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Factors Affecting Cotton Production in Pakistan: Empirical Evidence from Multan District

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Abstract

This paper attempts to examine the factors affecting cotton production in Multan region using primary source of data. A sample of 60 small farmers, 25 medium and 15 large farmers was randomly selected from two Tehsils namely Multan and Shujabad of district Multan. The Cobb-Douglas Production Function is employed to assess the effects of various inputs like cultivation, seed and sowing, irrigation, fertilizer, plant protection, inter-culturing / hoeing and labour cost on cotton yield. The results depicted that seed, fertilizer and irrigation were found scarce commodity for all category of farmers in district Multan. The Cobb-Douglas Production Function results revealed that the coefficients for cultivation (0.113) and seed (0.103) were found statistically significant at 1 percent level. The Cost-Benefit Ratio for the large farmers was found higher (1.41) than that of small (1.22) and medium (1.24) farmers. There is a dire need to ensure the availability of these scarce inputs by both public and private sectors as these inputs were major requirement of the cotton crop.

Key Words: *Cotton; Cobb- Douglas Production Function; Cost Benefit Ratio; Marginal Value Product; Allocate Efficiency of Critical Inputs; Multan District; Pakistan*

Introduction

The cotton industry and cotton related services play the foremost role in Pakistan's economy and contributing 63.9 percent of the total exports earnings (Pakistan Economic Survey 2005). It provides raw material to local/domestic cotton industry comprising of 503 textile mills, 1263 ginning factories, 8.1 million spindles and 2622 oil expelling units. It also yields 3.5 to 3.6 million tons of cotton seeds which contributes over 64 percent of the total domestic edible oil production (Pakistan Cotton Ginners Association, Textile Vision 2005).

Cotton is cultivated on an area of 3.19 million hectares (Agricultural Statistics of Pakistan 2005). Approximately 77 percent of all Pakistan cotton is produced in Punjab and remaining 23 percent in other provinces (Pakistan Economic Survey 2005). On global basis, Pakistan is the forth largest cotton producing country of the world, after China, India and USA. Pakistan's share of total world cotton production in 2004-05 stood at 9.47 percent (Cotton Statistical Bulletin 2006). Pakistan is the third largest consumer, consuming 10 percent of the world production. It is the third largest yarn producer with 9 percent, second largest yarn exporter with 26 percent, third largest cloth producer with 7 percent and is also the third largest cloth exporter with 14 percent of the world cotton production (International Cotton Advisory Committee, 2005).

Cotton is cultivated mainly in Punjab and Sindh provinces of the country. The production process involves rationale use of inputs including seed, pesticides, fertilizers and irrigation. There is a significant increase in cotton production during the last decade but still potential yield has not yet been exploited. However, the advanced production technologies and judicious use of inputs at the subsidized rates can enhance the production of cotton.

Different studies have been conducted to ascertain the factors which are responsible for enhancing the production and ultimately benefiting the farmers. Khan et al. (1986) and Hassan (1991) observed that high cost of inputs, scarcity of financial resources, lack of access to the markets and untrained farmers are responsible for the low yield per hectare and ultimately reduction in the benefits to the farmers. Nabi (1991) calculated that the use of inputs has a direct bearing on the production and profit of the farmers. He found that cultivation cost, sowing cost, seed, fertilizer, pesticide, irrigation and labour are the important variables in production of cotton. Plant protection and irrigation are the most important variables which affect the cost of production.

Anwar (1998) concluded that if the above mentioned variables were managed in a good and economical manner, the production could be increased, cost of production could be decreased and net income to the farmers could be enhanced. Carlos et al. (2002) developed yield and acreage model of Pakistan, Australia and India. He concluded that the yield depends upon the price of cotton, the price of competing crops, fertilizer price, rainfall, cotton harvested area and time trend.

In order to analyze the determinants of cotton production, the present study is conducted in Multan district, a central area for the production of cotton in Pakistan.

Objectives of the Study

The main objectives of the study are:

a) To analyze the cost of production for different categories of the farmers affecting cotton production.
b) To calculate the cost-benefit analysis of cotton production.
c) To calculate the economic efficiencies of various inputs during course of cotton production.

Data and Methodology

The study is based on the primary data collected from the target area (Multan district) through a comprehensive questionnaire from 60 small growers (having < 12.5 acres of land), 25 medium (having > 12.5 acres but < 25 acres of land) and 15 large growers (having > 25 acres of land) in March, 2006. The growers were selected at random from two tehsils of district Multan namely Multan and Shujabad. At the second stage of sampling, 10 villages from 5 union councils of these two tehsils were selected randomly. The number of sample growers of the district was proportionately distributed among the randomly selected villages based on the share of small, medium and large growers of the villages. At the third stage, farmer's sample was selected from the list of the farmers of these villages. The major portion of samples comprised of small farmers followed by medium and large.

In order to estimate the cost of production of cotton crop, the crop budgeting technique was used. In this technique, different fixed and variable inputs are used. Land rent was the major fixed input while cultivation (LCC), fertilizer (LFC), irrigation including canal and tube-well (LIC,) inter-culture / hoeing (LINTC), labour cost (LLC), plant protection (LPPC) and sowing cost (LSC) were taken as variable cost. To ascertain the economies of scale, Cobb-Douglas Production function is used. Therefore, the log-linear form of the production function is given as under:

$$\boldsymbol{LnY = \alpha + \beta_1 LnX_1 + \beta_2 LnX_2 + \beta_3 LnX_3 + \beta_4 LnX_4 + \beta_5 LnX_5 + \beta_6 LnX_6 + \beta_7 LnX_7 + u}$$

Where

LnY	=	Dependent variable representing Yield /acre
X1	=	Cost of cultivation
X2	=	Cost of fertilizer
X3	=	Cost of Irrigation
X4	=	Inter-culturing + Hoeing cost
X5	=	Labour cost
X6	=	Cost of plant protection
X7	=	Cost of seed and sowing
α	=	Constant/ Intercept
βs	=	Coefficients to be estimated
u	=	Random disturbance term
Ln	=	Natural Logarithms

The production function was estimated using Ordinary Least Square (OLS) technique. The cost benefit ratio was calculated after calculating gross income and total cost.

Mathematically; **CB ratio = GI / TC**

Where, CB = Cost Benefit Ratio
GI = Gross Income
TC = Total Cost

In order to estimate the allocative efficiency of inputs, the Marginal Value Product (MVP) was estimated. The MVP is the value added by the specific variable. If we denote the farm revenue by Y, and X_i represents the level of resources and b_i is the coefficient of Cobb-Douglas Model (Heady and Dillon 1969), it can be shown as under:

$$\textbf{MVP of } X_i = b_i * Y / X_i$$

Where, Y is the mean value of output
X is the mean of respective input cost
The allocative efficiency of X_i = MVP X_i / Opportunity Cost of X_i

Results and Discussion

The present study endeavors to investigate the role of various inputs, the cost benefit ratio for the farmers and the allocative efficiency of the inputs.

i) Cost of Production

Per acre cost of production of the cotton crop is estimated in Multan for small, medium and large growers and the results are reported in Table 1.

Table 1: Cost of Production of Seed Cotton in Multan District (Rs /acre)

Operations	Small	Medium	Large	Overall
Cultivation cost	1600.39	1645.25	1687.68	1644.44
Sowing cost	870	879.41	915.16	888.19
Fertilizer cost	1467.02	1999.75	2458.45	1975.07
Irrigation cost (canal + tube well)	1629.07	1771.12	1833.06	1744.42
Interculture / hoeing cost	1855.42	1605.15	1621.77	1694.11
Plant protection cost	2841.99	3170.59	3557.26	3189.94
Labor cost	2412.51	2553.07	2886.8	2617.46
Rent	3750	3750	3750	3750
Total cost per acre.	16426.4	17374.3	18710.18	17503.6
Gross Income	20064	21596.3	26426.4	22695.5
Net Income Per Acre	3637.6	4221.91	7716.22	5191.95

Source: Authors' estimations

The results show that in all categories of the farmers, cost of production of large farmers was 12 percent and 7 percent higher over small and medium growers respectively. The net per acre return for medium and large farmer was 16 percent and 112 percent higher than that of small farmers respectively. The small farmers suffered due to the scarcity of inputs and lack of adoption of advanced technologies.

The results of Cobb-Douglas Production Function for Multan District are described in Table 2.

Table 2: Cobb-Douglas Production Function results for the farmers in District Multan

Description of factors	Coefficient	SE	t-values
Cultivations	0.113***	0.014	7.796
Seed	0.103***	0.026	3.962
DAP (Fertilizer)	0.191*	0.084	2.273
Urea (Fertilizer)	0.158**	0.052	3.034
Irrigations	0.220*	0.087	2.514
Plant Protection (PP)	0.169*	0.065	2.588
Hoeing/intercultural	0.102*	0.048	2.154

Source: Authors' estimations
*** = Significant at 1 percent level
** = Significant at 5 percent level
* = Significant at 10 percent level

a) Cultivation Cost

Table 2 shows that coefficient for the variable of cultivation is 0.113 showing the positive relation between yields i.e. dependant variable and the number of cultivations. It shows that yield value per acre would increase by 11.3 percent if we increase the cultivation cost by 1 percent. This variable is found highly significant indicating the strong impact on cotton yield.

b) Seed Cost

The importance of seed in the cotton production is widely accepted. It has been proved through various studies that the role of seed in the cotton production is very significant. The data results for the district of Multan given in Table 2 depicts that cotton production on per acre basis can be increased by 10.3 percent by increasing the expenditure on seed by 1 percent. The coefficient for this variable is statistically significant at 1 percent level. The expenditure on seed means use of good quality seed and improved methods of sowing.

d) DAP Fertilizer

This is one of the important components of fertilizer. This component is mostly being used by the cultivators prior to germination of crop. DAP fertilizer is playing very important role in the cotton yield as it has been realized that it provides the support to the fruit of the plant. The dependent variable response to this variable is estimated as 0.191 showing that the cotton yield in rupees will be increased by 19 percent if there will be increase in the use of 1 percent expenditure on DAP fertilizer. Statistically this variable is found highly significant showing the strong impact on cotton yield in the district of Multan (Table 2).

e) Urea Fertilizer

This is the second important component of fertilizer. It is the nitrogenous fertilizer and was found responsible for the vegetative growth of the plant. Farmers were found using this component of fertilizer after the germination of plant. In the district of Multan, the coefficient of this variable is estimated as 0.158, indicating that cotton yield in this district is responding 15.8 percent to the 1 percent increases in the use of urea fertilizer. This variable is statistically significant from zero at one percent level of significance. The results are depicted in (Table 2).

f) Irrigation

Irrigation means to apply water to the crop through different sources. Keeping in view the importance of this factor, farmers were found using different sources of irrigation. By increasing one percent expenditure on irrigation, cotton yield will respond by 22 percent. Statistically it is found significant at 5 percent level of significance. The coefficient for this variable is at the maximum as compared to others variables showing the relative importance of this factor (Table 2).

g) Plant Protection

Cotton crop is very sensitive to pests and diseases. In order to control the attack of pests and diseases farmers were using heavy pesticides. So the role of this factor is also important in the cotton production. Like others factors the factor productivity for this variable is also estimated which came out to be 0.169 showing that cotton income on per acre basis can be increased in the district of Multan by 17 percent by increasing the expenditure on plant protection measures by one percent. When its significance was tested, this variable was found significant at 5 percent level. Thus it is concluded that this factor is also playing very important role in the cotton production in the district of Multan.

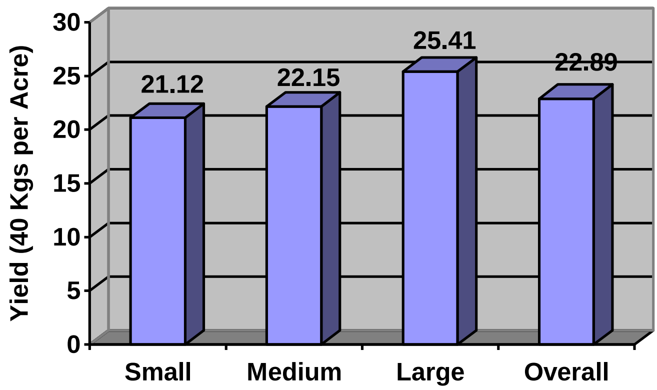
h) Hoeing / Inter-culturing

In the study area, most farmers were found practicing the intercultural practices to their crops. Most of the small farmers are doing this practice manually, while others are doing it mechanically. It is also a realized fact that intercultural practices plays important role in the cotton yield. This factor was also included in the model. On analysis, results depicts that cotton yield response to this variable is 10 percent in the district of Multan. The coefficient for this variable is found significant at 5 percent level of significance (Table 2).

ii) Yield

Yield represented per acre production of cotton. Yield levels for the different category of farmers are given in Fig.1 which depicts that yield on per acre basis have an increasing trend as the size of holding increased. It was found that 21.12, 22.15, and 25.41 (40 kgs per acre) are for small, medium and large farmers respectively in the study area.

Figure 1: Seed Cotton Yield in Multan district



Data in the table depicts that yield on per acre basis had an increasing trend as the size of holding increases. Results revealed that the large farmers are efficient growers in district Multan. It is mainly due to the reason that large farmers are more technology and resource oriented as compared to small and medium growers.

iii) Cost Benefit Ratio

The cost benefit ratio for different categories of farmers is shown in Table 3.

Table 3: Cost-Benefit Ratio of Cotton (per acre basis) in Multan District

Description	Gross Income (Rs)	Total Cost (Rs)	Net Income (Rs)	Cost Benefit Ratio
Small Farmers	20064.00	16426.39	3637.61	1.22
Medium Farmers	21596.30	17374.33	4221.92	1.24
Large Farmers	26426.40	18710.18	7716.22	1.41
Overall farmers	22695.55	17503.6	5191.917	1.31

The analysis in Table 3 indicates that cotton is more economical for the large farmers as CB ratio was maximum (1.41) as compared to medium (1.24) and small (1.22) farmers.

iv) Ratio of Marginal Value Product to Opportunity Cost

Economic efficiency for the use of critical input of cotton in Multan district is shown in Table 4.

Table 4: Economic efficiency for the use of critical inputs of cotton in Cotton belt of Multan Region

Inputs	Coefficient	Mean Y	Mean X	MVP	Opportunity Cost (Rs)	Economic Efficiency
Cultivations	0.113	22695.55	5.47	468.8477	250	1.88
Seed	0.103	22695.55	6.88	339.7735	100	3.40
DAP	0.191	22695.55	25.76	168.28	40.29	4.18
Urea	0.158	22695.55	38.64	92.80	22.68	4.092
Irrigations	0.220	22695.55	26.39	189.20	66	2.87
Plant Protection	0.169	22695.55	5.87	653.42	543.43	1.20
Hoeing/inter-culture	0.102	22695.55	2.58	897.27	656.63	1.37

The data in Table 4 depicts that the ratios of MVP to opportunity cost in the district of Multan are greater than 1 for all the inputs showing the miss-allocation of resources. These ratios indicated that all the inputs are more or less scarce in the district of Multan. The seed, fertilizers and irrigation shows maximum scarcity in the study area.

Conclusion and Suggestions

There are many factors that affect the production of cotton. In this study, some important variables were considered to determine their effects on cotton productivity. All the variables were found positively contributing towards higher yield of cotton in study area. From the discussion, it was concluded that there was a dire need to fulfill the scarcity of resources for enhancing cotton production. Among them, the major inputs include availability of quality seed, fertilizers like DAP and Urea and Irrigation water. The study revealed that the yield and profitability increases as the size of holding increases. The large farmers in the study area were found more technology as well as resource oriented. However, the scarcity of inputs was witnessed with the small farmers resulting lower yield and lower profitability.

There is a need to develop a system to produce and distribute certified seed in public sector and the sale of unapproved varieties should be prohibited. Water is a scarce commodity throughout the world. The judicious use of the available water is, however, a management issue and, therefore, requires a well thought plan for the maximum utility of the available quantum by utilizing the advanced technologies. If these inputs are properly arranged and timely provided to the farmers, the cotton production can be further enhanced.

The cost of production for small farmers is higher resulting in low yield and low profit. The study reveals that the small farmers, who are already resource deficient, cannot bear the burden of increasing cost of inputs. To address this issue, provision of subsidized inputs for this category of farmers is the need of the hour which will help not only to enhance cotton productivity, profitability and improve the living standards of the small farmers.

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