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Economic Analysis of Maize Cultivation under Agro-Climatic Conditions of District Dera Ismail Khan

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Abstract: At Arid Zone Research Centre (AZRC), Dera Ismail Khan (D.I.Khan), a study was conducted to evaluate cost and benefit of Maize cultivation in district Dera Ismail Khan, Khyber Pakhtunkhwa during 2015. The economic analysis basic underlying assumption of Maize production was to assess the farmers / growers financial impact of Maize cultivation. A sample of 100 respondents from 5 major villages of Maize growing areas of D.I.Khan namely Dhap Shumali, Shorkot, Katcha, Shala Sharif and Naiwela were interviewed through pre-tested questionnaire. The results indicated that the average cost per acre was Rs. 42,190 and average production (output) of Maize was estimated to be 1350 kg per acre. Therefore, the gross return of Maize production was Rs. 71,700 per acre. The BCR was Rs. 1.669. Moreover, positive influence between return price and output of Maize was concluded from the study whereas negative effect of cost on the other hand was observed in maize production. It is concluded that Area, Tract, Seed, Lab, Fert, Pest and Comb Hrvt are statistically significant. As per equation 7 & 8, the calculated value of Maize area elasticity of production (0.64123) indicates that if maize area increase by 1%and all other inputs remain unchanged, production will increase by 0.64%. Similarly, the output elasticities of Tract, Seed, Lab, Fert, Pest and Comb Hrvt are 0.124587, 0.31244, 0.5874, 0.55461, 0.08248 and 0.65743, respectively, which can be interpreted in the same way.

Key words: Maize · Cost · Return · Profit · Cobb-Douglas · Pakistan

INTRODUCTION

In Pakistan maize is third important cereal after wheat and rice. It is mostly grown in Khyber Paktoon Khawa Province (KPK) as among 974 thousand hectares area of Pakistan, KPK has 422.9 thousand hectares area for maize crop. Maize production in Pakistan is 3707 thousand tons and the share of KPK is 741 thousand tons [1]. Maize is also used as a raw material for manufacturing of cooking oil, confectionary and bakers besides being used as feed for livestock. Its green ears, stalks and leaves are also fed to animals as an important source of fodder supply. However, per hectare (ha) yield of the country (also of the KPK Province) is much lower than that of the maize producing countries' average. The yield ha^{-1} can considerably be increased if proper arrangements are made. In this regard a benefit cost analysis was conducted to find out net income and expenditure of the mechanized verses traditional farming system. A number of researchers have presented their studies on various crops including Maize covering economic aspects. Onstad and Guse [2] reported in the study that the level of refuge for resistance management is used every year (over 15-20 year) and no European corn borers immigrate into the region over the same period. When complete mixing across blocks between generations is assumed, the transgenic block significantly lowers damage to maize in the refuges. For most scenarios without toxin-titer decline during maize senescence, a 20% refuge is a robust, economical choice based on current value. At extremes of initial pest density or crop value (price × expected yield), refuge levels as low as 8% or as high as 26% can be superior.

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Gustavo and Buckles [3] analyzed economics of the *abonera* maize production system, wherein maize is grown in rotation with a green manure crop (velvetbean, *Mucuna deeringiana),* with traditional bush-fallow cultivation of maize in the Atlantic Coast area of Honduras. A probabilistic cost-benefit analysis of introducing velvetbean into the existing maize cropping pattern is carried out for the field, farm and regional level. The probabilistic approach allows for a more comprehensive assessment of economic profitability, one which recognizes that farmers are interested in reducing production risk as well as obtaining increases in average net benefits. The analysis reveals that the *abonera* system provides significant returns to land and family labor over the six-year life cycle. The *abonera* is not only more profitable than the bush-fallow system but reduces the variability in economic returns, making second-season maize a less risky production alternative.

Andersen *et al*. [4] studied the agro-ecological effects on the soil fauna and agro-economic implications of the technology. Bt-maize produced a higher grain yield and grain size than a near-isogenic non-Bt variety or allowed a significant reduction in pesticide use. Concentrations of Cry1Ab in the Bt-varieties were sufficient to effectively control corn borer larvae.

Brookes [5] presented that in maize growing regions affected by ECB and MSB, the primary impact of the adoption of Bt maize has been higher yields compared to conventional non genetically modified (GM) maize. Average yield benefits have often been +10% and sometimes higher; in 2006, users of Bt maize have, on average, earned additional income levels of between _65 and _141/ha. This is equal to an improvement in profitability of +12 to +21%; in certain regions, Bt maize has delivered important improvements in grain quality through significant reductions in the levels of mycotoxins found in the grain.

MATERIALS AND METHODS

The study was conducted at Arid Zone Research Centre, D.I.Khan during 2015. For data collection, only major Maize producing areas of District were used. Five villages were selected randomly, which includes Dhap Shumali, Shorkot, Katcha, Shala Sharif and Naiwela, falls under the command area of Chashma Right Bank Canal (CRBC), D.I.Khan. The analysis is based on the primary data, 100 farmers out of major Maize growers of these areas were considered as sample for study. Necessary information from farmers was collected at their field or home by using pre-tested questionnaire to get the actual data. It included maximum information such as land holding, total cultivated area, area under Maize cultivation. However, main focus was on various inputs used in Maize crop production.

Statistical Analysis: Econometric view (E-Views) / SPSS package was used to analyze data. The detail is given below:

Cost and benefit of Maize will be compared through benefit cost ratios (BCR) formula also used by Samiullah *et al.* [6] and Santha [7]:

$$\textit{Benefit cost ratio of Maize} = TR / TC \qquad (1)$$

whereas, the TR is the per acre total benefit generated from Maize production and TC is the per acre total cost of Maize cultivation.

Profit Function:

$$\Pi = \text{Total Revenue (TR)} - \text{Total Cost (TC)}$$

$$\Pi = TR-TC \qquad (2)$$

where,
TR = P*Q (P= Price of output and Q=Output)
TC = V*X (V = Input price and X = Input purchased)

Therefore,
$$\Pi = PQ-VC \qquad (3)$$

Model of Profit Function: Empirical model of crop profit function in econometric form may be given as:

$$\Pi = \alpha + \beta_1 P + \beta_2 Q + \beta_3 C \qquad (4)$$

The above model described that (Π) is determined by the three major factors, which are as under:

P = Output Price
Q = Output Produced
C = Output Cost

Equations (2), (3) are used to generate equation (4) above. It indicates that profit (Π) depends on output price (P), total output (Q) and cost per unit © of out put produced. B_s are the parameters to be estimated and measure the change in (Π) with a unit change in the variables on right hand side as the case may be. This model was also used by Elahi *et al.* [9], Derbertin [10] and Samiullah *et al.* [6].

To show the input-output relationship, log linear Cobb Douglas production function will be used. The said model was also used by Samiullah [6], Hussain and Khattak, [11] and Haq *et al.* [12]. However, due to some additional variables used in the present study, it was modified accordingly. This model is widely used in agriculture for determining the nature of returns to scale. The following log linear Cobb-Douglas production function will be applied, using the least square method.

ln P = ln a0 + a1 ln Area+a2 ln Tract hr + a3 ln Seed + a4 ln Lab+a5 ln Fert + a6 ln Pest +a7 ln Comb Hrvt +ei (5)

The above model will then converted into following general form:

P=ao′Areaa1′Tracta2 ′Seeda*3′* Laba*4′* Ferta*5′* Pesta*6′* Comb Hrvta7’ *ei* (6)

whereas,

P	=	Total production (kg per acre)
Area	=	Area under maize
Tract	=	Tractor hours for land preparation
Seed	=	Seed used for cultivation
Lab	=	Labour used in cultivation
Fert	=	Fertilizer
Pest	=	Pesticides / insecticides
Comb Hrvta	=	Combined harvester for Harvesting
ao	=	Shows the impact of innovations or technology.

a1, a2, a3, a4, a5 a6 and a7 are the Output elasticities of Area, Tract, Seed, Lab, Fert, Pest and Comb Hrvt, respectively.

ei = Residual term (to include effect of omitted variables).

RESULTS AND DISCUSSION

To compare the cost and revenue of Maize, Benefit Cost Ratio (BCR) has been calculated by using equation-1 as under:

BCR for Maize = TR/TC
BCR for Maize = 71,700 / 42, 190
BCR for Maize = 1.669

The BCR clearly indicate that the Maize cultivation is profitable. One can earn Rs.1.669 by investing Rs. 1.

By using equation-2, net return is calculated as:

Net Return = TR-TC
Net Return = 71,700-a42,190
Net Return = 29,510

Estimated model as per equation-4:

Π	=	-0.0061 +0.783P+0.056Q+0.78C
Standard Error	=	{0.004} {6.12 E^{05}} { 0.07) {1.03 E^{-08}}
t-ratio	=	{-1.69} {1548.13}{0.75}{-753562}
R^2	=	0.89,
R^2 (adjusted)	=	0.73
F	=	6.39 E^{20}

F-test determines the overall goodness of fit/significance of the model. It is clear from the above model that the value of f-test is very high.

$F_{calculated}$=6.39 E_{20} > F tabulated= 3.12

i.e Calculated value of f-statistic is greater than tabulated value of f-statistic.

Thus the Model Shows Overall Significance: The co-efficient of determination (R2), indicates that the 89% variation in the dependent variable has been explained by the independent variables. The sign of independent variables shows that effects of explanatory variables are according to the theory. The theory states that cost is negative; relationship between the profit and price of output is also positive.

$t_{calculated} > t_{tabulated} = 1.895$, indicates that t-ratios of the factors confirms that, profit of the maize production (ð) is significantly determined by the three already mentioned factors of the model keeping all the other inputs constant. Thus, one rupee increase in per acre process (P) of Maize will increase the profits by Rs. 0.783, producing another kg of output (Q) will increase the profit by Rs 0.056, while each additional unit of per kg cost (C) will decrease the profit by Rs. 78. The estimation of the profit function revealed that profit is significantly affected by the above three mentioned factors. However, the effect of cost is higher than the effect of price and output of maize.

At the end, Cobb Douglas Production Function is calculated through equaton-5 given as under:

Table 1: Average Cost of Production of Maize Cultivation in D.I.Khan

S.#	Item/ Inputs	Unit	Quantity	Rate (Rs.)/unit	Total expenditure
1	Tractor hours	Hours per acre	2	800	1600
2	Grain of Maize	Kg	16	90	1440
3	Labor (from sowing to harvesting)	Man days	10	200	2000
4	Fertilizer				
4.1	Diammonium phosphate (DAP)	Bag	1	900	900
4.2	Urea	Bag	2	1800	3600
4.3	Zinc	Kg	10	70	700
5	Furadan (Insecticide)	Kg	10	90	900
6	Thnining	Man Days	6	200	1200
7	Hoeing and earthing up	Tractor hours	2	800	1600
8	Shelling	Hour	2	1500	3000
9	Empty bags	Per bags	15	30	450
10	Water charges (Canal System)	Seasonal	1	800	800
11	Land rent	Kanal	8	3000	24000
Total Cost	-	-	-	42,190	

Table 2: Average Total and Net Benefit of Maize

Item	Quantity (maund*)	Rate (Rs/maund*)	Total amount (Rs.)
Produce	33.75	2000	66,500
Stalk	-	4200	4200
Total Revenue	-	-	71,700
Net Revenue	-	-	29,510

* Maund = 40 kg

$$\ln P = 3.51008 + 0.64123 \ln Area + 0.124587 \ln Tract\ hr + 0.31244 \ln Seed + 0.5874 \ln Lab + 0.55461 \ln Fert + 0.08248 \ln Pest + 0.65743 \ln Comb\ Hrvt \quad (7)$$

Or in *general form is given as:*

$$\ln P = 33.54094375 + Area^{0.64123} + Tract\ hr^{0.124587} + Seed^{0.31244} + Lab^{0.5874} + Fert^{0.55461} + Pest^{0.08248} + Comb\ Hrvt^{0.65743} \quad (8)$$

It is concluded that Area, Tract, Seed, Lab, Fert, Pest and Comb Hrvt are statistically significant. As per equation 7 & 8, the calculated value of Maize area elasticity of production (0.64123) indicates that if maize area increase by 1% and all other inputs remain unchanged, production will increase by 0.64%. Similarly, the output elasticities of Tract, Seed, Lab, Fert, Pest and Comb Hrvt are 0.124587, 0.31244, 0.5874, 0.55461, 0.08248 and 0.65743, respectively, which can be interpreted in the same way.

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