

Factors Influencing Sustainable Production of Cotton in Pakistan: A Case Study From Bahawalpur District

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Abstract

Pakistan is one of the most important cotton producing and consuming country in the World. But there is instability in cotton production in Pakistan. The present study purpose is to explore the important factors affecting cotton production in Pakistan. A sample of 50 small farmers, 30 medium and 20 large farmers was randomly selected from different villages of Punjab province. Some production function was employed to assess the effects of education, land fertilization, weather, land preparation, seed, irrigation, etc on the productivity of cotton. The results revealed that the coefficients for cultivation (0.115) and seed (0.105) were found statistically significant at 1 percent level. The Cost-Benefit Ratio for the large farmers was found higher (1.35) than that of small (1.28) and medium (1.33) farmers. So, there is a huge need to educate the farmers on priority basis to adopt the recommended practices and to ensure the availability of these inputs. The extension staff can play a highly positive role in this regard. At the end, a detailed discussion is proposed to show the efficiency of the proposed model.

Keywords: Factors affecting cotton yield; Cost of production and cost benefit ratio; Marginal Value Product; Economic Efficiency;

1. Introduction

The purpose of this paper is to explore prospects and mechanisms for a transition to sustainable development of agriculture sector in Pakistan. The particular case examined here is cotton and cotton products, which together establish the largest economic sector in Pakistan, with appreciable trade exposure at every stage of production.

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Pakistan is the fourth largest producer of cotton in the world after Peoples Republic of China, USA and India, the third largest exporter of raw cotton, the fourth largest consumer of cotton, and the largest exporter of cotton yarn. Cotton is cultivated on an area of 3.19 million hectares [11]. Approximately 77 percent of all Pakistan cotton is produced in Punjab and remaining 23 percent in other provinces.

Pakistan's share of total world cotton production in 2004-05 stood at 9.47 percent [12]. Agriculture is one of the major sectors of economy in Pakistan. The economic development of Pakistan mostly depends on agriculture. As the industrialization progressed, the position of agriculture sector was dominated by service sector and at present, agriculture share ranks third in the GDP of Pakistan. Agriculture sector also provides raw material to the domestic cotton industry. The agriculture sector contributed 20 percent of GDP during (2007), whereas during 2008-09 its contribution was 21.8 percent (Pakistan Economy survey 2008-09). Agriculture is the main source of employment in the country.

The development report of UNDP for the year (2007-08) disclosed that 65 percent of Pakistan population lives in rural areas. In rural areas agriculture is the only source of their employment and 44.7 of the total employed labor force in the country mainly depend on agriculture. Pakistan can be called the land of cotton. Cotton fabrics dates 3000 BC and has excavated in the Indus valley of Pakistan [13]. 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. 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 [1].

1.3 million farmers (out of a total 5 million) cultivate cotton over 3 million hectares, covering 15 per cent of the cultivable area in the country. Cotton and cotton products contribute about 10 per cent to GDP and 55 per cent to the foreign exchange earnings of the country. Taken as a whole, between 30 and 40 per cent of the cotton ends up as domestic consumption of final products. The remaining is exported as raw cotton, yarn, cloth, and garments [2]. Cotton is a major fiber and cash crop of Pakistan and ranks at the top as foreign exchange earner. This crop provides livelihood to millions of people engaged in its trade and textile industry. Moreover, it provides raw material for our local industry and stands at the top of our exports sharing 62.3% to our total export [9].

In 1947, production of cotton was only 1.23 million bales, whereas an all time record cotton production of 14.6 million bales was achieved in 2004-05, which was the highest production in the history of Pakistan. The production process involves principle use of inputs including seed, pesticides, fertilizers and irrigation.

Water is a primary factor controlling plant growth [23]. It is stated that, when water was applied at 0.85, 0.70, and 0.55 or 0.40 ET (evapotranspiration) to cotton plants grown in pots, there was a close relationship between plant development and water supply [24]. There is a substantial increase in cotton production during the last decade but still potential yield has not yet been achieved. However, the use of advanced technologies and wise use of inputs at the subsidized rates can enhance the production of cotton.

Cotton is produced on large as well as small farms with significant differences in farming methods and access to technology. In Pakistan, cotton is grown on 3 million hectares mainly in the provinces of Punjab and Sindh. More than half of the farms are less than 2 hectares in area, although they cover only 11 per cent of the area. However, less than 2 per cent of the farms covering 24 per cent of the area are larger than 20 hectares in size. Key actors in this segment of the chain are the 1.3 million farmers, 20 pesticide companies, 114 seed companies, government seed corporations, government seed certification department, the agricultural extension system, the cotton crop research institutes, the irrigation department, commission agents, ginners, and agricultural credit companies. While some of these are more organized than others (e.g. the pesticide companies), it is not clear whether there is a governance

structure to influence inputs and outputs. 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 [3]. The literate farmers are in a position to tackle such problems in the most efficient ways. Earlier Raza and Ramachandran also indicated that farmer's education improves the management skills [5].

Different studies such as [20, 21] have been conducted to assure the factors which are responsible to increase the production and ultimately benefiting the farmers, those studies 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 [19,20]. The authors in [22] calculated that the use of inputs has a direct effect on the production and profit of the farmers. He found that cultivation cost, sowing cost, seed, fertilizer, pesticide, irrigation and labor are the important variables in production of cotton. Plant protection and irrigation are the most important variables which affect the cost of production [21]. To break down the causal factors of cotton production, the present study is conducted in Bahawalpur district, a central area for the production of cotton in Pakistan.

2. Problem Statement

COTTON, which is also known as 'white gold', is an important crop in many developing countries. The yield of the crop is dependent upon the environment in which it is grown and the management practices of the cropping system.

In Pakistan Cotton yields are stagnant for the last several years. The cotton production process involves use of several inputs including land preparation, inputs like seed, irrigation water, fertilizer, pesticide and labor etc. The prices of these inputs have increased resulting higher cost of production. In addition the cotton crop can be easily affected by various pests attack and natural hazards like rain, hail storm etc. Excessive rain at the time of sowing, high temperature at flowering stage, late wheat harvesting resulting in decline of area under the crop, leaf curl virus incidence, soil system, weather adversaries, pest attack and improper production technology in major cotton growing areas of Punjab and Sindh. The cotton support price trend, prices of inputs and weather play an important role in the cotton production. The production process involves different inputs. Every input has its significant influence and

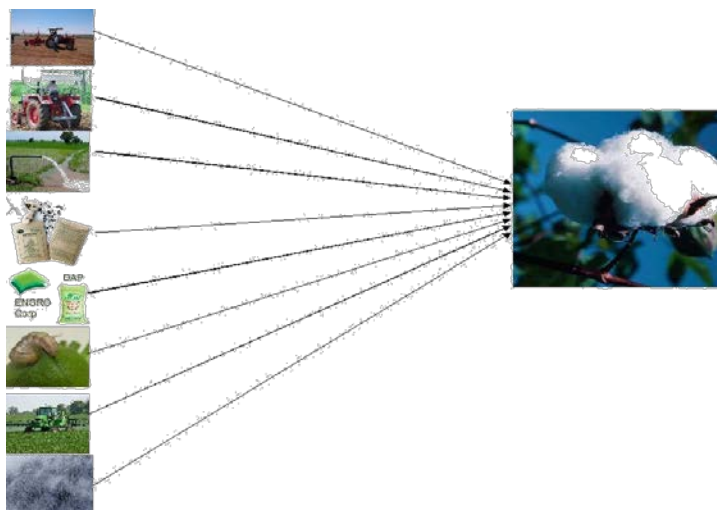


Figure 1: Factors which usually can affect cotton production

plays a vital role in this process. The basic is land and its preparation has key influence on the crop condition. There are many social as well as economic problems facing by cotton production including, illiterate farming community,

high cost of inputs, small land holdings, less adoptability of innovations by the farmers, lack of guidance to farmers, high cost of production and insecurity in the market, the cost of production being the most significant among them. In recent past two major factors had a significant impact on the economics of cotton production. They are extensive use of agrochemicals and yield stagnation. Among all agrochemicals, fertilizers and insecticides are of utmost importance.

There are no efficient alternatives to synthetic fertilizers and cotton production has to bear the use of nutrient supplements in the form of inorganic fertilizers. The core of the problem facing by the country's cotton industry has been the absence of a recognized and scientifically devised standardization system. The marketing and pricing system had been based on cotton varieties and weight, which resulted in a variety of grades and staples. The government therefore decided to introduce standardization and a pricing system based on premiums/discounts to bring Pakistan cotton on a par with internationally accepted standards and to ensure better returns for cotton growers, ginner, spinners and the national economy [14]. Among pesticides, insecticides are group of agrochemicals which is extensively used on cotton. In the cotton wheat system of Pakistan, there are a considerable number of farms that are both technically and allocatively inefficient [4]. 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 [6]. The author in [7] found that timely availability of inputs such as seed, fertilizer, weedicides and pesticides could enhance crop productivity. Insects, being living organisms, have adjusted with the injurious chemicals and learned to survive with insecticides. Consequently, insecticide use kept increasing causing a serious impact on the economics of cotton production. Currently, there is a greater need for new developments in production research but more and more researchers are confronted with maintaining the current status of yields in their countries. The cost of production has increased to unacceptable levels in many countries that threaten the economics of cotton production. There are different classes of the farmers for example small, medium, large, and their resources are also different. In this paper we study about the factors which affect the cotton crop and also why the large farmers gain more output than small or medium growers.

2.1. Objectives of the Study

- (1) To analyze the cost of production for different classes of the farmers affecting cotton production.
- (2) To calculate the cost-benefit analysis of cotton production.
- (3) To calculate the economic efficiencies of various inputs during course of cotton production.

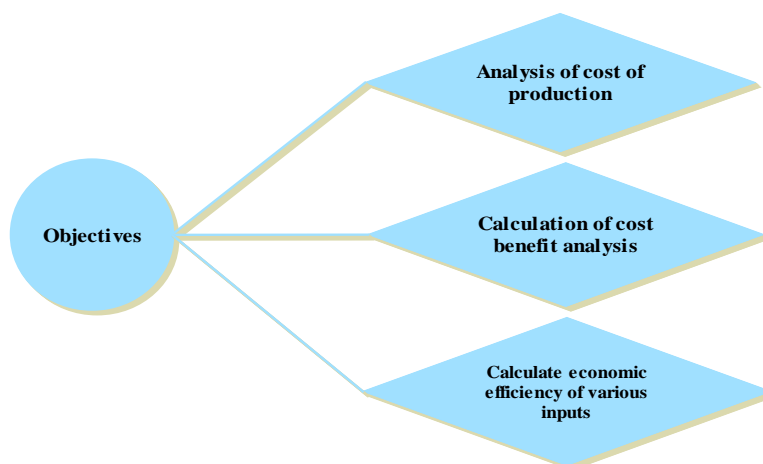


Figure 2: Objectives of the study

3. Data and Methodology

This research is established on the primary data accumulated from the target area (Bahawalpur district) through a comprehensive questionnaire from 50 small growers (having 12.5 acres of land), 30 medium (having 12.5 acres but 25 acres of land) and 20 large growers (having 25 acres of land) in March, 2006. The growers were selected at random from two tehsils of district Bahawalpur namely Bahawalpur and Ahmedpur east. 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, farmers sample was selected from the list of the farmers of these villages. To estimate the cost of production of cotton crop, we used the crop budgeting technique. 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,) hoeing (LINTC), labor 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 production function is given as under

$$\ln P = \gamma + \eta \ln Q1 + \eta \ln Q2 + \eta \ln Q3 + \eta \ln Q4 + \eta \ln Q5 + \eta \ln Q6 + \eta \ln Q7 + v$$

3.1. Parameters

LnP	Dependent variable representing Yield /acre
Q1	Cost of cultivation
Q2	Cost of fertilizer
Q3	Cost of Irrigation
Q4	Hoeing cost
Q5	Labor cost
Q6	Cost of plant protection
Q7	Cost of seed and sowing
γ	Constant
η	Coefficients to be estimated
v	Random disturbance term
Ln	Natural Logarithms

Mathematically;

$$CB \text{ ratio} = GI / TC$$

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

Marginal Value Product (MVP) was estimated to estimate the allocative efficiency of inputs. The MVP is the value added by the specific variable. If we denote the farm revenue by Z, and Yi represents the level of resources and fi is the coefficient of Cobb-Douglas Model (Heady and Dillon 1969) [10], it can be shown as

$$MVP \text{ of } Y_i = f_i * ZY_i,$$

Where, Z is the mean value of output,
 Y is the mean of respective input cost
 The allocative efficiency of Yi equals to MVP Xi

4. Results and Discussion

This study conducted to investigate the role of various inputs, the cost benefit ratio for the farmers.

4.1. Cost of Production

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

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

Operations	Small	Medium	Large	Overall
Cultivation cost	2000.69	2065.25	2085.68	2050.54
Sowing cost	1000.41	1049.16	1090.19	1046.58
Fertilizer cost	1700.02	2110.75	2660.45	2175.07
Irrigation cost	1800.07	1980.12	2020.06	1933.41
Interculture	2060.42	1820.15	1830.77	1903.78
Plant protection cost	3200.99	3480.59	3940.26	3540.61
Labor cost	3200.51	3260.07	3630.18	3363.58
Rent	6000	6000	6000	6000
Total cost per acre	20963.11	21766.04	23257.59	21995.58
Gross Income	26852.02	28960.79	31324.60	29045.80
Net Income Per Acre	5888.91	7194.75	8067.01	7050.22

The results in the table 1 show that in all classes of the farmers, cost of production of large farmers was higher than small and medium growers respectively. The net per acre return for medium and large farmer was higher than that of small farmers respectively. The small farmers suffered because they face scarcity of inputs and lack of advanced technologies.

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

Description of factors	Coefficient	S E	t – values
cultivations	0.115***	0.016	7.801
Seed	0.105***	0.028	3.972
DAP Fertilizer	0.193*	0.085	2.289
Urea Fertilizer	0.159**	0.053	3.039
Irrigation	0.222*	0.088	2.529
Plant Protection	0.168*	0.064	2.582
Hoeing	0.103*	0.049	2.161

Source: Author’s estimation

*** = Significant at 1 percent level

** = Significant at 5 percent level

* = Significant at 10 percent level

4.2. Cultivation Cost

(Table 2) shows that coefficient for the variable of cultivation is 0.115 which shows the positive relation between yields. It shows that yield value per acre would increase by 11.5 percent if we increase the cultivation cost by 1 percent. This variable is found very important and has strong impact on cotton yield

4.3. Seed Cost

The importance of seed in the cotton production is highly accepted. Different studies have been proved that the role of seed in the cotton production is very significant. The results for the district of Bahawalpur given in (Table 2) show that cotton production on per acre basis can be increased by 10.5 percent by increasing the expenditure on seed by 1 percent. The coefficient for this variable is statistically significant. The expenditure on seed means use of good quality seed and improved methods of sowing.

4.4. DAP Fertilizer

This is also an important component of fertilizer. This fertilizer is being used by the farmers before germination of crop. DAP fertilizer provides support to the fruit of the plant so it is one of the most important factor for cotton production. Cotton yield response to this variable is estimated as 0.193 showing that the yield will be increased by 19.3 percent if there will be increase in the use of 1 percent expenditure on DAP fertilizer. This variable is found highly significant which has strong impact on cotton yield in the district of Bahawalpur.

4.5. Urea Fertilizer

This is the second important component of fertilizer. It is the nitrogenous fertilizer and was found responsible for the vegetative growth and height of the plant. Usually farmers use this component of fertilizer after the germination of plant. In modern agriculture, the most critical problem for increasing yield and developing sustainable agriculture should be sufficient nutrient supply and successful protection of crop against herbivores and pathogens. Nitrogen and potassium are large amount elements that are required for crops growth, and play an important role in underpinning crop yield production and quality determination [15]. In the district of Bahawalpur, in (Table 2)the coefficient of this variable is estimated at 0.159, which shows that cotton yield in this district is responding 15.9 percent to the 1 percent increases in the use of urea fertilizer.

4.6. Irrigation:

The correct amount of water on your cotton crop is essential for producing high yields. Water stress reduced the plant foliage cover and the extent of reduction depends upon the severity and stage of the crop at which stress is imposed. In cotton, plant height was significantly reduced by water stress treatments [16]. It means applying water to the crop through different sources. The application of lower amount of irrigation water significantly reduced the plant height [17]. Proper irrigation management minimizes yield loss due to crop water stress, optimizes yield per unit of water applied and boost up the good management practices. The result is a greater return on investment. Seed cotton yield was significantly affected by drip irrigation application rate or water stress. When the amount of applied water through drip irrigation was reduced by 25% However, reduction of irrigation up to 50% yield than full irrigation [18]. This factor is important so, farmers were found using different sources of irrigation. We experienced by increasing one percent expenditure on irrigation, cotton yield will respond by 22.2 percent. Statistically it is found significant at 5 percent. This variable has maximum importance as compared to other variables. Irrigation and poor land quality we decide cost and fertilizer are important constraints that affect the crop productivity badly. The good management of these variables could increase production [8].

4.7. Plant Protection

Plant protection is very important for any crop but Cotton crop is most sensitive to pests and diseases. Use of suitable and heavy pesticides to control pests and diseases is an important factor. Significant discoveries about the impacts of farmers' knowledge on pesticide use, it nevertheless has its limitation. That is, using a cross section data set, we cannot fully control the impacts of time-invariant variables. In other words, the estimation results of this study might suffer from omitted variable bias [22]. So the role of this factor is also important in the cotton production. Productivity for this variable is also estimated, which was 0.168 showing that cotton income on per acre basis can be increased in the district Bahawalpur by 16.8 by increasing the expenditure on plant protection measure by one percent. Its significance was found at 5 percent level. This factor is also playing very important role in the cotton production in the district of Bahawalpur.

4.8. Hoeing

In the study area, most of the farmers were applying the inter-cultural practices to their crops. Small farmers are doing this practice manually, while others are doing that mechanically. But the fact is that inter-cultural practices plays important role in the cotton yield. This factor is also included in the model. By analysis, the results shows that cotton yield response to this variable is 10.3 percent in the district of Bahawalpur, it is also an important factor which plays a significant role to enhance the cotton production.

4.9. Yield

Yield represented per acre cotton production. Yield levels for the different class of growers are given in Fig.3 which describes that yield on per acre basis is increasing as the size of holding increased. It was found that 22.5%, 25%, and 28.5% (40 kgs per acre) are for small, medium and large farmers respectively in the study area.

Data in the table shows that yield on per acre basis is increasing as the size of holding increases. Results display that the large farmers are effective growers in district Bahawalpur. It is mainly due to the reason that large farmers have more technology and resources as compared to small and medium farmers.

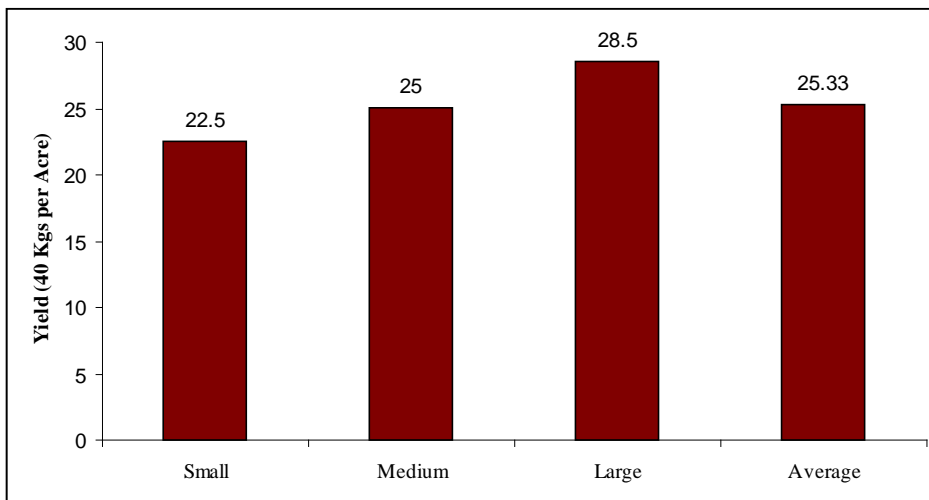


Figure 3: Seed Cotton Yield in Bahawalpur district

4.10. 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 Bahawalpur District

Description	Gross Income(Rs)	Total Cost(Rs)	Net Income(Rs)	Cost Benefit Ratio
Small Farmers	26852.02	20963.11	5888.91	1.28
Medium Farmers	28960.79	21766.04	7194.75	1.33
Large Farmers	31324.60	23257.59	8067.01	1.35
Overall farmers	29045.80	21995.58	7049.97	1.32

The analysis in (Table 3) shows that cotton is more economical for the large farmers as CB ratio was maximum (1.35) as compared to medium (1.33) and small (1.28) growers

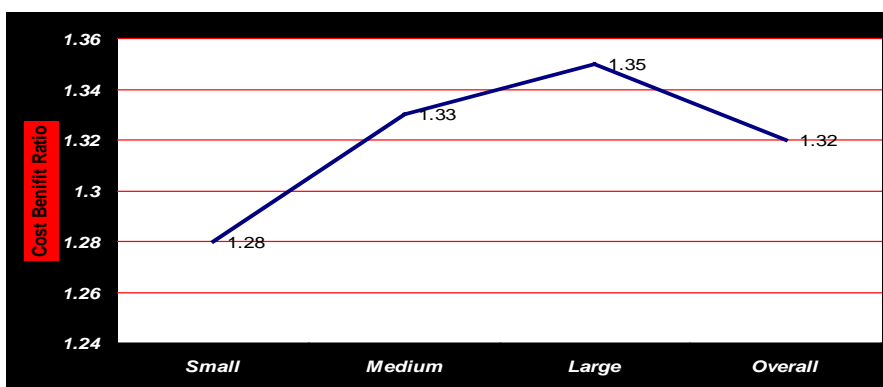


Figure 4: Cost-Benefit Ratio of Cotton

4.11. Ratio of Marginal Value Production to Opportunity Cost

In (Table 4) ratios of MVP to opportunity cost in the district of Bahawalpur are greater than 1 for all the inputs showing the miss-allocation of resources.

Table 4: Economic efficiency for the use of critical inputs of cotton in Bahawalpur Region

Inputs	Coefficient	Mean Y	Mean X	MVP	Opportunity Cost	Economic Efficiency
cultivations	0.115	29045.80	5.49	608.4275	301	2.02
Seed	0.105	29045.80	6.92	440.7238	129.10	3.41
DAP Fertilizer	0.193	29045.80	25.81	217.1964	54.19	4
Urea Fertilizer	0.159	29045.80	38.67	119.4280	28.30	4.22
Irrigation	0.222	29045.80	26.43	243.9715	78.29	3.12
Plant Protection	0.168	29045.80	5.85	834.1128	601.32	1.39
Hoeing	0.103	29045.80	2.60	1150.6288	709.27	1.62

These ratios show that all the inputs are hard to find in the district of Bahawalpur. The seed, fertilizers and irrigation are more important in this area.

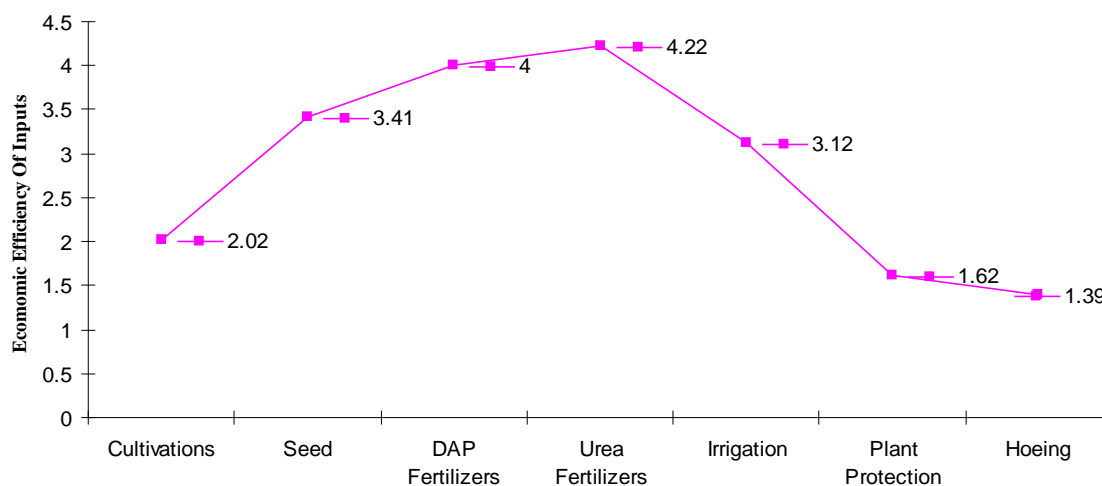


Figure 5: Economic Efficiency of several inputs

5. Conclusion and Suggestions

There are many factors which effect the cotton production. In this paper we considered some important factors those

have huge impact on cotton productivity. There are many factors which contribute towards higher output of cotton. In this study we concluded that there is need to enhance the resources to increase the production. Some major inputs contributing in higher yield of cotton are availability of resources, technology, water and important fertilizers. This study shows the average yield is going to increase as the size of land is increasing. It means the large farmer can get more out put than the small farmer, because large farmers are more resource and technology oriented than small farmers. So there is need to solve some important problem which can be cause of low yield. One of the most important factors of low yield is lack of education in the farmers. Education plays a vital role to enhance the production. But unfortunately most of the farmers are illiterate or do not have enough knowledge and experience to tackle the problems and to enhance the yield. Second important is preparation of land for production. It plays main role in production of any crop; Cotton is a deep rooted and heavy feeding crop. So it needs deeply tilled and well prepared soil but unluckily many farmers cannot do this job in efficient way due to lack of knowledge and lack of resources. Irrigation is also one of the important factors in cotton production as one% increase in number of irrigation could enhance yield of cotton crop up to 0.101%. Seed rate determines the plant population in a field.

It is an important factor in determining yield. The coefficient of seed rate was positive, however, it was statistically no significant. It may be due to the fact that the farmers were using seed according to recommended level. Accessibility of quality inputs such as seed, fertilizer, and their proper use play a vital role in cotton productivity enhancement. Plant protection measures such as, hoeing and application of pesticide to control diseases on cotton crop. Diseases on cotton crop are a growing problem in all cotton-growing areas of Pakistan. Effective plant protection measures increase in cotton yield significantly. Proper and timely use of fertilizers contributes towards higher yield and the cotton growers could enhance their crop production. If we manage above all variables properly the cost of production could be decreases and profit could be increases. This paper discloses that the small farmers, who are already resource deficient, cannot bear the burden of increasing cost of inputs. So, to overcome this problem the Government should provide subsidies on inputs for the small farmers, which will help to enhance cotton productivity, and improve the living standards of the small farmers.

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