ESTIMATING PROFIT , COST FUNCTION AND TECHNICAL EFFICIENCIES OF RICE PRODUCTION IN NEJAF FOR SEASON 2016*

A. K. Al-Mashhdani Z. H. Mahmood
Researcher Lecturer
Dept. Agric. Economic- Coll. of Agric. University of Baghdad
Alisaker19933@gmail.com Um_zeina@yahoo.com

ABSTRACT

The aim of this study was to estimate the profit and cost functions as well as economic, price, cost, and technical efficiencies beside the other economic indices at actual, optimal and profit-maximizing output of rice. A random sample of 240 rice farms in Nejaf province was used during the agricultural season 2016. From efficiency scales of profit function, it was shown that the output quantity had the greatest impact on the profit compared to other variables (average output costs and price). According to the cost function, the optimum output level and the profit- maximizing output level for the short run were 64.84 tons and 117.4 tons respectively. The lowest price that the farmer can accept was 194.83 thousand dinars / ton. At this price, the producer loss all fixed costs in the short run, hoping that the price of rice will improve in the long run. Net profit was estimated on the basis of actual output, cost minimizing output (optimal) and profit-maximizing output, which amounted to 8084.32, 30852.65 and 45547.5 thousand dinars, respectively. The of technical efficiency were 34%. and the cost efficiency was 0.52. We conclude from the study that economic resources have not been exploited optimally, indicating that actual output is far from optimal output. The study recommends a output policy aimed at increasing economic efficiency and optimizing the use of available resources.

Keywords: profit-maximizing output, optimal output, actual output.

***Part of M.Sc. thesis of the 1st author.**

مجلة العلوم الزراعية العراقية -2019 :50(5):1237-1246 المشهداني ومحمود

تقدير دوال الربح والكلفة والكفاءة الفنية لإنتاج الرز في النجف للموسم 2016

علي خضير عبد المشهداني زهرة هادي محمود
باحث مدرس
قسم الاقتصاد الزراعي – كلية الزراعة – جامعة بغداد

المستخلص

هدفت الدراسة الى تقدير دالتي الربح والكلفة بالإضافة الى الكفاءات الاقتصادية والسعرية والكلفة والتقنية الى جانب المؤشرات الاقتصادية الاخرى في انتاج الرز الفعلي والامثل والمعظم للربح. استخدمت عينة عشوائية من 240 مزرعة رز (صنف الياسمين) في محافظة النجف خلال الموسم الزراعي 2016.من خلال حساب دالة الربح تبين ان كمية الانتاج كان لها الاثر الاكبر على الربح مقارنة بالمتغيرات الاخرى (متوسط التكاليف، سعر الناتج). على اساس دالة الكلفة فقد بلغ مستوى الانتاج الفعلي والانتاج الامثل والانتاج المعظم للربح في الامد القصير 22.04 طن و 64.83 طن و 117.42 طن على التوالي. فيما بلغ اقل سعر يقبله المنتج 194.83 الف دينار وهو السعر الذي يخسر فيه المنتج جميع التكاليف الثابتة في الامد القصير على امل ان يتحسن سعر الرز في المدى الطويل. تم تقدير تم تقدير صافي الربح على استنادا على الانتاج الفعلي والانتاج المدني للتكاليف (الامثل) والانتاج المعظم للربح، اذ بلغ 8084.32 و 30852.65 و 45547.5 الف دينار على التوالي. اما الكفاءة الفنية فقد بلغت 34%، في حين بلغت كفاءة الكلفة 0.52. تشير نتائج الدراسة الى عدم الاستغلال الامثل للموارد الاقتصادية مما يدل على ان الانتاج الفعلي بعيد عن الانتاج الامثل. توصي الدراسة بضرورة اعتماد سياسة انتاج هادفة تؤدي الى زيادة الكفاءة الاقتصادية وتحسين استخدام الموارد المتاح.

الكلمات المفتاحية: الانتاج المعظم للربح، الانتاج الامثل، الانتاج الفعلي.

***البحث مستل من رسالة ماجستير للباحث الاول.**

***Received:18/8/2018, Accepted:9/12/2018**

INTRODUCTION

Rice is one of the most important crops in the development of the agricultural sector. It is also a staple food for the most tropical and subtropical countries. This crop is a main food for more than half of the world's population, especially in the Far East, Japan, India, China, Vietnam, Pakistan and other countries It is the third main crop after wheat and barley in Iraq and the first major summer crop, which occupies a prominent position in the agricultural production. It is highly favored and consumed by Iraqis. Rice grains contain 6-8% protein, 65-70% starch and 4- 6% oil. Rice is easy to digest, so it is recommended for people suffering from gastric diseases (21). Although rice cultivation is ancient in Iraq, it is relatively very limited compared to the production of other cereal crops such as wheat and barley. This is due to the lack of irrigation water available in the rivers during the growing season, and there are insufficient drains in most of the land to discharge excess water. This crop is grown at different areas of Iraq especially province of Najaf and Dewaniya which are fore front of the provinces in runs of area and production followed by the province of Maysan. Statistics of agricultural production indicate that the quantities produced from cereals such as wheat, barley and rice are insufficient to meet the needs of domestic consumption So, Iraq has to import these crops from abroad to meet the shortage in their production. The average rice cultivated area in Iraq was 331 thousand dunums, while the average cultivated area in Najaf was 142 thousand tons during the period 1980-2016. The contribution rate represented 43% of the average cultivated area in Iraq for, while the average total production was about 230 thousand tons, from which Najaf contributes by 47% (8). The research problem is the fluctuation of cultivated area of rice in Najaf province which led to a decrease in the production of this crop. Such decrease may be attributed to a technical and economic problems facing the cultivation of this crop including a decrease in the water quota and absence of optimization concept from farmers ideology. Therefore, it is necessary to search for modern methods to overcome these problems and the obstacles facing the cultivation of this crop.The study is based on the hypothesis that the rice farmers in Najaf province did not reach optimization both in runs of output or resources exploitation in the production process, which led to a decrease in economic efficiency of rice production.. This study aimed to estimate function production costs in the short-run, measurement of technical and economic efficiency and the efficiency of the cost for a sample of farmers in order to show how to expand the production that achieves the optimum level of the output and input. several other studies have addressed this issue using the rice crop in different geographical locations (1,2,3,5, 6,14,15,16,17,20,22).

MATERIALS AND METHODS

Well organized questionnaires were used to collect cross sectional data from a random sample of 240 rice (Jasmine variety) farmers which represented 7.5% of the total population in Najaf province for three districts: Abbasiya, Al-Manathira and Mashkhab during the agricultural season of 2016. Collected data were analyzed in statistical programs, Excel and Eviews10.

Descriptive analysis of rice costs for the research sample

Total variable costs (TVC): Results inTable1 Shows variable costs (for each donum) including production requirement costs (seeds, fertilizers, pesticides), mechanical processes, labor costs, and fuel and maintenance. According to the table, production requirement costs had the largest contribution among variable cost (35.55%), followed by the cost of mechanical work (29.63%), rented labours (20.11%), and finally fuel and maintenance (14.7%).

Table 1. Relative importance of items of variable costs rice crop production

Variable cost items	Value (1000 Dinars)	Relative importance%
Production requirements	461007.2	35.55
(Seeds, fertilizers, pesticides)	384346.18	29.63
Mechanical labor costs		
Rented labor	260835.18	20.11
Fuels and maintenance	190587.00	14.70
Total variable cost	1296775.76	100%

Source: calculated based on the questionnaire form.

Fixed costs (FC) fixed costs were divided in to two items: family labor costs, which constitute 84.1% of the fixed costs, and land rent (15.9%) .

Table 2. Relative importance of fixed costs items of rice production.

Fixed cost items	Value(thousand dinars)	Relative importance %
Family labor cost	190827.75	84.1
Farm rent	35962.5	15.9
Total fixed cost	226790.2	100

Source: calculated based on the questionnaire form

Total costs (TC)

The total costs of the rice production was divided into fixed costs and variable costs. The variable cost contribution ratio was 85.11%, while the fixed costs share did not exceed 14.89%. This gives a clear picture that the relative importance of variable costs is greater than fixed costs as shown in Table 3.

Table 3. Relative importance of fixed and variable costs from total costs of rice production

Total costs items	Value (thousand dinars)	Relative importance%
Variable cost	1296775.76	85.11
Fixed cost	226790.25	14.89
Total cost	1532566.01	100

Source: calculated based on the questionnaire

Estimation of profit function

Ordinary least square was used to estimate the parameters of profit function. The function model was estimated according to the economic theory which states that the profit equals to total revenue (TR) minus total cost (TC) (7). can be derived as follows:

$$\pi = TR - (TVC + TFC)$$

$$TR = P_Q * Q \,, TC = P_X . X + TFC$$

$$\pi = \sum P_Q . Q - [\sum P_X . X + TFC]$$

Where:

π: profit

: product price

Q: output

X:input

P_X : price of variable resources

TFC : total fixed costs

From equation, the profit function can be derived as follows:

$$\pi = (P_Q, AC, Q)$$

Accordingly, the profit function model can be specified as follows (10):

$$\pi = b_o + b_1 P_Q - b_2 C + b_3 Q + U_I$$

Where:

π: profit (100 ID) .

P_Q: output price per ton (1000 ID)

C: average production cost (1000 ID/ton)

Q: product size of rice (ton)

b_O: intercept

b_i: regression coefficients

U_I: error run

Economic, statistical and econometric analysis of profit function: The econometric relationships among profit function were analyzed by OLS which showed that the best model, according to economic and statistical logic, was the linear model (Table 4).

Table 4. Estimation of profit function for rice production

Variable	Coefficient	Std. Error	t- Statistic	Prob.
C	-18099.16	2597.575	-6.967713	0.0000
P	27.81494	3.680398	7.557590	0.0000
Q	425.5893	4.028052	105.6564	0.0000
AC	-5.189854	1.130801	-4.589537	0.0000
R-squared	0.980848	Mean dependent var	8108.046	
Adjusted R-squared	0.980605	S.D. dependent var	14717.82	
Sum of regression	2049.703	Akaike info criterion	18.10530	
Log likelihood	9.92E+08	Schwarz criterion	18.16331	
F-statistic	4028.870	Hannan-Quinn criter.	18.12868	
Prob(F-statistic)	0.000000	Durbin-Watson stat.	1.766343	

Source: Calculated using Eviews.10

Diagnostic tests indicated that the model has no autocorrelation by using LM at (0.184) probability for two lag periods. Therefore, the null hypothesis could be accepted, that is the model is free from autocorrelation.

Table 5. Test (LM) to detect the problem of autocorrelation
Breusch-Godfrey Serial Correlation LM Test

F-statistic	1.703509	Prob. F(2.234)	0.1843
Obs*R-squared	3.444231	Prob. Chi-Squre(2)	0.1787

Source: Calculated using Eviews.10

The result of Ramsey Reset test suggested a rejection of the presence of error in model derunination at probability (<0.001) for two lag periods.

Table 6. Ramsey Reset to detect an error in the model

	Value	df	Probabilit
t-statistic	5.142434	235	0.0000
F-statistic	26.44463	(1,235)	0.0000
Likelihood ratio	25.59288	235	0.0000
F-test summarv:			
	Sum of Sq.	df	Mean
Test SSR	1.00E+08	1	1.00E+0
Restricted SSR	9.92E+08	236	420128
Unrestricted SSR	8.91E+08	235	379240
LR test			
	Value		
Restrided LogL	-2168.636		
Unrestricted	-2155.840		

Source: Calculated using Eiews.10

On the other hand, multicollienerity between independent variables was found to be less than 10 using variance inflation factors test. From the last result, it can be concluded that the model is free from multicollienerity (12).

Table 7. Variance Inflation Factors Test of profit function for rice production

Variable	Coefficient Variance	Uncenter VIF	Centered VIF
C	6747396.	385.4477	NA
P	1354533	366.5343	1.000731
Q	16.22520	1.507475	1.057339
AC	1.278711	15.27005	1.057016

Source: Calculated using Eviews.10

The test of Breusch-Pagan-Godfrey showed that there is a problem of heteroscedasticity with a probability value of (<0.001).

Table 8 .Heteroskedasticity Test By (BPG).

F-statistic	15.99005	Prob. F(3,236)	0.0000
Obs*R-squared	40.54241	Prob. Chi-Square(3)	0.0000
Scaled explained SS	543.1386	Prob. Chi-Square(3)	0.0000

Source: Calculated using Eviews.10

This problem was treated using the Robust M-Weighted Estimator (R.M.W) regression method. Data is often characterized by natural distribution, but sometimes it may take a different pattern. This is due to the presence of abnormal values, which have a negative impact on the results of statistical and standard methods through a problem Heteroscedasticity (12). RMW method corrects the standard errors of White Heteroscedasticity that occurs as a result of the presence of outliers in the data. Estimation of this model using traditional methods such as OLS leads to the loss of its good properties. The RMW method modifies the extreme values in the matrix of the independent variables using the weighting matrix for the Least Squares Method (WLS). Then, the extreme values are addressed in response vector using the error vector (weighted least squares error vector). Finally, the new estimates are found by RMW (9).

Table 9.Estimation of profit function for rice production by Robust Least Squares

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-11090.14	1458.017	-7.606317	0.0000
P	18.70736	2.065804	9.055728	0.0000
Q	390.0880	2.260942	172.5334	0.0000
AC	-5.411933	0.634718	-8.526519	0.0000
Robust Statistics				
R-squared	0.698760	Adjusted R-squared		0.694931
Rw-squared	0.986822	Adjust Rw-squared		0.986822
Akaike info criterion	285.2258	Schwarz criterion		300.9903
Deviance	3.31E+08	Scale		1089.784
Rn-squared statistic	32288.41	Prob(Rn-squared stat.)		0.000000
Non-robust Statistics				
Mean dependent var	8108.046	S.D. dependent var		14717.82
S.E. of regression	2399.708	Sum squared resid		1.36E+09

Source: Calculated using Eviews.10

From the coefficient of derunination value R^2, it is obvious that the model explains 69% of the total changes in the profit function of Rice. This indicates the major influence of explained factors (PY, AC, and Q) on profit function, while only 31% of these changes are attributed to other factors were not included in the model. Results showed that all estimated coefficients for profit function were significant at 1% probability according to Z test. The profit function of the rice crop would take the following form:

$$\Pi = -11090 + 18.707PQ + 390.088Q - 5.412AC$$

The sign of all variables was in accordance with economic theory. Coefficients of product price and quantity took the positive sign with profit which implies a positive association between the profit and each of product price and quantity. Thus, an increase of price by thousand dinars (with other factors are fixed) will result in 18.707 thousands ID increase in profit, and one-ton increase in product will result in 390 thousands ID in profit (with other factors are fixed). On the other hand, production cost coefficients took the negative sign with profit, which implies a reverse relationship between profit and the average cost of production. An increase of thousand dinars in production cost will result in 5.41 thousands ID decrease in profit. It is obvious from coefficients of scale variables that the product price has the greatest influence on the profit.

Estimation of cost function

The total cost function was estimated using OLS and different functional formulas to derunine the appropriate relationship for variables included in the mathematical form. The linear formula which was subject to tests (economic, statistical and standard) was depended . Based on economic theory, the short-run total cost (10) function takes the following formula:

$$tc = a_o + b_1Q + b_2Q^2 + b_3Q^3 + ui$$

Table 10. Estimation of cost function of rice production

Variable	Coefficient	t-Statistic	Std. Error	Prob.
C	1056.817	4.117009	256.6954	0.0001
Q	275.1197	16.17088	17.01328	0.0000
Q2	-4.427606	-40.33907	0.109760	0.0000
Q3	0.032921	128.4162	0.000256	0.0000
R-squared	0.957355	Mean dependent var		7013.079
Adjusted R-squared	0.956813	S.D. dependent var		8996.835
S.E. of regression	1869.667	Akaike info criterion		17.92143
Sum squared resid	8.25E+08	Schwarz criterion		17.97945
Log likelihood	-2146.572	Hannan-Quinn alter.		17.94481
F-statistic	1766.040	Durbin-Watson stat		1.949639
Prob(F-statistic)	0.000000			

Source: Calculated using Eviews.10

The model shows that there is no auto-correlation problem because the calculated DW value is equal to (1.949), which is between (du <d <4-du) i.e. (1.704 <1.949 <2.296) and is located in the acceptance area of the null hypothesis which states that there is no problem of autocorrelation between residues. It is important to note that Q^2 and Q^3 are functionally related to the variable Q_i, but the relationship is nonlinear. Thus, this model satisfies the assumption that there is no linear relationship between the independent variables (11) because the model is non-linear .Because of the adoption of cross-sectional data, it is necessary to detect the problem of Heteroscedasticity. Breusch-Pagan-Godfrey (12) has been tested using Eviews.10, which includes the estimation of error square regression equation as a dependent variable (Q), Q2 and Q3 as independent variables(13). The test proved significant (F) from which it is possible to conclude that the estimated model suffers from the problem of heteroscedasticity as shown in Table (11).

Table 11. Heteroskedasticity Test By (BPG).

F-statistic	**34.46889**	**Prob. F(3,236)**	**0.0000**
Obs*R-squared	**73.12054**	**Prob. Chi-Square(3)**	**0.0000**
Scaled explained SS	**424.0729**	**Prob. Chi-Square(3)**	**0.0000**

Source: Calculated using Eviews.10

In order to overcome this problem, the Robust M-Weighted Estimator (RM.W) was used (9). After treatment, the short-run total cost function was estimated as in Table 12.

Table 12. Estimation of cost function of rice production By Robust Least Squares

Variable	Coefficient	SW. Error	z-Statistic	Prob.
C	900.2594	220.3158	4.086223	0.0000
q	307.4431	14.60211	21.05470	0.0000
q2	-3.676260	0.139893	-26.27899	0.0000
q3	0.030295	0.000327	92.71770	0.0000
Robust Statistics				
R-squared	0.520592	Adjusted R-squared	0.514497	
Scale	1213.733	Deviance	1473148.	
Rn-squared statistic	245920.9	Prob(Rn-squared slat.)	0.000000	
Non-robust Statistics				
Mean dependent var	7013.079	S.D. dependent var	8996.835	
S.E. of regression	45279.07	Sum squared resid	4.84E+11	

Source: Calculated using Eviews.10

Results showed that all estimated coefficients for cost function were significant at 1% probability according to Z test. Derunination coefficient was 0.52 which means that the total output explains about 52% of changes occurring in the production cost of rice, while other variables change (which represented about 48%) are attributed to other factors not included in the model, such as education, experience, age, and family size. The function passed all econometric tests, and thus it could depend on to derive the long-run cost functions.

$$SRTC = 900.259 + 307.443Q - 3.676\,Q^2 + 0.030\,Q^3 \ldots\ldots(1)$$

Both marginal and inrunediate costs were derived from the estimated production cost function (1) and could be expressed in the following equations:=

$$MC = 307.443 - 7.352Q + 0.09Q^2 \ldots\ldots(2)$$

$$SRATC = \frac{SRTC}{Q} = \frac{900.259}{Q} + 307.443 - 3.676Q + 0.030Q^2 \ldots\ldots(3)$$

According to average current production of farms which is (22.038) tons, both marginal and Average production costs are estimated at (189.134, 281.856 thousand dinars respectively). The estimated cost elasticity at this production level is about 0.67. Therefor. these farms are subjected to the increase in yields, and when the costs increase by a certain amount, the production will further increase

Optimal behavior of the product in the short run

In order to find the optimal behavior of rice producers in the short- run, and to identify the optimum level of production, the short-run objective of the product is either to maximize profit and gaining economic profits or to minimize costs (assuming that the market is the perfect market for competition and objective). Therefore, the optimal level of the cost minimizing output can be obtained by finding the minimum end of the average total cost function by performing the first differential of function (3) for the production volume (Q) and then equalizing it with zero as follows:

$$\frac{dSRATC}{dQ} = -900.259Q^{-2} - 3.676 + 0.06Q = 0 \dots\dots(4)$$

Multiply equation 4 by(- Q^2) results that:=

$$900.259 + 3.676Q^2 - 0.06Q^3 = 0 \dots\dots(5)$$

Equation 5 can be solved by trial and error or by Newton approach for solving non-linear equations (3). The last approach requires the assumption of an initial value to find out the current value. This calculation was repeated until the two values (initial and current) are equal or too closed to achieved the required accuracy i.e. the past value is almost equal to its current counterpart (4). Rice production was then estimated at lowest point of ATC (optimal production average) to be about 64.84 ton. This average is greater than that of actual production (22.038 tons) by 42.8 tons.

The minimum price accepted by farmers to supply their products

This was estimated by achieving the first differentiation for average variable cost function and equalizing it with zero (1).

$$SRAVC = 307.443 - 3.676Q + 0.030Q^2 \dots\dots\dots(6)$$

$$\frac{\partial AVC}{\partial Q} = -3.676 + 0.06Q = 0 \dots\dots(7)$$

$$Q = 61.27$$

Thus, the production size at the lowest point of average variable costs was estimated to be about 61.27 ton. By substituting of this value in equation 6, the minimum value for average variable cost was obtained which was 194.83 thousand ID that represents the minimum price acceptable by the producers.

The level of output that maximizes profit

This size can be calculated by equalizing the marginal cost with the product price (9) which is 685 thousand ID/ton, as follows:=

$$307.443 - 7.352Q + 0.09Q^2 = 685 \dots\dots(8)$$

$$0.09Q^2 - 7.352Q - 377.557 = 0 \dots\dots(9)$$

Constitution approach was used to solve this quadratic equation according to the following formula:=

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

For a=0.09, b=-7.352, c= -377.557:

$$Q = \frac{7.352 \pm \sqrt{(7.352)^2 - 4(0.09)(-377.557)}}{2(0.09)}$$

$$Q = \frac{7.352 \pm 13.785}{0.18}$$

Economic analysis showed the output which maximizes the profit (117.42 tons) which is higher than the optimal production size (64.83 tons) by 52.59 tons

Cost elasticity

The cost elasticity can be found by dividing the marginal costs on the average costs in the short-run for each of production levels represented by the actual production level of (22.04) ton, optimum production level of (64.84) tons, and the profit-maximizing level of (117.40) ton. The actual, optimal and profit-maximizing level were substituted in both MC and ATC. The elasticity at the actual output level (0.772) was less than the correct one. This indicates that production is subjected to increasing yields i.e there is a relative increase in production at a lower relative cost. Cost elasticity at optimal output was (1).This means that at optimal production level of (64.84 tons), the relative increase in output is equal to relative increase in the cost. Therefore, the production in these farms will be subject to the stage of yield stability. At profit-maximizing level of 117.4 tons, the elasticity was 2.31, which means that the relative increase in output is achieved with a relatively higher cost. Thus, the production of these farms is subject to the period of decreasing yields. (table 13).

Table 13 . marginal costs, elasticity Cost average variable costs and average total costs of rice crop in Najaf Governorate

Quantity	Average total costs	Average variable costs	Marginal costs	Elasticity Cost
10	363.709	273.683	242.923	0.667
22.037	244.739	241.004	189.134	0.772
30	254.172	224.163	167.883	0.66
40	230.909	208.403	157.363	0.681
50	216.648	198.643	164.843	0.76
60	209.887	194.883	190.323	0.906
64.835	209.102	195.216	209.102	1
70	209.984	197.123	233.803	1.113
80	216.616	205.363	295.283	1.363
90	229.606	219.603	374.763	1.632
100	248.846	239.843	472.243	1.897
110	274.267	266.083	587.723	2.142
117.433	297.141	289.475	685.221	2.306
120	305.825	298.323	721.203	2.358

Source: calculated based on the questionnaire

Measuring the Technical Efficiency of Rice Production

Technical efficiency, in general, means the production of as much as possible net output using a certain amount of resources, or achieve the same amount of output with the minimum possible resources. Technical efficiency can be measured as follows(18).

Technical Efficiency = (Actual Output / Optimum Output) * 100

(22.04 / 64.83) * 100 = 0.33.9%

It is evident from the technical efficiency measures that about 66% of the economic resources have not been fully utilized and this value is high, indicating that actual production is far from optimal production

Cost Efficiency of Rice

Cost efficiency can be obtained by dividing TC at actual production level on TC at optimal production level, according to the following formula (19):

$$CE = (Ci^{bi} \div Ci^{min})$$

Where:

CE: cost efficiency

Ci^{bi}: TC at actual production level

Ci^{min}: TC at optimal production level

$CE = \frac{7013.08}{13556.10} = 51.7$

Cost efficiency may take more or less than unit. It is achieved when it takes the correct one value (7). Cost efficiency for rice less than the unit implies that resources were not optimally exploited

Estimation of net income

The study involved the calculation of some economic indices such as net income for three production levels (actual, optimal and profit maximizing) depending on profit equation (2). These levels were respectively found to be 22.04, 64.83 and 117.42 keeping in mind that 685 thousand dinars is the price of rice ton (9) (equation 10).

$$\pi = TR - TC$$

$$\pi = 685 * Q - (900.259 + 307.443Q - 3.676\ Q^2 + 0.030\ Q^3) \ldots\ldots (10)$$

Substitution the values of actual, optimal and profit-maximizing production in equation (10), we obtain the net return at those levels which amounted to (8084.32, 30852.45, 45547.5 thousand dinars, respectively), as shown in table (11). The highest net return was achieved in case of profit maximizing production. However, the optimum level of production is characterized by producing one ton of rice at the minimum cost compared to other levels. The average cost of the optimum production volume reached (209.10) thousand dinars / ton, while the average cost at the profit maximizing production was about (297.09) thousand dinar/ton, and at the actual production level about (318.32) thousand dinars / ton. The highest level of average net return index was achieved at the optimum production volume, which was (475.90) thousand dinars / ton and the lowest level in the actual production amounted to about (366.80) thousand dinars / ton. The highest level of profitability efficiency was achieved at the profit maximizing production which was 2.30. For one dinar return index, it was found that one thousand dinars, spent on the optimal production size achieved a relative increase of 3.28. The profitability index from the total revenues showed that it reached the highest level at the optimal production followed by the profit maximizing production and then actual production. This means that the total revenues obtained from the optimal production will achieve a profit of (0.69) compared with the other levels of production which achieved a profitable profit estimated at 0.56 and 0.54 respectively. It can be concluded from the previous analysis that the level at the optimal production is the best according to economic indicators as shown in table (14).

Table 14. Economic indicators of rice crop production

Index	Actual product (ton)	Optimal Production size (ton)	Profit max. product (thousand dinars)
Product size (tons)	**22.037**	**64.835**	**117.42**
Total revenue (thousand dinars)	**15097.4**	**44408.6**	**80432.7**
Total costs (thousand dinars)	**7013.08**	**13556.10**	**34885.2**
Net return (thousand dinars)	**8084.32**	**30852.5**	**45547.5**
Average net return (thousand dinars / ton)	**366.80**	**475.90**	**387.9**
Average total costs (thousand dinars / ton)	**318.20**	**209.16**	**297.09**
Return dinar	**2.15**	**3.28**	**2.30**
Profitability efficiency	**1.15**	**2.28**	**2.30**
Profitability of the total revenue	**0.542**	**0.695**	**0.565**

Source: calculated based on the estimated costs and the profit function

Based on the results of this study, it can be concluded that the production quantity had the greatest impact on the profit compared to other variables (average production costs and Price). According to technical efficiency and cost efficiency, the economic resources used in the production process have not been optimally explained , resulting in low technical efficiency. By calculating the price of the crop, which achieves the optimum production volume of 194.83 thousand dinars / ton and comparing it with the price derunined by the state to purchase the output of rice of 685 thousand dinars / ton, we find that the price specified for the producers achieves economic profits that encourage producers to continue and expand in production. The study recommends to follow a production policy to increase economic efficiency and to achieve the optimal usage of available resources.

REFERENCES

1. Abdulai, A.; W. E. Huffman . 1998. An Examination of Profit Inefficiency of Rice Farmers in northern Ghana. Eco. Staff Paper Series. MSc. Thesis Iowa State Univrsity/ USA. pp:10-12

2. Abedullah, S. K. and M. Khalid. 2007. Analysis of technical efficiency of rice production in Punjab (Pakistan) implications for future investment strategies. Pakistan Eco. and Social Review 45(2): 231-244

3. Adinku, E. O. 2013. Production risk and technical efficiency of irrigated rice farms In the Greater Accra and Volta Regions Of Ghana. Ph.D. Dissertation. College of Agriculture and Consumer Sciences University of Ghana, Legon. pp:42-45

4. AL- Ukeili, O.K.; Z. H. Mahmood; and N. K. Abbas. 2015. Estimating the profit cost functions and economic and technical efficiencies of maize production in Babylon province/ Iraq. Int. J. TJAAS. 1(3):66-73

5. AL-Enizy, L. D.; and E. H. Ali. 2017. An economic analysis of barley production function in Wasit province for 2014. Iraq J. Agric. Sci., 48(4).pp: 1040-1056

6. Ali, M. J.; and M. A. Ferhan. 2012. An estimation of costs function and size economies of Babil governorate as case study. Iraq J. Agric. Sci., 43(2).pp: 65-74

7. AL-Shafi'i, Mahmoud Abdel Hadi 2005, Modernization in the Economics of Production and

Analysis of Competencies between Theory and Practice, Al-Muraqqab University, Libya. pp:137-145

8. Al-Younes, A.H. 1993. Production and Enhancing Field Crops. Ministry of Higher Education and Scientific Research, Baghdad University, Baghdad. pp:220-227

9. Audibert, J. Y. and O. Catoni. 2011. Robust linear least squares regression. Ann. Statistics, 39(5): 2766–2794

10. Debertin, D. 1986. Agricultural Production Economics. MacMillan Publishing Company, New York. pp:41

11. Doll, J. P. and F. Orazem. 1984. Production Economics Theory with Application. John Wiley and Sons, New York. pp:117

12. Gujarati, D. 2004. Basic Econometrics. McGraw-Hill Book Co. New York, pp:470

13. Hassani, R. K. 2016. Analysis study of cost function estimation and optimal scale for fish farms in Babylon in 2010. Diyala. J. Agric. Sci., 3(1): 93-100

14. Idiong, I. C. 2007. Estimation of farm level technical efficiency in small-scale swamp rice production in cross river state of Nigeria: a stochastic frontier approach. J . Agric. Sci. 3 (5): 653-658

15. Kea, S.;. and L. H. Pich. 2016. An analysis of technical efficiency for household's rice production in Cambodia: A case study of three districts in Battambang Province. J. Human-Soc Sci. 16:33.44

16. Mahmood, Z. H. 2018. Measuring the economic and marketing efficiency of greenhouses for cucumber crops in Dhiqar governorate –Al- Shatra district/Iraq during the agricultural season 2017. Iraq J. Agric. Sci., 49(5).pp: 775-785

17. Mahmood, Z. H.; A. S. Bahar and S. A. Nasir. 2018. Estimating profit and cost functions and economic and technical efficiencies of wheat production in Nejaf province – Al-Abbassiya township (a case study) for season 2017. Iraq J. Agric. Sci., 49(3): 400-409

18. Ogundari, K.; S.O. Ojo and I.A. Ajibefun. 2006. Economics of scale and cost efficiency in small scale maize production: empirical evidence from Nigeria. J. Soc. Sci., 13(2): 131-136.

19. Rahman, S. 2003. Profit efficiency among Bangladeshi rice farmers. Food Policy. 28(5-6): 487-504

20. Shukr, H. H.; S. F. Khater and A. G. Zaidan. 2014. An economic study for estimation profit function and economic efficiency of producing bee honey –Diyala province- a case study. Iraq J. Agric. Sci., 45(5).pp: 504-511

21. Statistical publications for years (1980-2016), Ministry of Planning and Development Cooperation, Central Organization for Statistics, Agricultural Statistics.pp:20-25

22. Trong, P. H. and O. Napasinfuwong. 2015. Profit inefficiency among hybrid rice farmers in Central Vietnam. Agric. Sci. Procedia 5 : 89 – 95.