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

Dilshad Ahmad 1,*, Muhammad Afzal 2

1Department of Management Sciences, COMSATS Institute of Information Technology, Vehari, Pakistan
2Department of Economics, Preston University, Islamabad, Pakistan

A R T I C L E  I N F O

Article history:
Received 20 December 2017
Received in revised form 18 March 2018
Accepted 2 April 2018

Keywords:
Benefit cost ratio
Cotton
Profit
Yield
Punjab
Pakistan

A B S T R A C T

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.

© 2018 The Authors. Published by IASE. This is an open access article under the CC BY-NC-ND license (http://creativecommons.org/licenses/by-nc-nd/4.0/)

1. Introduction

In the Sustainable Development Goals (SDGs) 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 subcategories 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, environmental 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 environmental, socioeconomic and health issues (Qasim et al., 2017).

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 Muzaffargarh 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 Tameiwla 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 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 | 7950.05 | 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% |

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  \hspace{1cm} (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.

II = TR - TC \hspace{1cm} (2)

II reported as the net profit, which gained total revenue minus total cost from cotton production. Equations as given below, which defines the formula,

\[ TR = P \times Q \]
\[ TC = V \times X \]

\[ V = \text{cotton crop input prices}, \ X = \text{cotton crop input purchased quantity} \]

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

\[ II = PQ - VC \hspace{1cm} (3) \]

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

\[ II = \Psi + \Psi_1 P + \Psi_2 Q + \Psi_3 C \hspace{1cm} (4) \]

II referenced as the profit, as specified with three factors
\[ P = \text{price of cotton crop output} \]
\[ Q = \text{quantity of output cotton crop produced} \]
\[ C = \text{expenditure/cost of cotton crop output} \]

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

Cotton crop profit II is estimated with cotton crop total output (Q), output price level (P) and all expenditures (C) used in the inputs of cotton cultivation of cotton crop. The change in profit II 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 \( \Psi \)'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

\[ \ln Y = \ln \Psi_0 + \Psi_1 \ln \text{Cropped Area} + \Psi_2 \ln \text{Land Preparation} + \Psi_3 \ln \text{Seed} + \Psi_4 \ln \text{Fertilizer} + \Psi_5 \ln \text{Pesticides} + \Psi_6 \ln \text{Irrigation} + \Psi_7 \ln \text{Labor} + \epsilon_i \hspace{1cm} (5) \]

where:
\[ Y = \text{Yield (output) of cotton crop per acre} \]
\[ \text{Cropped Area} = \text{Total area under cotton crop in acres} \]
\[ \text{Land Preparation} = \text{Land preparation (tractor hours per acre)} \]
\[ \text{Seed} = \text{Quantity of cotton seed used for sowing cotton crop in kg per acre} \]
\[ \text{Fertilizer} = \text{Fertilizer used in cotton crop (bags per acre)} \]
\[ \text{Pesticides} = \text{Pesticides used to control cotton crop pests (no per acre)} \]
\[ \text{Irrigation} = \text{Irrigation used for cotton crop (total no per acre)} \]
\[ \text{Labor} = \text{Labor participated during cotton crop (no of days of worker per acre)} \]
\[ \Psi_0 = \text{Reveals the impact of technology or innovation} \]
\[ \Psi_1, \Psi_2, \Psi_3, \Psi_4, \Psi_5, \Psi_6 \text{ and } \Psi_7 \text{ were signify as the } \Psi \text{'s.} \]

Cropped Area, Land Preparation, Seed, Fertilizer, Pesticides, Irrigation, and Labor Output elasticities were signify as the \( \Psi_1, \Psi_2, \Psi_3, \Psi_4, \Psi_5, \Psi_6 \text{ and } \Psi_7 \) while the residual term to mention the effect of omitted variables gives as \( \epsilon_i \).

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 \( = TR/TC \)
\[ TR = \text{Cotton crop total revenue per acre} \]
\[ TC = \text{Cotton crop total cost per acre} \]

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

\[
\begin{align*}
\text{Cotton crop production net return per acre} &= TR - TC \\
\text{Cotton crop production net return per acre (Rs)} &= 90078.54 - 71898.28 \\
\text{Cotton crop production net return per acre (Rs)} &= 18180.26
\end{align*}
\]

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.

\[
P = \text{Cotton crop prices which farmers receives of output in Rs} \\
Q = \text{Quantity of cotton produced in Maunds} \\
C = \text{Expenditure of cotton production Rs (cost)}
\]

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

\[
R^2 = -19.42617 + 8.123127P + \\
\quad 7.013521Q - 3.012432C
\]

\[
\text{Standard Error} = \\
\quad \{4.234512 \{1.213141 \{0.201234 \{0.392876 \}
\]

\[
\text{t - ratio}\ = (-4.786541 \{6.278951 \{29.13214 \{-5.987652 \}
\]

\[
R - squared = 0.894321 \quad \text{Adjusted R - squared} = 0.872341 \quad F - statistic = 749.7892 \quad (Prob(F - statistic) 0.000000)
\]

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;

\[
F - \text{statistic} = 749.7892 > F - \text{tabulated} = 629.2132
\]

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

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.
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;

\[
\ln Y = 1.342151 + 0.043216 \text{Cropped Area} + 0.13216 \text{Land Preparation} + 0.923412 \text{Seed} + 0.234287 \text{Fertilizer} + 0.612347 \text{Pesticides} + 0.021345 \text{Irrigation} + 0.232149 \text{Labor}
\]

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

There is no grant, fund or financial support from any institution for this research work.

References

Ahmad D and Afzal M (2012). Technical efficiency of cotton farmer: Evidence from Punjab (Pakistan). International Journal of Management, IT, and Engineering, 2(12): 74-86.

Ahmad D, Chani I, Rauf A, and Afzal M (2016). Economic analysis of cotton cultivation under ago climatic conditions of district muzaffargarh American-Eurasian Journal of Agriculture and Environmental Sciences. 16(6):1498-1503.

Anwar M, Chaudhry IS, and Khan MB (2009). Factor affecting cotton production in Pakistan: Empirical evidence fromultan district. Journal of Quality and Technology Management, 5(2): 91-100.

Anwar N (1998). Optimization of quantitative factors, contributing to yield variability of wheat: A case study of Rachna Doab. M.Sc. Thesis, Department of Agriculture Economics, University of Agriculture Faisalabad, Faisalabad, Pakistan.

Derbertin DL (2012). Agriculture production economics. 2 Ed., Macmillan Publishing Company, New York, USA.

Elahi ME, Shah M, Mansoor M, and Rachid A (2016). Economic analysis of maize cultivation under agro-climatic conditions of district Dera Ismail Khan. American-Eurasian Journal of Agriculture and Environmental Sciences, 16(4): 765-769.

GOP (2015). Provincial Bureau of Statistics. Government of Punjab, Provincial Agriculture department Government of Punjab, Punjab, Pakistan. Available online at: punjabgov.in

GOP (2016). Economic survey of Pakistan. Government of Pakistan, Pakistan Bureau of Statistics, Ministry of Finance, Islamabad, Pakistan. Available online at: www.pakistan.gov.pk

GOP (2017). 6th population and housing census. Government of Pakistan, Pakistan Bureau of Statistics, Ministry of Finance, Islamabad, Pakistan. Available online at: www.pakistan.gov.pk

Haq ZA, Munir K, and Muktar A (2002). Role of farm size in input use and productivity of potato in Shigar Valley of Baltistan Area: An econometric analysis. Sarhad Journal of Agriculture, 18(2): 245-250.

Hussain A and Khattak NR (2011). Economic analysis of sugarcane crop in DistrictCharsada. Journal of Agriculture Research, 49(1): 153-163.

Jamro SA, Ali MU, Buriero M, Ahmad MI, Jamro GM, Khan A, and Jakhro MI (2017). Impact of various sowing dates on growth and yield parameters of different cotton varieties. Journal of Apply Environment Biology Sciences, 7(8): 135-143.

Nazli H, Sarker R, Melike K, and Orden D (2010). Economic performance of BT cotton varieties in Pakistan. In the 2010 Annual Meeting (No. 6181). Agricultural and Applied Economics Association, Denver, USA.

Qasim M, Siddiqua A, Sadef Y, Bashir A, Khalid M, Naveed M, and Ali S (2017). Climate change: Potential health effects on vulnerable population and malnutrition food security challenges: A case study of Shakargarh. Journal of Applied Environmental and Biological Sciences, 7(10): 180-188.

Samillah M, Shah U, Kalimullah U, Rehmat and Ibrarullah (2014). Profitability of rice production in D. I. Khan Pakistan. Journal of Agriculture Research, 27(3): 244-249.

Samuel I, Basavaraja H, Pushpanjali, and Rajni R (2015). Production, growth and export competitiveness of raw cotton in India: An economic analysis. Agriculture Research and Technology: Open Access Journal. 1(1): 1-5.

UN (2016). Sustainable development goals (SDGs) report. United Nations: Department of Economic and Social Affairs. New York, USA.

Zahra N, Akmal N, Habib N, Rani S, Nazir M, and Raza I (2017). Impact of climate change hostilities on livelihood strategies: A case study of rainfed pothwar area of Pakistan. Journal of
