JOURNAL OF AGRICULTURE & SOCIAL SCIENCES
1813–2235/2005/01–4–332–334
http://www.ijabjass.org

Factors Affecting Cotton Yield: A Case Study of Sargodha (Pakistan)

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ABSTRACT

The present study was carried out to determine the important factors affecting cotton production in the Punjab province of Pakistan. A sample of 75 cotton growing respondents was randomly selected from different villages of Sargodha district. Cobb Douglas type production function was employed to assess the effects of education, land preparation, seed, irrigation, etc. on the productivity of cotton. Education, plant protection measures, fertilizer and land preparation were contributing towards higher cotton yield on the sampled respondents' farms. So, there is a need to educate the farmers on priority basis for adopting recommended practices. The extension staff can play a pivotal role in this regard.

Key Words: Cotton; Cobb Douglas production function; Yield; Pakistan

INTRODUCTION

There are two principal crop seasons in Pakistan, namely the kharif and the rabi. Rice, sugarcane, cotton, maize, bajra and jowar are kharif crops while wheat, gram, tobacco, rapeseed, barley and mustard are rabi crops. Cotton is the important non-food kharif crop and a leading source of foreign exchange earning. It accounts for 8.2% of the value added in agriculture and about 2% of GDP (GOP, 2004). In addition to providing raw material to textile industry, surplus lint cotton is exported. Cotton also provides edible oil, feed and fibre. It provides raw material to textile mills, ginning factories and oil expellers.

The present cotton scenario is exciting and holds even better prospects for future, both in terms of employment and exports. Production of cotton was provisionally estimated at 10048 thousand bales during 2003-04, which is 1.6% lower than the previous year. The pest attack in the early kharif season is primarily responsible for lower production of cotton crop during this year. Cotton was cultivated on an area of 2989 thousand hectares, which was 7% higher than last year (GOP, 2004). The progressive farmers obtain cotton yields ranging two to three times the national average yield, which is 570.99 kg ha^{-1}. No doubt, there was a significant increase in cotton productivity but still potential yield is not exploited. This means that existing technologies possess the needed capability to increase the cotton yield.

The gap between progressive farmers yield and the national average yield represents the untapped yield reservoir existing at the current level of technology. Highest priority should, therefore, be given to bridge the gap in order to produce enough to meet our future demand for fiber and edible oil. Highest yields at the experimental stations or the progressive farms prove that appropriate technologies best suited to our conditions are available and adoption of such technologies by progressive farmers is economical too.

A variety of factors either climatic or inputs affect cotton productivity. A difference of opinion persist among experts regarding the factors responsible for increased cotton production and the extent of contributions made by these factors towards enhanced cotton productivity. Ali (1983) identified biological factors responsible for yield gap at farmer's field through on farm experiments and socio economic constraints. These factors result in low adoption of new technology by the farmers and thereby causing yield gap. Khan *et al.* (1986) and Hassan (1991) found that lack of trained manpower, lack of finance and marketing facilities, and high cost of Agricultural inputs were responsible for low crop yield. Nabi (1991) worked on the relationship between productivity in general and the input usage. He showed that farm size, labour, seed, fertilizer, irrigation, number of cultivation and working capital were the important variables in the production process. Irrigation water and poor land quality weedicide cost and fertilizer are important constraints that affect badly crop productivity. The good management of these variables could increase production (Anwar, 1998).

Cotton management in complex farming systems is influenced by time conflicts in the harvesting of preceding crops and the sowing of cotton and interactions due to residual effects on succeeding crops (Byerlee *et al.*, 1986). Iqbal *et al.* (2001) found that timely availability of inputs such as seed, fertilizer, weedicides and pesticides could enhance crop productivity.

There are various factors that influence cotton yield. They include physical factors such as land preparation, seed, irrigation, plant protection measures, etc. and qualitative variables like education, age, farming experience, etc. The

farming community is in a dire need of updated information to boost up the cotton production. This requires conducting a detailed study and making recommendations on the basis of the findings from the study. The present study was conducted on a district basis due to financial and transportation constraints keeping in view the importance of cotton crop in the economy of Pakistan. The main objective of this study was to determine the effects of various factors affecting cotton yield.

METHODOLOGY

The paper is based on primary data collected through a comprehensive questionnaire from 75 cotton growers of Sargodha district for the year 2003. Cotton growers were selected randomly from three villages of the district. From each village, 25 farmers were interviewed for detailed information.

A regression equation was estimated assuming a modified Cobb-Douglas type production (Ahmad *et al.*, 2003, 2004; Bakhsh *et al.*, 2005) function for cotton in order to determine the contributions made by various inputs and managerial factors towards higher cotton productivity. The detailed model and description of the variables included in the model are as under:

Log linear form of the function

$$LnYLD = ß_1 + ß_2LnEDU + ß_3LnLP + ß_4LnSEED + ß_5LnIRR + ß_6LnPPM + ß_7LnN + ß_8LnP + u$$

Where,

LnYLD = Natural log of cotton yield in kg per acreage
LnEDU = Natural log of schooling years of the respondent
LnLP=Natural log of number of tractor hours for land preparation
LnSEED=Natural long of seed in kg per acreage
LnIRR=Natural long of number of irrigation per acreage
LnPPM=Natural log of cost of plant protection measure in Rs per acreage
LnN=Natural log of nitrogen in kg per acreage
LnP= Natural log of phosphorus in kg per acreage
$ß_i$ are coefficients to be estimated and u is disturbance term

RESULTS AND DISCUSSION

This study was designed to investigate the role of farmers' management practices in achieving higher cotton productivity in Sargodha district. The assessed factors include education, land preparation, seed irrigation, plant protection measures, nitrogen and phosphorus. The effects of these factors on cotton yield were investigated through multiple regression analysis. The Cobb Douglas type production function was estimated using the ordinary least square (OLS) method.

The R^2 value of 0.49 can be regarded as quite a good fit in view of the cross-sectional data involved in this study, since it implies that about 49% variation in yield is explained by the independent variables included in the model (Table I). The influence of the independent variables on cotton yield is discussed in detail as follows.

Table I. The Production function estimates of cotton

Variables	Coefficients	t-value
Constant	2.481^{***} (0.349)	7.099
LnEDU	0.150^{**} (0.075)	1.998
LnLP	0.153^{*} (0.082)	1.868
LnSEED	0.308^{NS} (0.204)	0.961
LnIRR	0.101^{NS} (0.101)	1.008
LnPPM	0.244^{***} (0.048)	5.069
LnN	0.113^{**} (0.056)	2.037
LnP	0.184^{**} (0.082)	2.224

Figures in parenthesis are standard errors; NS=Non-significant *significant (P<0.10), ** Significant (P<0.05), *** highly significant (P<0.01); Dependent variable: Logarithm of yield in kg per acre; R^2 = 0.49 F value = 6.24; Number of observation = 75

Education. Education plays a vital role in the adoption of improved technology and attaining higher productivity level. The educated farmers manage various farm practices in a better way as compared to illiterate farmers and they learn easily about new development and innovation regarding production technology of crops. Moreover, they are in a better position to know about prevailing marketing situation at local and national level regarding farm inputs and outputs. The results of the study indicate that coefficient of schooling year was positive (0.15) and was statistically significant at 5% probability level. This result indicates that one% increase in schooling year could enhance cotton yield by 0.15%. This increased yield would result due to better management practices and adoption of latest technologies in cotton cultivation. As cotton crop is more sensitive to disease and pest attacks, so, timely identification of such problems and appropriate measures to control such attack are the utmost important. The literate farmers are in a position to tackle such problems in the most efficient ways. Earlier Wu (1977), Dhakal *et al.* (1989), Raza and Ramachandran (1990) and Lin (1991) also indicated that farmer's education improves the management skills.

Land preparation. Cotton is a deep rooted and heavy feeding crop. It thus needs deeply tilled and well prepared soil for its tap root to penetrate deep into the soil and feeding roots to establish in the feeding zone. The results of the production function show that number of tractor hours for land preparation had a positive coefficient (0.153) and it was significant at 10% probability level. The positive coefficient implies that well prepared land contributes significantly toward higher yield of cotton crop. This finding is in full agreement with Khan *et al.* (1986) and Hobbs *et al.* (1992) who recommend deep tillage for minimizing compaction below the plough layer and for conserving moisture under rain-fed conditions.

Seed rate. Given the other factors, seed rate determines the plant population in a field of certain crop and thus, is an important factor in determining yield. The coefficient of seed rate was positive, however, it was statistically non-significant. It may be due to the fact that the farmers were using seed according to recommended level.

Irrigation. Although statistically non-significant, the positive coefficient of number of irrigation implies that one% increase in number of irrigation could enhance yield of cotton crop up to 0.101%. The reason for non-significance of number of irrigation was that the farmers were applying irrigation according to crop requirements.

Plant protection measures. Plant protection measures include weeding, hoeing and application of pesticide to control pest and disease on cotton crop. The incidence of weeds, pests and disease on cotton crop is a growing problem in all cotton-growing areas of Pakistan and adoption of chemical control methods are increasingly becoming popular among the cotton growers. The results of the production function reveal that cost of plant protection measures had a positive coefficient (0.244) and it was statistically highly significant. This result indicates that additional cost of plant protection measures increases cotton yield significantly.

Fertilizer use. The recommendations regarding application of chemical fertilizers to cotton crop also emphasize the use of balance dose of fertilizers (N: P: K). Therefore, variables of P-nutrients and N-nutrients were included in the model. The coefficients of nitrogen nutrient and phosphorus nutrient were positive and were statistically significant at 5% probability level. The results indicated that the more use of fertilizer contributed towards higher yield and the cotton growers could enhance their crop production by applying appropriate combination of N: P: K.

CONCLUSION AND SUGGESTIONS

There are many factors that affect cotton productivity, namely socio-economic, biological, managerial and physical. In this study, some important factors were taken into account to determine their effect on cotton productivity. These vital factors were schooling years of the respondents, land preparation, irrigation, seed rate, plant protection measures and fertilizer nutrients. All these factors were found positively contributing towards higher yield of cotton crop in Sargodha district. However, the effects of schooling year, land preparation, fertilizer and plant protection measures were significant.

Reorientation of breeding research is required to evolve high yielding, and disease resistant varieties for cotton. Moreover, extension systems should emphasize in training farmers to control weeds and disease and pest attack. Field visits and demonstration by extension staff could be right steps in the right direction.

There is a need to emphasize research and extension strategies. The provision of sufficient resources to research and extension systems is suggested for developing and promoting new technologies to combat disease and pest attack on cotton crop.

Timely availability of quality inputs such as seed, phosphatic fertilizer, weedicides and pesticides play the key role in cotton productivity enhancement. The efforts of agencies and departments involved in the distribution and quality control of vital inputs need to be accentuated further. This would ensure timely availability and quality of these inputs to the cotton growers.

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(Received 10 January 2005; Accepted 20 July 2005)