Estimating the economic perspective of cotton crop in southern Punjab of Pakistan

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ABSTRACT

This study has focused to find out the cost and return (profit) of cotton cultivation in district Bahawalpur namely known the core cotton zone of Punjab Pakistan. The profitability of the cotton cultivation was measured with the application of economic analysis (benefit cost ratio) for the year 2012-13. In the data collection, procedure a pretested developed questionnaire was used for the collection of two hundred and forty cotton farmers. The estimated profitability of benefit cost ratio was 1.25, which has indicated as investment of one unit, it returns the 1.25 with net return of 0.25. A proper econometric model applied to analyze the cotton profit function, which has reported cotton prices and output positively while cost of inputs inversely related to profitability of cotton. In the production function model cropped area, land preparation, seed, fertilizer, pesticides, irrigation, and labor have indicated the positive and significant association with cotton production. Cotton friendly policies, stability in cotton prices, subsidizing cotton inputs and adequate provision of credit are prerequisite measures to increasing cotton cultivation and production.

1. Introduction

In the Sustainable Development Goals (SDG$_S$) of United Nations (UN) no poverty, zero hunger, good health and wellbeing of masses are first three priority ones measures out of seventeen targeted goals (UN, 2016). In developing economies, increasing population is a burning issue regarding to inadequate availability of resources and required needs of population. Pakistan's estimated population is 207.7 million and 6th most populated country of the world (GOP, 2017). According to 6th population household census population growth rate is 2.4% from 1998 to 2017 (GOP, 2017). In the economy of Pakistan, agriculture shares 19.8% of gross domestic product with major employing source of 42.3% total labor force (GOP, 2016). Major crops, minor crops, livestock, forestry and fishing are subcategorizes of agriculture sector. Major crops shares 4.67% in gross domestic product and 23.55 percent as value added in agriculture. Cotton and sugarcane are cash crops while wheat, rice and maize food crops among major crops (GOP, 2016).

In the economy of Pakistan, cotton crop has major contribution in providing raw material to textile industry and exporting cotton lint. Cotton shares 1% in gross domestic product and 5.1% value added to agriculture sector (GOP, 2016). In leading cotton, producing countries Pakistan is 4th major cotton producing and 3rd major cotton consuming country of the world. Pakistan produces 6.94% of total cotton production and consumes 9.2% of the world cotton (GOP, 2016).

In the current decade, a significant decreasing tendency in cotton cultivation and production has reported in Pakistan. According to estimated statistics in 2004-05 cotton cultivation area was 3193 thousand hectares and production 14265 thousand bales while in 2015-16 cotton cultivation area estimated 2901.98 thousand hectares with production of 9917.41 thousand bales (GOP, 2015). In Pakistan, Punjab province produces the major share in cotton cultivation and production. In last five years, a significant decline in cotton-cultivated area has estimated in Punjab from 88% to 77% of total cotton areas of the country. The estimated statistics has reported as decline of cotton production in Punjab almost 82% to 64% of total cotton production of Pakistan (GOP, 2015). In Punjab, southern belt of provinces is commonly known as the cotton zone, which shares the major cotton production of province. Cotton crop is

cultivated more than 80% area in southern Punjab and it produces more than 80% cotton of province (GOP, 2015) (Table 1). A sequential declining status of cotton cultivation and production in this area has negatively influenced the local and national economic growth. Market imperfections, envoirmental dynamics and inadequate policy measures of government are major constraints in

squeezing cotton cultivation and production in the country. There is serious threat to the farmers regarding to the climate change, which frequently cause failure of crop productivity with outcome of huge financial losses (Zahra et al., (2017). Climate change have multiple sever envoirmental, socioeconomic and health issues (Qasim et al., (2017).

Table 1: Contribution of Southern Punjab in cotton area and production of total Punjab cotton crop

Years	Punjab cotton area(000) hectares	Southern Punjab cotton crop area(000) hectares	Southern Punjab share in cotton area percentage	Punjab production (000) bales	Southern Punjab cotton production (000) bales	Southern Punjab share in total Punjab cotton production %
2011-12	2533.69	2050.09	80.91%	11129.00	9408.82	84.54%
2012-13	2308.68	1904.39	82.42%	9526.00	8121.41	85.25%
2013-14	2199.02	1840.88	83.71%	9145.00	7958.05	87.02%
2014-15	2322.85	1930.32	83.10%	10277.00	8825.19	86.29%
2015-16	2242.72	1864.74	83.14%	6343.00	5501.72	86.74%

Cotton friendly emergency measures are prerequisite for encouraging cotton farmers to increasing cotton cultivation and production in the cotton belt. A net benefit of producer is measured with cost benefit analysis of cost and revenue. In economic literature, cost benefit analysis has frequently employed in measuring the economic applications. Cogently application of cotton crop inputs in cultivation has minimization of cost and maximization of production outcomes with the increasing net profit (Anwar, 1998). Inadequate application of mechanization and underutilization of resources discourage small farmers to economize the cost of cotton production as compared to medium and large farmers (Anwar et al., 2009).

In current era, increasing role of research and development in agriculture with innovative verities of BT cotton farmers adopting such verities can economize their cost and increase production (Nazli et al., 2010). Adequate legislation is prerequisite to introduce to regulate BT cotton verities in the country to increasing cotton production and profitability of farmers. In adopting BT cotton verities, Indian farmers have economized their cost with increasing cotton production and profitability in cotton crop (Samuel et al., 2015). The economic analysis of maize cultivation in Dera Ismail Khan investigated in the study and empirical estimates have justified maize cultivation profitability (Elahi et al., 2016). Cotton cultivation in district Muzaffargrh

has profitability according to economic analysis of the study (Ahmad et al., 2016). The multiple varieties of the cottonseed have variation in the sowing schedule in attaining the maximum profitability it is prerequisite to scheduled sowing of such varieties for maximum output (Jamro et al., 2017).

2. Material and method

Simple random sampling approach was adopted in the selection of study area in Southern Punjab. Bahawalpur district was randomly selected for data collection of the study area. Ahmedpur Sharqi and Bahawalpur tehsils were randomly selected out of five tehsils of Ahmedpur Sharqi, Bahawalpur, Hasilpur, Khairpur Tameiwlai and Yazman for sample of data.

Sample size was further subdivided as three villages were randomly selected from each tehsil for collection information of respondent. A sample size was collected 240 cotton farmers with 120 from each tehsil for the year of 2012-13. A pretested questionnaire was developed for data collection with relevant and appropriate information of crop. In ease to understanding of questions respondent were communicated in local and national language Urdu, Punjabi and Saraiki and according to availability at home or fields. A sample size distribution of data as given below in Table 2.

Table 2: Sample Size distribution of data collection

District	Tehsil	Villages	Respondent no
	Bahawalpur	Goth Mehrab	40
		Chak No 24/BC	40
		Chak No 12/BC	40
	Subtotal of Tehsil		120
Bahawalpur	Ahmedpur Sharqai	Kotla Musa Khan	40
		Tibbi Izzat	40
		Bukhtiari	40
	Subtotal of Tehsil		120
	District Grand total		240

2.1. Statistical analysis

In the statistical analysis of data, the study has employed the Econometric View (E-View) version 7. In literature, economic analysis has measured with

cost benefit analysis and formula employed in this study followed by the studies of Derbertin (2012), Hussain and Khattak (2011), Haq et al. (2002) and Ahmad and Afzal (2012).

$$Cotton\ Benefit\ Cost\ Ratio\ =\ TR/TC \qquad (1)$$

In Eq. 1 as elaborated, the benefit cost ratio with TR as referred the total revenue and TC reported as the total cost. Total revenue of cotton crop determines the benefits generated through the production of cotton crop. Total cost determines the all expenditures of inputs regarding to cotton cultivation.

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

Π reported as the net profit, which gained total revenue minus total cost from cotton production

Equations as given below, which defines the formula,

$TR = P * Q$
[P = price of cotton crop output, Q = quantity of cotton crop output]
$TC = V * X$
[V=cotton crop input prices, X=cotton crop input purchased quantity]

Eq. 3 defines the specific form of formula, which is given below

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

2.2. Econometric model of cotton profit function

Empirical functional form of cotton profit function, which analyzed in econometrics procedure used in numerous studies Haq et al. (2002), Derbertin (2012), Hussain and Khattak (2011), Haq et al. (2002) and Ahmad and Afzal (2012) also employed in the study as given below

$$\Pi\ =\ \Psi\ +\ \phi^1 P\ +\ \phi^2 Q\ +\ \phi^3 C \qquad (4)$$

Π referenced as the profit, as specified with three factors
P = price of cotton crop output
Q = quantity of output cotton crop produced
C = expenditure/cost of cotton crop output

The combination of Eq. 2 and 3 has the originated form of the Eq. 4 as given above

Cotton crop profit Π is estimated with cotton crop total output (Q), output price level (P) and all expenditures © used in the inputs of cotton cultivation of cotton crop. The change in profit Π reflected the change in price of output, quantity of output and cost of inputs used in the model, which have measured in the model with the parameters as indicated in the notion as ϕ's.

In the agricultural studies, Cobb-Douglas production function empirical estimates of returns to scale have numerously considered more reliable. A number of advantages of Cobb-Douglas production function in estimation procedure as compared to others approach in ease of estimation it has applied by many studies as Samiullah et al. (2014), Hussain and Khattak (2011), Haq et al. (2002) and Ahmad and Afzal (2012). In the study for log-linear Cobb-Douglas production function least square method has applied as given below

$$Ln\ Y\ =\ ln\Psi 0\ +\ \Psi 1 ln\ Cropped\ Area\ + $$
$$\Psi 2\ ln\ Land\ Preparation\ +\ \Psi 3\ ln\ Seed\ + $$
$$\Psi 4\ ln\ Fertilizer\ +\ \Psi 5\ ln\ Pesticides\ + $$
$$\Psi 6\ ln\ Irrigation\ +\ \Psi 7\ ln\ Labor\ +\ ei \qquad (5)$$

where:
Y=Yield (output) of cotton crop per acre
Cropped Area = Total area under cotton crop in acres
Land Preparation = Land preparation (tractor hours per acre)
Seed=Quantity of cotton seed used for sowing cotton crop in kg per acre
Fertilizer= Fertilizer used in cotton crop (bags per acre)
Pesticides= Pesticides used to control cotton crop pests (no per acre)
Irrigation= Irrigation used for cotton crop (total no per acre)
Labor= Labor participated during cotton crop (no of days of worker per acre)
$\Psi 0$= Reveals the impact of technology or innovation

Cropped Area, Land Preparation, Seed, Fertilizer, Pesticides, Irrigation, and Labor Output elasticties were signify as the $\Psi 1$, $\Psi 2$, $\Psi 3$, $\Psi 4$, $\Psi 5$, $\Psi 6$ and $\Psi 7$ while the residual term to mention the effect of omitted variables gives as the ei.

3. Results and discussion

In cotton, crop productivity procedure involves the multiple inputs as land preparation, seed, fertilizer, pesticides, irrigation, labor services and others intercultural activities. Crop cultivation expenditures are mostly sub categorized in fix cost and variable cost. The potential use of available resources can economize the variable expenditures and have significant role in cotton production. In Table 3 which reported below per acre cotton production has estimated 29.47 maunds with average per acre total cost of Rs. 71898.28. Cotton crop per acre total revenue has estimated as Rs. 90078.54 with net profit per acre Rs. 18180.26 as reported in Table 4 which given below.

3.1. Benefit cost ratio

Cotton production benefit cost ratio has reported in Eq. 1 as indicated the total revenue and total cost comparison, which has given below

$Benefit\ cost\ ratio\ of\ cotton\ production\ =\ TR\ /\ TC$
$TR\ =\ Cotton\ crop\ total\ revenue\ per\ acred$
$TC\ =\ Cotton\ crop\ total\ cost\ per\ acre$
$Benefit\ cost\ ratio\ of\ cotton\ crop\ =\ 90078.54\ /\ 71898.28$
$Benefit\ cost\ ratio\ of\ cotton\ crop\ =\ 1.25$

In regarding estimation of benefit, cost ratio cotton cultivation is profitable in district Bahawalpur

as reported in above equation. The estimated profitability of investment in cotton production has considered as Rs 1 invested in cotton production it gains 1.25 in return with net profit of gains 0.25 with investment of Rs 1.

Table 3: In Bahawalpur district average cost of cotton cultivation

Serial no	Cotton inputs	Units	Quantity	Rate/Rs	Total Cost Rs
1	Mechanization/Tractor	Hour/per acre	9.91	427	4232.42
2	Cotton seed	Kg/per acre	8.83	251.2	2218.09
3	Usage of fertilizer				
3.1	Urea fertilizer	Bag/per acre	2.73	1702.1	4646.73
3.2	Nitrophos fertilizer	Bag/per acre	1.41	1235	1741.35
3.3	DAP fertilizer	Bag/per acre	0.89	2701.1	2403.97
	Total cost of fertilizer				8792.06
4	Crop irrigation	No/per acre	17.09	705.8	12062.12
5	Usage of Pesticides	No/per acre	6.3	1124.61	7085.04
6	Cotton picking	Rs per 40 kg	29.47	339.71	10011.25
7	Labor participation cost				
7.1	Land preparation cost	day/ per acre	1.37	313	428.41
7.2	Labor Potha cost	day/ per acre	1.14	621	875.61
7.3	Labor fertilizer cost	day/ per acre	4.17	323	1346.91
7.4	Labor irrigation cost	day/ per acre	11.02	321	3537.42
7.5	Labor pesticides cost	day/ per acre	6.51	319	2076.69
	Total labor cost				8265.04
8	Cultivated land rent	Kanal	8	2404.03	19232.24
	Total Cost				71898.28

Table 4: Average per acre Revenue and cost of cotton cultivation in District Rahim Yar Khan

Serial no	Item	Quantity(maunds)	Rate(maunds)	Total
	Cotton Production	29.47	3012.37	88774.54
Revenue Per acre	Cotton straws	Per acre Rs		1304
	Total revenue	Per acre		90078.54
Cost per acre	Cost	Per acre		71898.28
Net Profit		Per acre		18180.26
B/C ratio		Per acre		1.25

Cotton crop production net returns as indicated in Eq. 2, which has calculated as below

Cotton crop production net return per acre $= TR - TC$
Cotton crop production net return per acre $(Rs) =$ 90078.54 − 71898.28
Cotton crop production net return per acre $(Rs) =$ 18180.26

Multiple factors have significant role in cotton production procedure while price of cotton crop, quantity of cotton output produced and inputs cost have specific impact in cotton cultivation and production.

P = Cotton crop prices which farmers receives of output in Rs
Q = Quantity of cotton produced in Maunds
C = Expenditure of cotton production Rs (cost)

Model estimation of cotton production as given in Eq. 4.

$\Pi = -19.42617 + 8.123127P + 7.013521Q - 3.012432C$
Standard Error $=$ {4.234512} {1.213141} {0.201234} {0.392876}
$t - ratio =$ {−4.786541} {6.278951} {29.13214} {−5.987652}
$R - squared = 0.894321$ *Adjusted* $R - squared = 0.872341$ $F - statistic = 749.765$ $(Prob(F - statistic)\ 0.000000)$

The significance or goodness fit of the model is measured with the F-test which is referred with the empirical estimation of the model. The goodness of fit or significance of model is reported if the calculated value of F-test greater than the tabulated value of F-test. The model, which applied in the study, has goodness of fit or significance as calculated value of F-statistics value is greater than tabulated value of F- statistics as given below;

$F - statistic = 749.7892 > F - tabulated = 629.2132$

In the estimation procedure, R^2 indicates the coefficient of determination, which justifies the variation in dependent variable, which has explained with explanatory variables. The R^2 value is 0.89 which indicates as 89 percent variation in dependent variable is due to independent variables. In profit function form, output level, prices of output and cost of inputs are key variables. According to sequential form of economic theory and regarding to profit function inputs cost negatively affects profit function while prices of output positively affects profit function. In the empirical estimates, estimated sign of explanatory variables are in sequence with economic theory and econometric model.

In the production, function model the functional relationship of profit, price of output, output level and cost of inputs as reported below. Empirical findings have indicated if Rs 1 increases in price of output would increases, 8.12 percent while increase in output level in one unit increase the profit 7.01 percent. There is a negative relationship in cost of inputs and profit as one-rupee increase in cost reduces the profit level 3.01 percent. In the

profitability of cotton, cotton production, cotton output prices and inputs cost major determinants while cotton output prices have more significant role in cotton cultivation and its profitability.

The estimated Eq. 5 of Cobb-Douglas production functions as given below;

$$Ln\ Y = 1.342151 + 0.043216\ Cropped\ Area + 0.13216 Land\ Preparation + 0.923412 Seed + 0.234287 Fertilizer + 0.612347 Pesticides + 0.021345 Irrigation + 0.232149 Labor \qquad (6)$$

The estimates of cropped area, land preparation, cottonseed, fertilizer, pesticides, irrigations and labor in cotton crop in Cobb-Douglas production function model are according to theory and expectations. All the estimated coefficients of the production model have positive and significant relationship with cotton production. The estimated coefficients of the variables cropped area and land preparation of cotton crop have indicated as the one percent increase in the cropped area and land preparation will increase cotton production 0.04 percent and 0.123 percent.

According to the coefficients of the seed, fertilizer and pesticides as increase in one percent in cottonseed, fertilizer and pesticides would increase 0.92, 0.23 and 0.61 in cotton production. The estimated coefficients of the irrigation and labor have indicated as one percent increase in irrigation and labor would increase in the cotton production 0.021 and 0.232 percent.

4. Conclusion and suggestions

In the empirical economic estimation of cotton crop have analyzed, as the cotton cultivation is profitable to the cotton farmers in southern Punjab. The profitability of cotton has positive and significant relationship in cotton prices and its production while cost inputs of cotton crop inversely related with profitability of cotton. In the economic analysis of the study benefit cost ratio 1.25 indicates the strong positive and significant association between profitability and cotton production. There is a positive and significant association in inputs variables cropped area, land preparation, cottonseeds, fertilizer, pesticides, irrigation and labor and cotton production. Market imperfections, environmental climatically changes and inappropriate policy measures have severe impact on cotton farmer's wellbeing. Adequate measures regarding to cotton friendly policies, adequate provision of finance and subsidizing inputs are prerequisite for encouraging cotton farmers increasing cultivation of cotton crop and improving the wellbeing of farmers.

Acknowledgement

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