Journal of Genetic and Environmental Resources Conservation, 2014, 2(3):362-368.
www.jgerc.com

The use of the cost function in the estimation of technical efficiency, cost efficiency and profit for wheat and barley crops in the province of Diyala

Easkander H. Ali[1] and Aliya H. Lafta[2]*

[1]College of Agriculture and [2]College of Education, Ibn al-Haytham, University of Baghdad, Iraq.
*Corresponding author: alya_60@yahoo.com

Abstract

The cost function is one of paramount importance for economic planning, where describes the most efficient patterns of economic productivity, in light of the information and the prevailing technology. Hence the importance of the use of cost function analysis after the entering the components price associated with the extent of the impact of economic and other factors in what is classified internally or with external influence. So study aimed to estimate the cost functions for wheat and barley, by using estimation of production efficiency and cost efficiency and profit. Through questionnaire form randomly collected from 54 farmers for wheat and 51 barley farmers in Diyala Province from Iraq and adopted multiple models to estimate the cost function. It turns out that the Cubism formula is the most suitable for the analysis of the relationship between the cost of production factor as dependent and production as independent variable, due to passing for economic, statistical and econometric tests, standard and found that the size of the minimizing costs for wheat and barley crops reached 36.5 and 58 tons, respectively, the results indicated that farmers are losing some of their resources, and when compared to the cost efficiency and the efficiency of profit, showed that there is a difference between them ,this means there is absence of a positive relationship between them because each and every one of them measures the different quality of the improvement in the efficiency of the farms.

Keywords: Cost function, Production efficiency, Cost efficiency.

Introduction

Improved of economic performance considering goal sought by the different farming systems, many developing countries, including Iraq suffer from poor use of available resources which leading to low economic efficiency of farm and economic efficiency one of the important indicators which to identify the efficiency of the administration, in directing different economic resources. Economic communities aims for the allocation of resources, in order to achieve higher economic efficiency from mixing factors of production and get a bigger production, where it is the most important point for efficiency in economic theory. Economists gave great importance to efficiency, illustrated by describing Jevans to the problem of efficiency as the main problem in the economy as it lies the importance of the principle of efficiency in the utilization of human and material resources at the lowest cost possible, which is to achieve the greatest level of output at a certain level of technological available (Kalu and Mbanasor, 2008).

The low prices of agricultural products and import pressure consequent decrease in the strength of the market and requires of production units to accelerate the reduction of the levels of inefficiency, not only in the cost side but also in the part of the revenue, Where low levels of profitability making at decline all levels of inefficiency and that is necessary for the survival and progress the work study of efficiency has become a very important and that by estimating profit efficiency and cost efficiency (Berger and Mester, 1997). Which measures the change in the efficiency of the unit for the estimated costs to produce a set of output by better-performing units and are characterized by efficient administrative units through the exercise of control over the cost and use of inputs at low prices and quantities suitable with the amount required for optimal operation.

Also, cost efficiency can be produced from the adoption of management techniques and technology to achieve productivity costs kept to a minimum and when it approaches measure the degree of origin of the best practice costs, Lack of efficiency is due in this case to use larger quantities of inputs in light of the prevailing price and quantity

of output. The technical efficiency is the measure of success of farm in the production maximum power output of a set of input set, and so they represent a physical relationship between the inputs used in the production process and how to enable the farm to use the best available technological variables (Chavas and Alibra, 1993).

The grain crops have great importance to the stability and human progress, as these crops constitute a third of the dry matter and about half amount of protein in the human addressed by his nourishment, and in Iraq there are important strategic crops and is closely related to food security. And that it should impair grain cultivation in priority attention by the planners and agricultural policy makers and should work to achieve self-sufficiency in grain, which represents a strategic goal. Especially that Iraq possessed large tracts of arable land and produces a variety of cereal crops such as wheat and barley, but the predominant nature of this production in Iraq was the extreme volatility in the direction and development of both the scope of the acreage or production and productivity. Where is an annual average of areas planted with grains approximately (88%) of the cultivated area in Iraq and the percentage of its contribution to the agricultural production amounted to (47.6%), Despite this expansion, at the other hand, domestic demand was growing at rates above potential domestic supply, making Iraq suffers from a food deficit and imports large quantities of wheat for many reasons, including the decline in the productivity of wheat and barley crops in exchange for higher production costs associated with the deviation of actual production process for his optimization. This causing wasteful use of resources and the lack of appropriate production and space, which is achieved with the lowest cost and the greatest profit , especially when these crops have not glory economically cultivated small sizes, which led to the reluctance of some of the farmers grow these crops for lack their potential costs cover sizes accompaniment, so the study aimed to estimate the cost functions and find out the size that achieves economic efficiency, including the estimate of cost efficiency and profitability efficiency.

Materials and Methods

The fulfillment of the requirements of this search by obtain the data in light of a questionnaire prepared for this purpose and collected randomly by personal interview from wheat and barley farmers in the province of Diyala, collected by 54 farmers for wheat and 51 of barley farmers in the province, which is located in central Iraq, northeast of Baghdad (the capital) and the estimated area an about (17685) square kilometers representing 4.1 of the area of Iraq. Note that the total arable land is estimated at 3,390,283 Donum we selected wheat and barley crops because they represent the highest percentage among cereal crops in terms of area planted with grains (Wheat, Barley, Corn and Rice) as it stood at the grain area in 2013 approximately by 5.70405 million Donum (Ali, 2014).

Results and Discussion

The concepts derived from economic theories as well as previous studies are the most important considerations when choosing and determine the appropriate mathematical equation. It is worth mentioning that the mathematical equation transactions are being obtained vary according to many factors and then the main problem in the study of production costs depend on the choice of mathematical equation for the function costs that fit with the prevailing conditions and phenomena under study. The short-term cost function estimated which represented the cost of crop (wheat, barley) TC as the dependent variable, which is affected by the output Q, by using the least squares OLS method (Salvator and Reagl, 2002). Cost function estimated for the two crops, and the equation Cubism was most compatible with economic theory concepts and passed strongly statistical and standard tests as show in Tables (1 and 2).

Tables show logical function estimated from the economic point of view as Q output signal is positive, then the output square signal Q^2 negative and signal output Q^3 cube positive. This supports the assumption convex shape of the cost curve and thus the form of average total cost curve takes the U shape. From a statistical standpoint, the t-test proved significant as it was the estimated parameters resulting of cubic output significant at the level of 1%, while the square output moral, moral in wheat costs function also but at the level of 5%, meaning this could be relied upon to estimate the relationship. The estimated strength of the model of wheat, expressed by $R^2$was (0.84) meaning that 84% of the variability in the total costs caused by the change in the total production of wheat, and that 16% of these changes are due to factors not included in the model, sucked the track by the random variable, while the output variable in the function of the barley crop was able to explain 91% of the variability in total costs, and this is an important value as long as accompanied with estimates of statistical significance.

Table (1): The estimated parameters of the production function of wheat costs.

Variables factor	Parameters	Estimators	SE	t
constant	B^0	-89.23	528	0.169
Output	Q	364.02	116.51	3.12**
Output square	Q^2	-11.196	5.452	2.053*
Output cubic	Q^3	0.153	0.063	2.194**
R square	R^2	0.84		
R square adjusted	$\bar{R}^2$	0.83		
F test	F	88.349		
Correlation Coefficient	D.W	1.68		
Variance inflation Factor	VIF	6.25	N=54	

Source : Based on the work of the researcher to the results of the analysis.
Variables factor significance: *Significant at the %5 level, * *Significant about %1 level

Table (2): The estimated parameters of the short run cost of Barley costs

Variable factors	Parameters	Estimators	SE	T
Constant	B^0	64.55	155.4	0.415
Output	Q	328.009	43.204	7.592**
Output Square	Q^2	-6.709	2.347	2.859**
Output Cubic	Q^3	0.058	0.030	1.909
R Square	R^2	0.91	N=51	
R Square adjusted	$\bar{R}^2$	0.90		
F test	F	157.704**		
Correlation Coefficient	D.W	1.7		
Variance inflation factor	VIF	11.1		

Source: Based on the work of the researcher; the result of the analysis came
*Significant at the %5 level, **Significant at %1 level

Model in order to be accepted and supported must conduct appropriate tests to detect second-class problems; autocorrelation problem has been detected by D.W test, which showed that wheat-free of this problem, as long as the calculable d = 1.68 is greater than the amount of du (1.57) and smaller than 4-du (2.42) and reached d=1.7 in barley function is greater than the amount of (1.67) du by DW table and the less than of 4-du at the level of 0.01. for the problem of multiple linear correlation the model satisfies the absence of multiple linear relationship between the independent variables and because the estimated non-linear model in terms of the variables as Q2 and Q3 associated with variable Q, but the relationship is not linear (Gujarati, 2004). The problem Heteroscadassticity was detected in wheat by PARK function test, which includes regression square error being a as an independent variable (Gujarati, 2004).

$\sigma_i^2 = \sigma^2 X_i^B e^{vi}$

Lin σ_i^2 = Ln σ^2 + B Ln Xi + vi

Ln u_i^2= b0 + b1 Ln X +vi

Lnu_i^2 = 11.34 + 0.665 Ln Q

t= (13.32) (1.69)

F = 2.878 R2=0.05

Under this test was discovered there is no problem of Hetero it is found that the calculated value of t- test for tendency of regression equation error less than tabular t, As in barley function was detected the problem that is often associated with the CT data, were detected using Glejser) test, which shows the lack of correlation between the absolute value of the residuals and the independent variable as shown by the following test: (Gujarati, 2004).

$|\hat{U}i| = \hat{B}_0 + \hat{B}_1 X$

$|\hat{U}i| = 0.741 – 0.005 X$

t= (6.820) (0.520)

F = 0.27 R2 = 0.005

Optimization and production Efficiency: The production efficiency were obtained in the case of minimization by finding minor end of the total average production function and hold the first differentiation of the function, The optimal size of the output of the wheat crop of 36.5 tons and 58 tons of barley crop, so the size that is achieved at the lowest average cost AC, Where medium cost curve intersects with the marginal cost curve MC and this is the size that the product must be reached even equal the marginal cost with medium costs at the lowest value of the medium of the costs, and when compared to the optimal size of

the two crops with actual production achieved at the level of the sample note that the product is still in the first stage which are intermediate costs outweigh the marginal costs, it means that there is a savings in capacity, and the expansion of the farmers in production for as long as this is possible in the long term, As it will be enough time, which allows the product to expand horizontally as well as vertically to the expansion of production or the so-called heavy production and that this expansion leads to lower average total costs in the long term and thus increase the actual production. Technical efficiency can be obtained as follows (Elfeel *et al.,* 2013).

Technical Efficiency = the actual production rate for the study sample / production rate reducing costs

TE (wheat)=$\frac{13.2}{36.5}$ = 0.36

TE (Barley)= 8.8/ 58 =0.15

This result showed large deviations from the ideal limit, which indicates weakness in management's ability to control the costs and low-level planning of the production process input There are 64% of the economic resources are not optimally exploited for wheat farms and 85% in barley farms, making the actual production away from solarize also that there is a large discrepancy between the amount produced and costs at the level of farmers.

Elasticity of Cost (E): Cost Elasticity estimated by dividing the marginal costs MC on average costs AC (Douglas, 2008), with compensation the average production of the sample, which was 13.2 ton and 8.8 ton of both crops:

$$E = \frac{MC}{AC}$$

Upon application, the elasticity of the production costs of both wheat and barley was 0.62 and 0.84, respectively. The increase in wheat production by 10% will leads to increase in the costs by 6.2%, and increase the production of barley in the same proportion will leads to increased costs by 8.4%. In other words, these projects have the savings in capacity, which can expand their activities, to growth production and to optimize the size of output, which has the average cost equal to marginal cost, and then the elasticity become equal to the one. As long as the value of the elasticity less than one, referring to the possibility of obtaining a relative increase in production compared to the relatively lower increase in the costs and in this case the average costs are greater than the marginal costs.

Cost Efficiency: Cost efficiency can be calculated by dividing the total costs to the level of actual production on the total cost of the optimal level of production (Ogundari, 2006; Mandos and Pastor, 2001) according to the following equation:

$$CE = \frac{Ci^b}{Ci^{Min}}$$

As the

CE = Cost Efficiency

Cib = total costs to the level of actual production

CiMin = Total cost of the optimal level of production

When applicable, the cost efficiency of wheat crop

CE = $\frac{3206}{5810.9}$ = 0.55

CE = $= \frac{2337.1}{6177.6} = 0.37$

This a low result came because it did not achieve the required level but higher than the estimated cost efficient using DEA method, which obtained in another study in the same area (Ali, 2014), This result is consistent in terms of disparity between estimates of the methods used, with the characteristics of each method, because for each of them have some of the advantages and disadvantages that directly affection the points ability efficiency. The rise in production efficiency and the low level of efficiency in DEA method, compared in to the one that we have obtained may probably due to the rise or decline It assumes the absence of random error, which makes the points inefficient biased upwards or downwards and thus increase or decrease the estimated efficiency levels are estimated of Or is attributed to a decline in technical efficiency due to the deviation of the actual output at optimize production, because it was accompanied by an increase in higher costs of production due to the low productivity of crops because of the deterioration of the productivity of agricultural lands and the cultivation of not good varieties as well as most farmers sell their production in their home areas at a much lower price than the government price because of marketing problems and administrative complexities.

Profit Maximizing Output: Intended by point of profit maximization, the point at which achieved the biggest possible profit and can be found from the equality of marginal cost with marginal revenue or unit price of the product in the full market competition (Henderson, 1980).

MC = MR or MC = Py

As the MC = marginal cost, MR = marginal revenue, Py = unit price of the product

Note that wheat prices ranged from a minimum limit of 400 thousand dinars per ton, which is sold in the study area and an upper limit was 780 thousand dinar per ton as a price that gets it when marketing to the province silos, while barley crop prices ranged between 300-600 thousand dinar / ton, But we noticed that most of the farmers are selling the

product nearby markets because of high transport costs and administrative complexities in the marketing process, the average price reached 600 thousand dinars per ton of wheat and 450 thousand dinar for barley.

$364.02 – 22.39Q + 0.459 Q^2 = 600$ ..... for wheat

$0.459Q2 – 22.39Q – 235.9 = 0$ .....(1)

After arranging the equation No. 1 and adoption on Quadratic Equation we can determine the production level that maximizes profit as it reached 57.6 ton, and the second derivative is:

$\frac{\partial \pi^2}{\partial q^2} = -22.39 + 0.918\ q < 0$

Since the second derivative is negative that means we achieve sufficient condition of maximize profits.

$328.009 – 13.4Q + 0.174Q^2 = 450$ .....for barley after arranging the equation

$0.174Q^2 – 13.4Q – 121.9 = 0$ .....(2)

by analysis the equation 2, and using Quadratic equation we get the output that maximizes the profit as it stood at 85.2 tone, and it's the actual output by 77 ton, total revenue was estimated at 34 650 thousand dinar at the farm price prevailing in the region.

To make sure of the validity of the results obtained, profit function was estimated and we could be expressed it as follows:

$\Pi = TR – TC$

$\Pi = 450Q – 328.009Q – 6.7Q^2 + 0.058Q^3$

$\Pi = 121.9Q + 6.7Q^2 – 0.058Q^3 = 0$

$\frac{\partial \pi}{\partial Q} = 121.9 + 13.4Q – 0.174Q^2 = 0$

$\frac{\partial^2 \pi}{\partial \pi^2} = 13.4 – 0.348Q = 0$

When compensate85.2 in value of Q, is clear that the second derivative -16.2 take a negative value, and this recipe is a maximum and the profit function.

Net income at the Actual, Optimal level and maximize profit production: Net income was estimated for each level of production, which is estimated (optimization, maximizes level of production) based on the profit function $\pi = TR - TC$ (Adinya, 2009).

$\Pi = TR – TC$

$\Pi = 600 * Q – (-89.23 + 364.02Q – 11.196Q^2 + 0.153Q^3)$ .....(3)

$\Pi = 450Q – (-64.5 + 328.009Q – 6.7Q^2 + 0.058Q^3)$ .....(4)

After the compensation amounts of wheat production at the three levels described in Q (equation number 3) we get net income at the actual production reduced cost and maximizes profit level as it stood at 4801, 16170 and 21588 thousand dinar respectively. Note that the net income earned at the actual level, at least estimated about 11369 it achieved at the optimal level by 16 787 thousand dinar. The net income derived with the level of production that maximizes profit. But if we substitute barley production levels in the Q in the equation 4 we get net income amounted about 1622.9, 19922.2 and 0.28088 thousand dinar at the actual level of production, costs minimized maximizes profit, respectively, it is noted that the net income of the sample is reduced by about 18299.3 thousand dinar from its counterpart at the optimal output level and net income at the level of the net profit increases by about 26465.1 thousand dinars and notes that the average cost declined with the expansion in production, and decreases when the marginal cost is less than the average variable costs it was the lowest level at which the optimum production with increasingly efficient use of resources and then realized the maximum efficiency of the farm. In other words, the item is produced at the lowest possible average cost (Table 3).

Profit Efficiency: The profitability of efficiency can be obtained by dividing the net income (profit) on total costs, to clarify any productivity levels the most efficient, and then find a profitability efficiency at every level as it stood at 1.5 and 2.8 and 1.6 for wheat and 0.69, 3.2, 2.7 for Barely) when the actual production and optimization of production and which maximizes profit level this means that the optimal level of production is the most efficient among the various levels (Omonona *et al.,* 2010), when estimating the efficiency of profit which presupposes the existence of the practice of market power on prices, and on this basis based on income to calculate the efficiency of profit. Profits maximize when the difference between the net income and the value of the amount of input be greater, and therefore the efficiency of the profit is calculated as follows:

$Pr.E = \frac{Pj}{Pj^*}$

Pr.E = efficiency of profit, Pj = actual profit realized sample, Pj * = profits that are associated with the highest income.

The profit efficiency of wheat at estimation = 0.22

This means that the sample can increase the profits of wheat production by 78% which indicates that there is roomy for farmers to improve their levels of efficiency of their production processes by reducing the deviations from optimal. The efficiency profit of produced barley crop, about060.05this result indicates lower profits accruing and that profits are almost equal to the cost of the average per farm level the comparison between the cost efficiency of profitability and efficiency are important efficiency concepts are in line with two economic aims namely reducing costs and maximizing profits we conclude by comparing the estimated values with the optimum limit for both profit efficiency and cost efficiency which

necessitates an increase in performance rates of profits larger than the increase in costs this means that farmers have failed to cover costs and achieved high levels of inefficiency in profit causing the distance from optimize , when comparing the cost efficiency and profit efficiency we see that there is a difference between the two this means there is no-positive relationship between the two. Because each measures different quality of improvement in the efficiency of farms, perhaps this is due to the disparity between the farmers and the extent of technical ability and achieve high performance rates. This result can be strengthened through the result of which was the average cost higher than profit efficiency or may be due to the lack of the administration sought to reduce costs because of the protection afforded by profit.

Estimate size of the optimal area: The optimal size of the area was determined by estimating the regression equation, area by donum unit was the dependent variable and the volume of production in ton as independent variable (Hindi, 2009). As follows

$A = B0 + B_1Q + ui$

$A = 3.458 + 1.369\ Q$.....(5)

T = (1.986) (13.031)

F = 169.8 R^2=0.76 D.W = 1.83

$A = 0.537 + 2.348\ Q$.....(6)

t = (0.770) (25.292)

F = 639.08 R^2 =0.92 D.W=2.3

When we compensate the value of Q by the optimal output volumes of the wheat crop(36.5)ton in the equation No. 5, the optimal area will be53.4dounum to achieved economic efficiency , can be exploited by farmers to get the optimum size of the production, which minimize the costs and maximize profit, Noting that the actual size of the cultivated area in the sample was 18.48 dounum and 87.8% of the farmers for possession of less than optimal capacity, it refers to the possibility of expansion in the cultivation of the crop to benefit from the advantages of mass production capacity (savings Capacity). The cultivated area that achieved by the size of the production which maximizes profit totaled 82.3 dounum, and some economic indicators can be summarized in Table (4), when compensate for optimum production size of barley of Q in the equation No. 6 we get 135.2 dounum. Optimal space can be exploited by farmers to obtain the optimum size of the output of which is minimizing costs noting that the average size of the actual space in the sample 15.8 acres and that 84% of farmers possessing less than optimal capacity. This indicates the possibility of expansion in the cultivation of the crop and benefit from economies of amplitude (the advantages of mass production). The area of production achieved that maximizes profit amounted to 200.5 dounum.

Table (3): Economic indicators for wheat growers in the sample.

Indicators	Actual level of production	Production level reduced costs	Output level maximize profit
Output (ton)	13.2	36.5	57.6
Total Cost (thousand D)	3118.6	5729.6	12791
Total Revenue(thousand D)	7920	21900	35560
Net Income(thousand D)	4801	16170	21588
Average Coasts (thousand D/ton)	357.1	440	226
Cost Elasticity	0.62	1	1.3
Optimal Area(donum)	18.48	53.4	82.3
Profit Efficiency	1.5	2.8	1.6

Source: prepared by the researcher, depending on the estimated costs function and profit function.

Table (4): Economic indicators of barley farmers

Indicators	Actual Level of Production	Optimal Production Level	Output Level Maximizes Profit
Output(ton)	8.8	58	85.2
Total Revenue(thousand D)	3960	26100	3834.0
Total Coast(thousand D)	2337.1	6177.6	10252
Net Income(thousand D)	1622.9	19922.2	28088
Average Coasts(thousand D/ton)	273.5	134.5	178.1
Coast Elasticity	0.83	1	2.5
Area(dounum)	15.8	136.7	200.5
Profit Efficiency	0.69	3.2	2.7

Source: prepared by the researcher, depending on the estimated costs function and profit function.

References

Adinya, I.B. 2009. Analysis of costs-Returns Profitability in Groundnut marketing in Bekwarra Local Government Area cross River state, Nigeria. The J. Anim. Plant Sci., 19(4): 212-216.

Ali, E. H.2014. Measuring of Economic Efficiency and Determining the Economic Size of Farms in Diyala Province, Ph.D Thesis, College of Agriculture, University of Baghdad.

Berger, A.N. and Master, L.J. 1997. The side black box what explains differences in the efficiency of financial institution. J. Banking finan., 21: 895- 947.

Chavas, J.P. and Aliber, M. 1993. An analysis of economic efficiency in agriculture: A non-parametric approach, J. Agric. Res. Eco., 18.

Douglas, B.B. and Michael. D.W. 2008. Microeconomics. McGraw Hill.

Elfeel, A.M.; Eaibd, E. and Hamid, N.A. 2013. Economic analysis for the lux biscuits costs of production in the Egyptian company for food production. Biscomisr Alex. J. Agric. Res., 58(3): 263 – 277.

Gujrati, N. D. 2004. Basic Econometrics. McGraw Hill Co. Press, LTD.

Henderson and Quandt. 1980. Microeconomic theory: A mathematical approach. 3rd ed., McGraw Hill, London.

Hindi, M.A. 2009. Economic analysis of costs of production of olive oil in jerash Governorate/ Jordan. J. Agric. Sci., 5(3): 327-396.

Mandos, J. and Pastor, J.M. 2001. Cost and Profit Efficiency in Banking: an international comparison Europe, Japan and the USA. Appl. Eco. Letters, 8: 383-387.

Mbanasor, J.A. and Kalu, C. 2008. Economic Efficiency of commercial vegetable production System in Akwa I. Bom state, Nigeria. Translog stochastic frontier cost function Approach. Tropical and subtropical Agro-cost systems, 8: 313-318.

Ogundari, K.;Ojo, S.O. and Ajibefun, I.A. 2006. Economics of scale and cost Efficiency in small scale mazia production: Empirical Evidence from Nigeria. J. Soc. Sci., 13(2): 131-136.

Omonona, B.T.; Egbetokum, O.A. and Akanbi, A.T. 2010. Farmers Resource use and Technical Efficiency in cowpea production in Nigeria. Eco. Anal. Policy, 40(1): 87-97.

Salvatore, D. and Reagle, D. 2002. Theory and problems of econometrics. 2nd ed., McGraw Hill, 128pp.