship between a number of variables, it is necessary to formulate this relationship in a mathematical way to obtain a model to study the economic phenomena in an applied manner. This step determines the dependent variable and the explanatory variables.
2- Previous theoretical predictions about the sign and size of parameters and these expectations as theoretical criteria based upon when evaluating the results of the model estimate.
3- Mathematical form of the model in terms of the number of equations, and their characteristics, whether linear or nonlinear.

Based on the above, the dependent variable and independent variables in the search can be specified as follows:

Y: The dependent variable represents the amount of production (tons)

Independent variables included:

L: The number of labor hours (Labor)

K: represents the capital and includes all costs that are converted into production at the end of the production year. (Capital).

Cobb-Douglas Production Function estimation:-

The logarithmic production function was estimationusing multiple regression analysis, which illustrates the relationship between the total production of the crop and the independent variables, Based on economic, statistical and standard indicators and using the OLS method, multiple models of independent variables were tested. The best model of the relationship of the crop production function with the most important variables affecting it was tested. The model was adopted in a double logarithmic format and was consistent with economic, statistical and standard logic. The estimated treatments were as shown in Table (1).

Table1.Cobb-Douglas Production Function.

Dependent Variable: LNY
Method: Least Squares
Date: 07/11/18 Time: 09:53
Sample: 1 30
Included observations: 30

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNL	0.190834	0.138190	1.380956	0.1786
LNK	1.258596	0.144584	8.704969	0.0000
C	-4.878762	0.741976	-6.575362	0.0000

R-squared	0.837807	Mean dependent var	3.808835
Adjusted R-squared	0.825792	S.D. dependent var	0.836169
S.E. of regression	0.349002	Akaike info criterion	0.827159
Sum squared resid	3.288657	Schwarz criterion	0.967279
Log likelihood	-9.407385	Hannan-Quinn criter.	0.871984
F-statistic	69.73405	Durbin-Watson stat	2.044498
Prob(F-statistic)	0.000000		

The source is prepared by researcher using a program evwies9

Economic Analysis:-

The production function of the alfalfa yield indicates that all the parameters are consistent with economic logic. Note that the parameter value of the variable in the double logarithmic function represents the production elasticity of this variable. We observe from the estimated function that the flexibility of capital reached (1.259) is a positive value which is higher than its equivalent, it is more influential than the other variables. This means that the increase of capital by 1% leads to an increase in production by (1.259%).
With Assuming the stability of other factors. as for work, its flexibility was second in terms of strength of effect, with flexibility reached(0.191). whichrepresents a positive value, indicating that the increase of the labor factor by 1% leads to an increase in total production by 0.191%. the independent variables whose partial flexibility values show that the production of these resources ranked within the second economic stage, indicating that these resources are used within the rational phase of production.

The total flexibility is the sum of the partial elasticities (1.45), which means that it shows an increasing return to scale. This indicates that the increase in the quantities used in the production resources by 1% leads to an increase in the production of the crop by 1.45% meaning that they provide the possibility of increasing total production increasingly when resources are used at a fixed rate.

Statistical Analysis:-

The statistical results in the production function shown in Table (1) show that the most important productive inputs that affect the quantity of production are the positive effect of (labor, capital). The F test showed the significance of this function, indicating the realism of the function and the importance of the variables. The partial significance of each variable shown by the t-test shows significant capital at 1% and no significant work.The $\mathbf{R^{-2}}$ showed that about (0.83) of the changes in the dependent factor (production quantity) were caused by the change in the factors involved in the model and that 17% of those changes were due to other factors not included in the model and expressed by the random variable.

Standard Analysis:-

The model showed the absence of the problem of auto correlation according to the (LM) test and from this we conclude that there is no problem of self-correlation among elements of the random variable. Because of the dependence of the study on (cross section data).Which can include the problem of instability of heterogeneity of variance is more prevalent than the time series data, this phenomenon must be detected in the estimated function and when applying the previous information according to the test (White), which indicated that the model is free from the problem of instability of heterogeneity of variance. Since the estimated model is logarithmic, this type of conversion will address the problem, because the conversion to logarithmic formula will reduce the difference between values (Guajaratiy, 1978, p: 173). The multi-line correlation problem was detected using the Klein test, which showed that the estimated model did not suffer from this problem.

Table 2.Standard Tests.

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	0.052726	Prob. F(2,25)	0.9487
Obs*R-squared	0.126011	Prob. Chi-Square(2)	0.9389

Heteroskedasticity Test: White

F-statistic	0.998374	Prob. F(5,24)	0.4398
Obs*R-squared	5.165454	Prob. Chi-Square(5)	0.3960
Scaled explained SS	6.049479	Prob. Chi-Square(5)	0.3014

	LNL	LNK
LNL	1.000000	0.757334
LNK	0.757334	1.000000

The source is prepared by researcher using a program evwies9

Economic derivatives of the production function:-

The productive function includes some derivatives, the most important of which are the derivatives that cannot be dispensed with in decision making from the addition of a resource or a deduction from it. It is very important in determining the efficient resource group used in the production process:

- Average Production
- Marginal Production
- Elasticity of Production
- Elasticity of substitution
- Marginal Rat of Technical substitution

To use the economic derivatives above, conversion of the output function requires its logarithmic formula:-

Ln Y = -4.87 + 1.259 Ln K + 0.191 LnL

To formula of Cobb-Douglas Production Function to become:-

$Y= 0.007 (K^{1.259}) (L^{0.191})$

Total productivity, marginal and medium capital factor:-

To find the economic derivatives for the capital factor, we calculate its equivalence after fixing the work at the average:

$TPk= 0.009K^{1.259}$

The average production equation was obtained from the following equation:

$APk = (y / k) = 0.009K^{0.259}$

The marginal production equation was calculated as the first partial derivative of the estimated production function as follows:

$MPk= (\delta y / \delta k) = 0.011K^{0.259}$

Table3.Total productivity, marginal and medium capital factor.

Capital ID	Total Production TP	Average Production AP	Marginal Production MP
7000	624.052	0.0892	0.1089
10000	977.783	0.0978	0.1195
13000	1360.498	0.1047	0.1279
16000	1766.972	0.1104	0.1349
20000	2340.126	0.1170	0.1430

The source is calculated by the researcher after returning the model to the exponential formula.

Through the marginal productivity and the average productivity of the capital factor.it is noted from Table (3) that the marginal and average productivity increases with the increase of capital with the rest of the factors remaining at the average indicating that this resource is within the first production stage.

The Total productivity, marginality and medium of the work factors:-

For the formulation of economic derivatives for the labor factors, we calculate its equivalent after the capital is fixed at the average as follows:

TPL= $\mathbf{0.089L^{0.191}}$

The average output equation was obtained from the following equation:

$\mathbf{APL = (y / L) = 0.089L^{-0.809}}$

The marginal production equation was calculated as the first partial derivative of the estimated production function as follows:

$\mathbf{MPL= (\delta y / \delta L) = 0.016L^{-0.809}}$

Table4.Total productivity, marginality and medium of the work factors.

Labor hours	Total Production TP	Average Production AP	Marginal Production MP
40	0.1800	0.0045	0.0008
80	0.2055	0.0026	0.0007
120	0.2221	0.0019	0.0003
160	0.2347	0.0015	0.0003
190	0.2425	0.0013	0.0002

The source is calculated by the researcher after returning the model to the exponential formula.

The results of Table (4) show that the marginal and average productivity of the labor component decreases with the increase in the number of added labor hours with the stability of the factors rest at the average. The marginal output is less than the average output, indicating that this resource is within the logical production stage.

The rate of marginal substitution among production elementsMRTS:-

The process of analysis of the relationship between two sources relates to a fixed quantity of production. The rational economic behavior requires the exploitation of the resources to replace the production of this fixed quantity so as to use the most abundant and least expensive resources whose characteristics do not often require a fixed proportion of resources.

The marginal average of technological substitution $\mathbf{MRTS_{LforK}}$equivalent to dividing the marginal product of the work ($\mathbf{MP_L}$) on the marginal product of capital ($\mathbf{MP_K}$) (Shahata,2006).

$\mathbf{MRTS_{L\ for\ K} = MP_L / MP_K = -\ dl / dk}$

$$= \frac{0.007\ (\ 0.191)\ K1.259\ L0.191-1}{0.007\ (1.259)K1.259-1\ L0.191} = \frac{0.191K1.259\ L-0.809}{1.259K0.259\ L0.191} = \frac{0.191L}{1.259K}$$

In the MRS equation, the marginal substitution rate decreases constantly when a production resource is replaced by another resource. When the resource used decrease than the second resource, the production of a quantity of output increases. The more significant the substitution of units of the first factor replaces the second factor. In other words, Thefactor that will compensate for the deficiency of the other element in one unit and this is known as the principle of diminishing marginal output (Leftwich, 1976. P[160]). Which has a great importance because it refers to the achievement of the second condition of price efficiency, as this condition appears in the curve of the equal productiontowards theorigin point (Atia, 2005).

Flexibility of substitution:-

The flexibility of substitution among productive resources and labor hours and capital (Shehata, 2006) is measured as follows:

$$\mathbf{ES = ES_{L\ for\ K}\ (L/K)}$$

$$= \frac{0.191\ L}{1.259K}$$

$$\mathbf{=0.152}$$

To calculate the share of each factor of production, this is by dividing the estimated flexibility of each factor by the total flexibility of the function (Bi / B, S).

When applying this, we obtain the share of each productive resource of the total production. on this basis, the capital is the first and then the working hours, respectively (0.87, 0.13).

Second: estimation of economic efficiency and its components:-

Capacity efficiency and technical efficiency:-

Capacity efficiency is the standard that determines the nature of the capacity return of any production unit by measuring capacitance efficiency. The main reason for this method is that economies of scale can directly determine the efficient and inefficient production unit. Capacity efficiency is measured by the Variable Return Scale (VRS) and the Constancy of Return Scale (CRS). Using the DEA method. Thus, the degree of technical efficiency obtained through VRS, CRS is divided into two parts, and one of them due to inefficient capacitance and the other due to technical inefficiency. If there is a difference between the technical efficiency obtained from VRS and CRS for the production unit, this means that the production unit suffers from a lack of (volumetric efficiency) which is equivalent to the difference between technical efficiency in VRS, CRS, so that the degree of inefficiencies obtained for any production unit can be related with technical inefficiency or inefficient size. The capacity efficiency (volumetric efficiency) of the unit is calculated by dividing the technical efficiency index of the unit with CRS stability to the technical efficiency index of the unit itself as follows:

Sei = $\frac{TEicrs}{TEivrs}$

If Sei:1 means capacity efficiency (size), while Sei> 1 means no capacity efficiency (porras, 2011), the data envelope loading model is used to measure economic efficiency and its components in case of stability of size and other returns. Technologyefficiency(Input-Oriented) refers to the ability to reduce the use of physical production to a specific level of production and to the possible increase in production using a specific set of inputs and the possible reduction in input to a specified amount of output (Osborne, 2006).

By reviewing the data of Table 5, it was found that the rate of technical efficiency in light of the change in capacity return was 0.821%, and this means that the sample can increase its output by 0.179 to reach the (one) at the optimum size or reach the lowest point on the long-term cost curve. Also the results of technical efficiency in Table 5 refers to that the technical efficiency ranges from (0.469-1). It was also noted that 33.3% of the farmers in the sample achieved 100% capacity efficiency. They can be considered as model farms and can continue according to the current combination of production factors although their size efficiency does not exist. This means that total production increases by adding other production variablefactors.

The results of the technical efficiency in light of the change in capacity returns showed that 11 of the sample farmers, by 36.66%, were 100% efficient, While 1 of the sample farmers by 3.33% efficient, while the technical efficiency with changing capacity returns was 4 farmers, by 13.33%, while 3 farmers were with efficiency of 10%, the efficiency was 20% for 6 sample farms and 6.66% for two farms of sample and 10% for the last 3 farms. as for the results obtained in light of the stability of capacity return to the farmers of the sample, the average of it reached 0.748%.

The results showed that 9 of the sample farmers were efficient in light of the stability of the capacity returns. The efficiency achieved 100% by 30% of the sample farmers, and 21 of the other farms achieved percentage between 3.33% and 13.33% Which is equal 70% from total number of sample farms due to the inefficiency of these farms for the poor conditions and conditions surrounding the province and the lack of encouragement to the cultivation of this crop, as well as low technical efficiency of these farms to the small cultivated areas and the weakness of the management in the farms.

Table.5 Technical efficiency in terms of change, yield stability and capacity efficiency.

firm	crste	vrste	scale	Yield size	firm	crste	vrste	scale	Yield size
1	0.919	0.928	0.991	drs	17	0.467	0.501	0.932	Irs
2	0.835	0.913	0.915	irs	18	0.748	0.759	0.985	drs
3	1	1	1	-	19	0.715	0.728	0.982	irs
4	0.335	0.527	0.636	irs	20	0.736	1	0.736	irs
5	1	1	1	-	21	0.821	0.971	0.846	irs
6	1	1	1	-	22	0.504	0.534	0.942	irs
7	0.629	1	0.629	irs	23	0.704	0.767	0.918	irs
8	0.659	0.716	0.919	irs	24	0.545	0.653	0.834	irs
9	0.682	0.682	1	-	25	1	1	1	-
10	0.629	0.697	0.903	irs	26	0.44	0.77	0.571	irs
11	0.812	0.825	0.984	drs	27	1	1	1	-
12	0.892	0.896	0.995	drs	28	1	1	1	-
13	1	1	1	-	29	0.44	0.77	0.571	irs
14	1	1	1	-	30	1	1	1	-
15	0.478	0.534	0.894	irs	mean	0.748	0.821	0.905	
16	0.452	0.469	0.965	irs					

The source of the work of researchers using program DEAp.

1- Specialized and economic efficiency of sample farms:-

Before beginning to discuss the results obtained in Table 6, we must know what we mean by specialized competence and economic efficiency. Specialized competence refers to the production of a certain quantity of outputs and the lowest possible cost of production inputs (Qurmla, 2015). Economic efficiency means the use of production resources in a manner that can increased the production with same of the previous production costs or the achievement of the previous production with lower costs (Alhchami andAgili, 2015). Economic efficiency includes both technical efficiency and price efficiency. Technical efficiency reflects the productive supply ratio to produce a specific level of production, and the price efficiency reflects the maximal combination of profit. Economic efficiency results from both technical efficiency and price efficiency (Kopp, 1981). Economic efficiency is achieved through the exploitation of productive resources in the best alternative uses (Masood, 1985). The results in Table 6 indicate that the efficiency of the specialty ranged between 0.24 and the one with average 0.577. This ratio is relatively low and indicates the potential of the farmers to increase their production. This means that the redistribution of economic resources will provide 0.423 of the production cost while maintaining the current production at the same level. This means that the output can be increased by 0.423 without raising the amount of resources used. and this value move us to the point of contact between the curve of the equal product and the budget line. This result is low when compared to the technical efficiency indicator, which has an impact on low economic efficiency (cost efficiency). Three farms achieved 100% specialized efficiency, representing 10% of the total sample at the same time technically and economically efficient. The results showed that 8 farms with technical efficiency, but without the specializeefficiency ,and the reason is due to high costs of production factors, which means that the production of the market at this point has technically efficiency andnot has specialize efficient.

As for the economic efficiency (cost efficiency) which is equal The of technicalefficiency multiplying by the specialized efficiency which averaged 0.498, ranging between 0.194-1. This indicates that the farms can produce the same level of production in light of the reduction of costs by only 0.502 or less of the economic resources and this level of decline due to the decline in the specialized efficiency and to not benefit according to the concept of economies of capacity when purchasing production factors or when selling production. This is also due to the lack of government support and encouragement to farmers for agriculture and interest in this crop in Diyala governorate.

Table 6.Technical, customized and economic efficiency.

firm	te	ae	ce	firm	te	ae	ce
1	0.928	0.972	0.902	16	0.469	0.414	0.194
2	0.913	0.351	0.32	17	0.501	0.413	0.207
3	1	0.474	0.474	18	0.759	0.255	0.193
4	0.527	0.608	0.32	19	0.728	0.409	0.298
5	1	1	1	20	1	0.742	0.742
6	1	0.44	0.44	21	0.971	0.897	0.871
7	1	0.675	0.675	22	0.534	0.42	0.224
8	0.716	0.298	0.214	23	0.767	0.39	0.299
9	0.682	0.354	0.242	24	0.653	0.342	0.223
10	0.697	0.337	0.235	25	1	0.249	0.249
11	0.825	0.969	0.8	26	0.77	0.472	0.363
12	0.896	0.949	0.851	27	1	0.924	0.924
13	1	1	1	28	1	0.903	0.903
14	1	1	1	29	0.77	0.434	0.334
15	0.534	0.368	0.196	30	1	0.25	0.25
				mean	0.821	0.577	0.498

The source of the work of researchers using program DEAp.

IV. Conclusions

1- The average of cultivated area within the study sample was 4.2 donums, indicating that the cultivated areas of the crop are small areas and there is a lack in cultivation of this crop, which indicates a lack of interest in planting it.
2- The production elements are used within the second stage and increasing those leads to increased production by a larger percentage.
3- There is the possibility of replacing the capital element of work and this is the introduction of technology of mowers and others in the cultivation of the crop.
4- Production can be increased by 18% or production of the same current output using 82% of the resources, indicating that there is waste of resources.

V. Recommendations

1- It is essential for the government to support farmers by providing seeds and chemical fertilizers for being subsidized,reliable origin and source at subsidized prices. And direct the farmers to increase the cultivation of this crop by expanding the cultivated areas, especially that Diyala governorate is characterized by large areas that have not been exploited.

2- Directing the farmers to reduce manual labor and encourage the use of modern machinery and mechanization and irrigation systems, which in turn saves the effort and money in the farms.

3- Direct the Directorate of Agriculture in the governorate to work a special program directed at farmers, especially in the modern management because they need to.

4- The development of agricultural plans and price policies for this crop and opening of many marketing routes to reduce the burden on farmers and protect them and reduce the reluctance of farmers to grow this important crop.

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