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DETERMINANTS OF DECLINE IN COTTON CULTIVATION AND ITS REPLACEMENT WITH ALTERNATIVE CROPS IN PUNJAB, PAKISTAN

Muhammad Usama Ali[1], Anisa Abdul Rehman[2], Usman Ali Asghar[3], Mohsin Raza[*4], Muhammad Shafique[5], Muhammad Rizwan[6]

[1]*Department of Agriculture and Resource Economics, University of Agriculture Faisalabad*
[2, *4,5]*Department of Agricultural and Resource Economics, MNS- University of Agriculture Multan*
[3]*Agri consultant / Farm Manager at Kasuri Research Farm*
[6]*MPhil Scholar, NCBA&E Multan*

[1]usama96ali@gmail.com, [2]amjrehman76@gmail.com, [3]usmanaliasghar2015@gmail.com, [*4]mohsinji774@gmail.com, [5]mshafiqsjd@gmail.com, [6]m.rizwan703@gmail.com

Corresponding Author: *
Mohsin Raza
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ABSTRACT

Cotton as a major cash crop in Pakistan is recognized as the country's economic backbone. It accounts for about 0.8 percent of total GDP and 4.1 percent of the overall agriculture value addition. In the last 2 decades, there is a decrease of 10 percent in the area, 10.02 percent in production, and 1 percent decrease in yield. The farmers hesitate to take risk of growing cotton and shift towards other crops. During the same time period, the trend has clearly shown a major shifting of cotton crop toward rice, sugarcane, maize, and fruits. The primary data were collected from 100 farmers located in 4 tehsils of district Khanewal during 2021. The secondary data was taken from various government websites from 1991 to 2020. The objective of this research was to examine the past trend and future forecast of the area, production and yield of cotton crop. The present study also aimed to find the alternative crops being replaced with cotton. The study also identified the factors affecting the decline of cotton area in the major "Cotton-Wheat System" districts of Punjab. Cotton area, production, and yield was forecasted through ARIMA model. Multiple Liner Regression Model was used to determine the relationship between cotton yield and different explanatory variables. This study finds that the major alternative crops which replaced cotton were rice (35%), maize (22%), citrus (12%), other crops (28%). 3% farmers were found those who did not replace their cotton crop with any other. Age, education, cotton growing experience, total income, and land preparation cost has positive and significant impact on cotton yield. The value of R^2 was 0.286. One of the major causes of this diversion towards alternative crops is continuous increase in temperature. This continuous increase is damaging the cotton crop. In early stage of cotton, the rise in temperature increases humidity, this increase in humidity provides favorable environment to the white fly which is the major pest of cotton. The present study found that more time consuming, high cost of production and highly effected by high temperature as the major social, economic and environmental challenges/constraints respectively. Non availability of canal water and unfit quality of ground water, attack of pests, high cost of production and less demand by local consumer were also issues found in cotton cultivation. Improvement in supply of canal water, proper management of crop residue, allocation of special zones for cotton and sowing of genetically improved verities resistant to high temperature, and produce good quality lint are some recommendations for the revival of cotton crop in the study area.

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Key words: *Cotton, forecasting, alternative crops, temperature, cotton yield*

1. INTRODUCTION

Pakistan's economy is entirely built on agriculture, which is regarded as the country's backbone. With the contribution of 19.2% to the GDP, agriculture is the most important sector in Pakistan's economy. It gives employment to more than 38.5% total labor force in Pakistan with 65-70 percent of the population relying on it for their income. In the recent years growth rate of agriculture is narrowed down by reduction in arable land, water shortages, change in climate, increase in population and shift of labor from rural areas to cities. Despite new technologies and increase in production capacity, the sector has been facing many serious challenges like severe variations in temperature, diversion in precipitation pattern, shortage in water supply and high input prices (GOP, 2020). Cotton (Gossypium hirsutism L.) sometimes known as "white gold," is a large non-meal cash crop. It is planted as an industrial crop, mostly for the production of fiber. The cotton crop occupies 15% of agricultural land. Its time period is from April to August which is also known as kharif period. Cotton is also farmed on a relatively small scale throughout the months of February and April (GOP, 2018). India produces the majority of the global cotton which is 27% of the total world. Pakistan is the world's fifth largest producer of cotton, accounting for 6.23 percent of total global production. However, Pakistan consumes 9.3 percent of total global utilization. Punjab and Sindh are Pakistan's top cotton-producing provinces. In year 2020-21, Punjab produced 5040 thousand bales of cotton, whereas Sindh produced 2170 thousand bales and adds 27.59 percent of Pakistan's total cotton production. Both provinces generated more than 98 percent of the country's total cotton agricultural output (USDA, 2020).

Cotton crop production fell by 22 % in 2020-21 as compared to the previous year, making it difficult for the textile sector to increase supply. Cotton was cultivated on 2,517 thousand hectares in 2019-20, with an output of 9,148 thousand bales. But in 2020-21cotton was grown on 2,079 thousand hectares, with a total production of 7,064 thousand bales A decrease of 17.4 % in area and 22.8% in production is recorded (GOP, 2020).

Farmer's adoption to the latest and good farm techniques can help the farming industry to thrive. Producers in Pakistan can benefit from improved farm methods which are given by researchers. Farmers frequently express reluctance to use new technologies. To solve this challenge, farmers and extension officers and field officials must have a deeper knowledge of each other. Different resource planning and diverse traditional values are the primary causes of gaps in productivity. These factors may be socio-economic (education, age, agricultural experience etc.), biological (varieties of seed, fertility of soil, climate conditions, temperature, rainfall etc.), input accessibility, policies of government, and visits of the farmers field by the extension staff. Climatic changes, agriculture land availability, pests, availability of agricultural equipment's and some other factors that affect production are often beyond the control of small and traditional farmers. Farming should be made more efficient in order to promote Pakistan's economic development and alleviate poverty, and a national policy is also required to address these problems.

1.1. Area, Production and Yield of cotton

Year	Pakistan and Punjab					
	Area (000 hectares) Pakistan	Area (000 acres) Punjab	Production (000 bales) Pakistan	Production (000 bales) Punjab	Yield (kgs/hec) Pakistan	Yield (mound/acre) Punjab

2011-12	2,835	6261	13,595	11129	815	22.86
2012-13	2,879	5705	13,031	8628	769	21.47
2013-14	2,806	5434	12,769	8146	774	21.64
2014-15	2,961	5740	13,960	10277	802	23.02
2015-16	2,902	5542	10,074	6343	587	14.72
2016-17	2,489	4486	10,671	6978	729	20.00
2017-18	2,700	5078	11,946	8077	753	20.48
2018-19	2,373	4665	9,861	6826	707	18.82
2019-20	2,517	4645	9,148	6306	618	17.46
2020-21	2,079	3821	7,064	5044	578	15.84

Source: (GOP, various issues)

The table represents the area, production and yield of cotton in the decade in Pakistan and Punjab. In Pakistan the production of cotton continuously decreasing with the decrease in area and yield. In 2011-12 the production of cotton was 13,595 thousand bales with an area of 2,835 thousand hectares and in year 2020-21 the production decrease to 7,064 thousand bales with a decrease of 2,079 thousand hectares in area. 27% of cotton area is decrease in these 10 years and 49% of production decrease in the same time period. While in Punjab the production of cotton also continuously decreasing with the decrease in area and yield. In 2011-12 the production of cotton is 11,129 thousand bales with an area of 6,261 thousand acres and in year 2020-21 the production decrease to 5,044 thousand bales with a decrease of 3,821 thousand acre in area. 38% of cotton area is decrease in these 10 years and 54% of production decrease in the same time period. As it clearly represented from data that decline in production is more as compared to area which mean that in past decade there is a steep decline in yield per acre. This steep decline in output cause production to fall more than area of cotton.

Reddy et al., (1998) researched how cotton (Gossypium hirsutism L.) is affected by temperature. A wide range of temperature information would be beneficial for estimating both cotton development and rate of growth. Consequently, an experiment was done in naturally light, temperature and CO2 controlled cabinets from the time of emergence until 56 days following it. In the day/night cycles, the cabinets were set to 12°C/20°C, 17°C/25°C, 22°C/30°C, 27°C/35°C, and 32°C/40°C. Throughout the trial, plant heights, node counts, and leaf area were measured weekly, and dry weight measurements were taken at three intervals. About 3 weeks after emergence, main stem elongation, leaf area increase, and biomass deposition rates were extremely sensitive to temperature. Prior to then, they were largely indifferent to temperature changes in their environment. As a result, stem lengthening, leaf area development, and biomass deposition occurred at a temperature of 30°C/22°C respectively. Temperatures over 30/22°C did not affect growth rates as much as they did development rates, as measured by the number of main stem nodes generated, the number of flowering branches, and the number of flowering branch nodes. At 22°C /30°C, 4 times as many flowering branches were generated as at 12°C/20°C, whereas low temperatures produced more vegetative branches. 32°C/40°C plants had their flower

buds (squares) removed. As a result, at 22°C/30°C, almost all bolls and squares were maintained; at 27°C /35°C, around 10 percent of bolls and squares were lost. When grown at any temperature acceptable for cotton, this cultivar produced squares in a shorter amount of time than was predicted by old researches.

Mahmood et al., (2011) examined that mealy bug was originally discovered in India in 2004 and was found to be harming cotton in the state of Gujarat. Vehari (Punjab) and Sanghar (Sindh) were the first places in Pakistan to report it in 2005. Almost all of Pakistan has been affected, except for the high mountains. A lot of vegetables and decorative plants have been damaged, and Pakistan cotton might be at risk.

Ali et al., (2012) explained that textile production is a vital part of Pakistan's economy. Land preparation, picking, and marketing are all steps in the cotton production process. The cost of manufacturing has grown over time due to the high cost of inputs. Land rent accounted for 28.536% of the overall cost, whereas seed accounted for the smallest percentage (21.336 percent). Throughout the years, pesticides have seen the most increase in input cost increases (8.98 percent). Despite this, seed saw the fastest rate of growth at the lowest input cost (4.26 percent). Additionally, the increase in input costs in 2002, 2002, 2006, and 2007 has resulted in a negative return on investment overall.

Ataullah et al., (2014) explained that Pakistan's most of the economy is based on the textile sector. Its role in GDP, trade and manufactured value added (MVA) is largest. The sector employs 39 percent of Pakistan's workforce. More over 60 percent of Pakistan's exports are textile-related items, which contribute 9.5 percent to the country's GDP. The Pakistan Textile Industry, on the other hand, isn't generating the profits it might. External issues like law and order, the energy problems, a lack of foreign capital, unfriendly regulations and taxation, and the abolition of quotas are typically cited as the main causes of this poor performance. But there were also industry-wide challenges that led to the industry's poor results.

Bakash et al., (2014) investigated that there were a number of factors that affected cotton productivity in the Punjab area of Pakistan that were examined in this study. In addition to other traditional criteria such as agricultural inputs, socioeconomic variables and animal assets are included in the study. Estimation of a Cobb-Douglas production function was made. There is a consideration of the effects of livestock assets on different farm features, such as the percentage of Bt cotton, cotton acreage, and a dummy for excellent quality land. Variables such as Bt cotton area and the ratio of Bt to non-Bt cotton area were shown to be substantially associated to cotton output in this study. Animal husbandry and pesticide usage have a combined influence on cotton production of 0.39 percent, whereas livestock and Bt cotton contribute 0.01% to cotton yield. Livestock integration in farming systems can also increase crop production, therefore improving farm revenue and farming community livelihood.

Abbas and Ahmad (2018) researched that it is possible that the quality of cotton fibers has an influence on the textile quality and, as a result, on the farmer's revenue. Counting the elements that affect fiber diameter, durability, consistency index ratio, and micronaire is therefore required to maximize these properties. Due to its capacity to escape severe temperatures and water deficiency circumstances at reproductive stage, early cotton (Gossypium hirsutum L.) plantings have the potential to significantly increase planting potential. Early planting resulted in delayed flowering and boll development, which enhanced the quality characteristics staple, staple firmness, and consistency index ratio but decreased micronaire. A substantial effect was seen in the interplay between planting period and genetic data. The major goal of this study was to determine the optimal planting dates for cotton-wheat cropping systems at different sites in order to optimize cotton output and fiber quality. All agronomic techniques stayed the same over this time period. The cotton sown late on June 15th has maximum staple size (29.77 mm), staple firmness (27.74 g/tex) and consistency index ratio (84.76%), whereas its maximum micronaire (5.39 g inch-1) value was observed which was sown early on May 1st.

Micronaire (5.50 g inch-1) and maximum staple length (29.96 mm) were among the characteristics of cotton cultivar MNH-886. On average, 29.12 mm of long fibers, 27.23 g/tex of staple hardness, and 82.25 percent consistency index ratio were recorded in the 2nd year, compared to 5.21 g inch-1 in the first year.

Mahboubi and Avarand (2018) investigated the reasons behind the decrease in cotton cultivation in the Central District of Gonbad-e Kavos in Golestan province. The study is both empirical and survey-based. The study's target population was all 15234 farmers living in two rural districts (Fajr and Soltanali) in Gonbad-e Kavos. 375 of them were chosen at random as the research sample. Experts of extension and agronomy confirmed the face validity of the data collected using a questionnaire. Cronbach's alpha method was used to conduct the reliability analysis, and the coefficient was 0.84. SPSS 19 was used to analyze the data. The findings revealed that the most major factors of the fall in cotton cultivation, according to respondents, were a lack of skilled personnel for conventional cotton picking, skills shortages, and expensive wages of qualified labor. According to factor analysis, constituent factors of unwilling farmers to plant cotton are divided into nine categories: socioeconomic characteristics, workers, creative agriculture, output and market facilities, production profitability, agricultural helpful technology, technical institutes, and inputs grades. All these account for 62.58 percent of the entire alteration in grudging farmers to plant cotton. This study suggested that cotton planting, protection, and harvesting be mechanized, and that machine harvesting be developed in order to reduce costs, particularly cost of labor, with a focus on applied research in the area of making appropriate and affordable machinery for seed sowing, cultivation, and harvesting.

Jans (2021) explained that cotton is an important economic resource since it is one of the most widely produced natural fibers on Earth. Although cotton has a wide range of environmental adaptations, future climate change may have an impact on its growth and irrigation water requirements. As part of our research, we are using the process-based, spatially precise biosphere and hydrological model Lund–Potsdam–Jena managed land (LPJmL). According to our model, cotton yield levels are in good accord with published numbers, and cotton production water consumption is in line with estimates. In accordance with the Inter-Sectoral Impact Model Intercomparison Project (ISIMIP) methodology, we estimate future cotton yields using an ensemble of five general circulation models under four typical concentration paths. Due to both the climatic effects on cotton production and cotton production's influence on water resources, it's important to analyses how future climate change may affect crop yield and its resource requirements. - As a result of the high level of uncertainty surrounding CO2 fertilization and the absence of mechanisms for boll abscission under extreme heat, our results should be viewed as hopeful. Although cotton is not included in (LPJmL), it enables for numerous large-scale researches to examine climate change impacts on hydrological variables and agricultural productivity and carbon capture.

The study of review of literature showed that there were a number of factors that affected cotton productivity in the Punjab, Pakistan. Among them, weather plays an important role in population of insects and fruiting of cotton balls. Cotton production is favorably impacted by cultivated area, field management, pesticides, fertilizer, irrigation, and labor. Farmers must adhere to policies that address input pricing and cotton production in order to boost profitability and improve the socio-economic condition of their communities. The present studies also revealed that the quality of cotton fiber has an influence on textile quality and, as a result, on the farmer's revenue. Counting the elements that affect fiber diameter, durability, consistency index ratio, and micronaire is, therefore, required to maximize these properties. The review also showed that Early planting resulted in delayed flowering and boll development, which enhanced the quality characteristics staple, staple firmness, and consistency index ratio.

2. Significance of study:

The diversion of farmer from cotton to other crops is a matter of great concern. Because the economy of Pakistan mainly depends on textile

products and the decline in cotton production directly affect her GDP and exports. Cotton and cotton-related products account for 10% of the country's gross domestic product (GDP) and 55% of its foreign exchange earnings. The country is heavily reliant on the textile industry and its related sector. So, present study is of great importance as it ultimately helps different stakeholders to know about the causes of this recent decline in area and production. In the last 2 decades, there is a decrease of 10 percent in the area, 10.02 percent in production, and 1 percent decrease in yield. The recommendations about production techniques and policy recommendations will benefit both farmers and the government to remove the constraints by follow them and ultimately it again makes the cotton growers and country's textile industry to prosper. So, that our economy can sustain its position.

3. Objectives:

1. To examine the past trend and future forecast of the area, production and yield of cotton
2. To examine the socio-economic characteristics of cotton growers
3. To identify the factors effecting the decline of the cotton area in the Punjab
4. To provide recommendations for effective policy intervention based on the findings of the study for policy makers as well as cotton growers

4.METHODOLGY:

4.1. Study area:

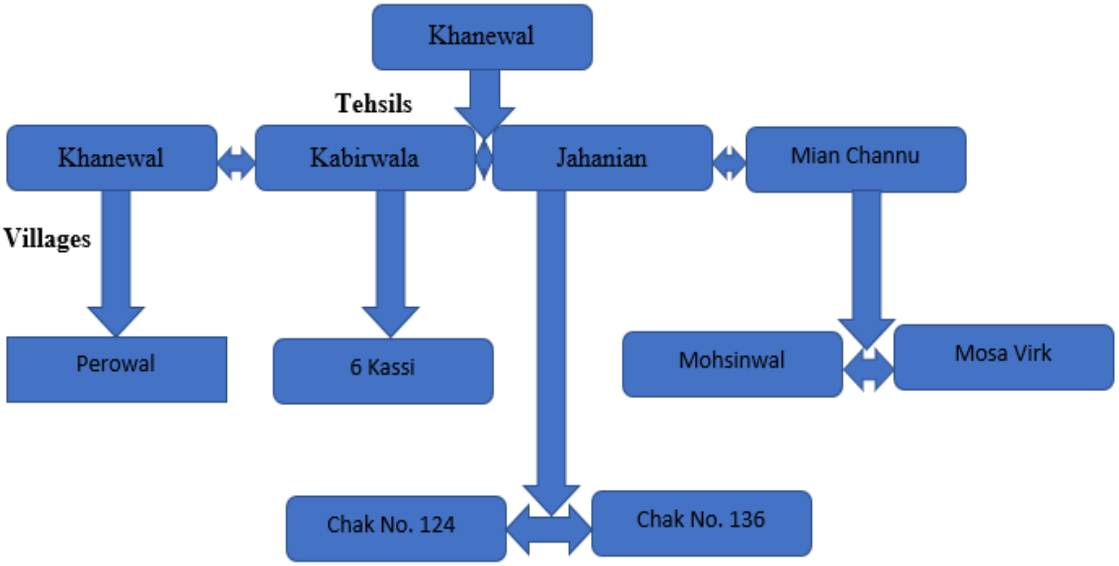
The district Khanewal was selected for this study. Khanewal is district of Punjab located in southern Punjab. In terms of population Khanewal is the 36th biggest city of Pakistan. In past, the land where Khanewal is now located was barren and was known as Gunji Bar or Kabirwala Bar. A bar is a geographical term used to refer elevated land on river banks. Originally, this region was on the southern bank of the Ravi River. Ravi used to flow from the east to the west of Multan city at that time. As time passed, the river continues to change its flow, and the river turns this barren land into a fertile soil.

Area, Production and Yield of cotton in district Khanewal

Year	Area	Production	Yield
2015-16	351	539.24	19.76
2016-17	444	769.41	22.29
2018-19	413	622.85	19.39
2019-20	388	473.31	15.69
2020-21	290	337.37	13.96

Source: (CRS, Punjab)

Table elaborate the production, yield and area of cotton in district Khanewal. In 2015-16, the district Khanewal cotton cultivation area was 351 thousand acres, with 539.24 thousand bales produced and a total return of 19.76 mounds per acre. In 2020-21 the cotton area decreased to 290 thousand acres and the production decreased to 337.37 thousand bales with decrease in yield to 13.96 mounds per acre. More than 37% of production decrease in 5 years in district Khanewal. District Khanewal has four tehsils named as Khanewal, Kabirwala, Jahanian and Mian Channu,



4.2.Sampling selection:

The two main and crucial requirements for extraordinary sampling were that

- Representation of sampling must cover whole population
- The sample size must be sufficient

To study the whole population is not possible for any researcher due to short period of time and large no. of respondents. So, the researcher draws a sample. In this study multistage techniques of sampling were used for data collection. All the 4 tehsils of Khanewal were selected for this purpose. From each tehsil 2 villages were selected. So total 8 villages were selected from where data was collected. These villages were selected to investigate the factors affecting cotton production. And the crops which replace cotton in recent years.

The interview from big and small farmers was taken and ask about the cost of production and yield of cotton in year 2020 and with which crop they replace cotton and what is the cost of production of that crop. The primary data on which the study has done were collected from Khanewal. All the 4 tehsils of Khanewal district were selected. And from each tehsil 2 villages were selected. These villages represent the average condition of the whole tehsil. From each tehsil 25 respondents were selected. 10-15 respondents were selected from each village. So, total of 100 farmers interview was taken on the basis of questionnaire showing different levels of productivity.

The one-to-one interview is the main tool for gathering the needed information. The format of questionnaire was English because of academic purpose. But when these questions were asked to the farmers then these questions were translated into the Urdu, Punjabi or Saraiki according to the feasibility of farmer. The translation of questionnaire was done very carefully so that the correct and exact meaning of question might not get change. The time of interview was set according to the feasibility of farmer in order to get following benefits

- High rate of response from farmer
- Control of the situation during interview
- Collection of additional information which helpful in research

5. Data analysis

For analysis of collected data Microsoft Office Excel software package and SPSS package were used.

5.1. Descriptive statistics

In descriptive statistics socio-economic measures such as maximum, minimum, mean and standard deviation were found out of age, education, cotton growing experience, alternative crops growing experience, and cost of production etc. Average was calculated by using given formula.

$$AM = \sum X/N \quad \text{(Eq. 3.1)}$$

Where AM = Arithmetic mean

N = Total number of cotton growers

$\sum X$ = Total number of variables in the study

The percentages of the data were found out by using the given formula
P = F/N*100
P = Percentage of the sample
F = Frequency of the data
N = Total number of observations

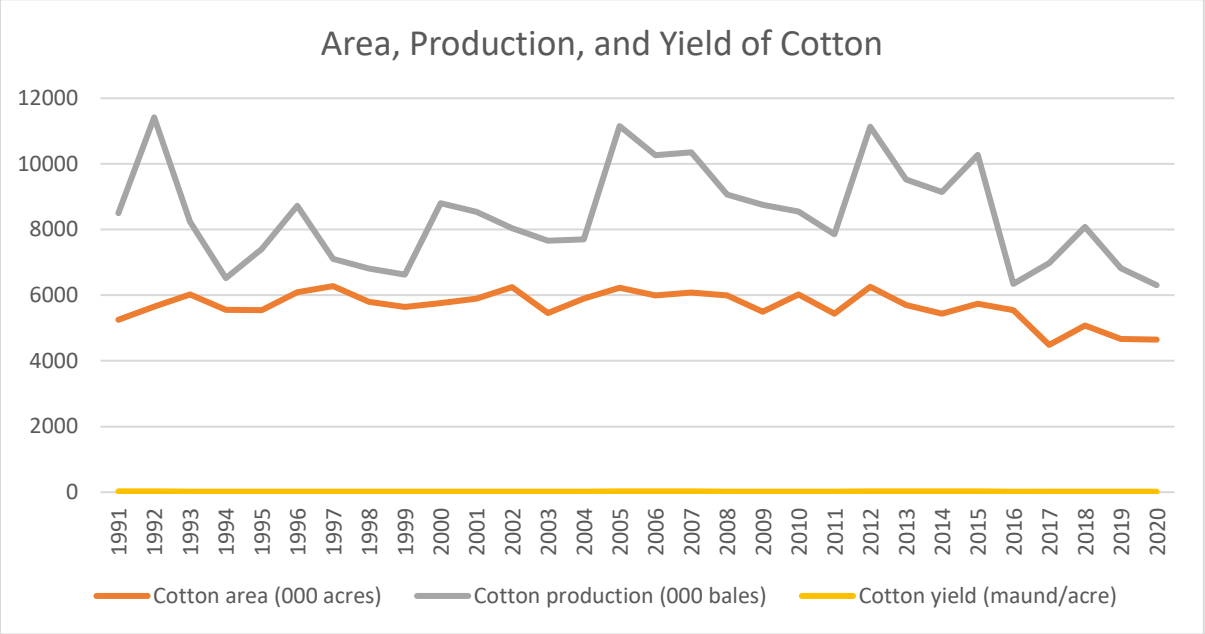
5.2. Past trends and future forecast:
Time series forecasting predicts future activity by utilizing information about historical values and associated patterns. Most of the time, this is about seasonality issues, cyclical fluctuations, and trend analysis. For forecasting ARIMA model was used because forecasts find by this model are more accurate and reliable. Historical data is represented in a linear graph used for forecasting. This method is most reliable when the data spans is a long period of time. Data can be analyzed at various time intervals, such as hourly, daily, monthly, quarterly, annually, or at any other interval to obtain information about the future. A forecast is the smartest and authentic if based on a huge number of observations obtained from a long period of time.
General equation for ARIMA model.
Y(t) = 0.000+Z(t-1)-0.348

5.3. Economic analysis of cotton production:
It was a hard task to find cost of production of cotton crop from farmers. There are variable and fixed costs which were used in production cost. Total revenue of crop per acre, gross margins, net returns from crop and benefit cost ratio were also calculated. Results were explained in chapter four in detail. General equation of profit function is
$\Pi = PY\text{-}TC$ (Eq. 3.3)
In the given equation
Π = Profit
P = Output price/mound
Y = Total output
TC = Total cost
General form of total cost (Variable cost and Fixed cost) is
TC = V1Lp + V2Fr + V3Sc + V4Irr + V5Pes + V6Hr
So,
TC = Total cost (Rs.)
V1Lp = Land preparation cost (Rs.)
V2Fr = Fertilizer cost (Rs.)
V3Sc = Seed cost (Rs.)
V4Irr = Irrigation cost (Rs.)
V5Pes = Pesticide cost (Rs.)
V6Hr = Harvesting cost (Rs.)

5.4. Econometric analysis:
Regression analysis is done to find the relationship between dependent and independent variables. In this study multiple regression model was applied to find the factors affecting the cotton yield. The model's equation was given below.
$Y = \beta 0 + \beta 1X1 + \beta 2X2 + \beta 3X3 + \beta 4X4 + \beta 5X5 + \beta 6X6 + \beta 7X7 + \mu i$ (Eq. 3.4)
Y = Yield/acre (mounds)
X1 = Age (Years)
X2 = Education of respondent (Years)
X3 = Cotton growing experience (Years)
X4 = Total Income (Rs.)
X5 = Land preparation cost (Rs.)
X6 = Total fertilizer cost (Rs.)
X7 = Cultivated area (Acres)

6. RESULTS AND DISCUSSION:

6.1. Time series forecasting
Time series forecasting predicts future activity by utilizing information about historical values and associated patterns. Most of the time, this is about seasonality issues, cyclical fluctuations, and trend analysis. As with any forecasting method, excellence is not assured. There are two main ways to analyze time-series data using statistical techniques. The first way is by drawing inferences on the relationship between variables over time and how they affect each other. And the second way is by predicting future trends and in this study second technique is used.
Historical data is represented in a linear graph used for forecasting. This method is most reliable when the data spans are a long period of time. Data can be analyzed at various time intervals, such as hourly, daily, monthly, quarterly, annually, or at any other interval to obtain information about the future. A forecast is the smartest and authentic if based on a huge number of observations obtained from a long period of time.



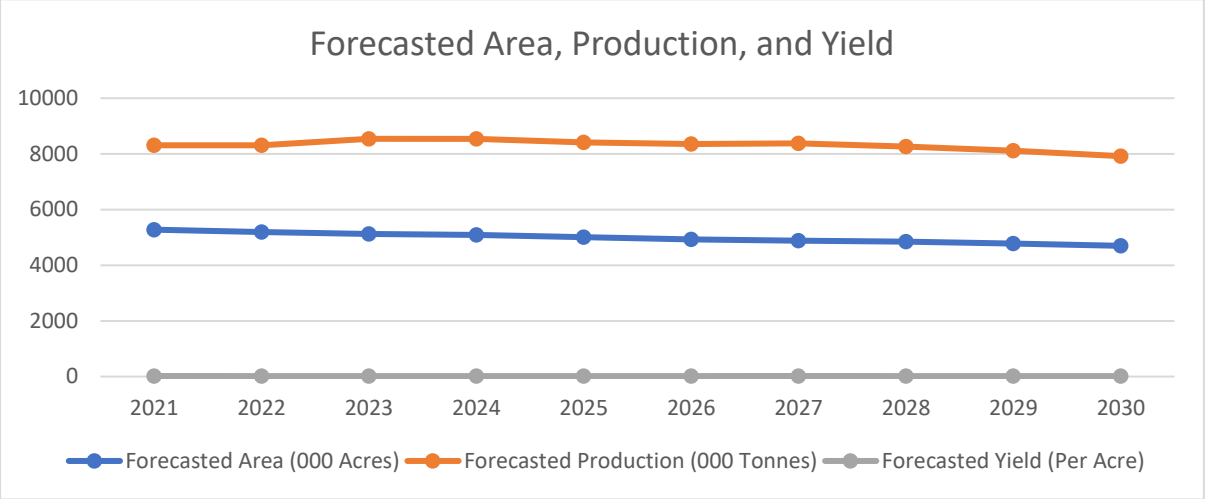
Graph. Time series data of area, production, and yield of cotton **Source:** (CRS, Punjab)

This is the graph of cotton area, production and cotton yield. This graph represents a huge change in cotton area and cotton production in the last 30 years. In economics on the basis of past data researcher do forecasting. Forecasting takes place to make the research interesting and to see whether in future the situation will be better or worst. Now same forecasting is done in the above data. The table below shows the forecast area, production and yield of cotton in next 10 years.

6.2.Forecasted area, production and yield

Year	Forecasted Area (000 Acres)	Forecasted production (000 tons)	Forecasted Yield (Per Acre)
2021	5278	8315	19.8
2022	5188	8306	20.02
2023	5128	8542	20.67
2024	5090	8534	20.71
2025	5010	8417	20.62
2026	4926	8356	20.68
2027	4881	8380	20.82
2028	4847	8262	20.61
2029	4778	8113	20.44
2030	4698	7919	20.19

Source: Author's own calculations



Source: Author's own calculation

6.3. Socio-Economic Characteristics of sampled household:

The second objective of this research is to examine the socio-economic characteristics of cotton growers. Studying socio-economic characteristics of farmers are very crucial in any research because these ultimately affect the yield of crop. The most important variable including in this study are age, family system, family size, level of education, tenancy status, experience of farming, experience of alternative crops etc.

Data collection is not so much easy, so very often social scientist face conditions in which it is difficult to get response. Different persons have different nature, so you do not deal with them in a single way. You adopt different methodologies to deal with different persons. It totally depends on the researchers experience and efforts how he deals with the respondent in order to collect detailed and correct information.

➢ Most of the respondents of the village were illiterate and not know about the importance of research. So, for convincing the respondent a lot of time was spent. To tell them how we use this data for the research. But most of the time they were not agree with our research and they thought that this data is used against them, that's why they don't feel save in giving details about their income and house hold. So first of all, a lot of time spent to remove this misunderstanding by explaining them the purpose of research and assure them that the information remains confidential.

➢ But there is also a second case in which respondent does not agree with the researcher and does not give him an interview

➢ In some cases, the farmer did not cooperate with the researcher and share false information. Especially when researcher asked them about their age, family size and house hold income. They thought that researcher was any government agent and they were distrustful about him. They thought that this person could create problems for them by giving this information to the tax department.

Socio-economic characteristics are the main part of any research. In any questionnaire first researcher asked about these characteristics from the respondents. These characteristics include gender of respondent, age of the respondent, education and experience of respondent, family size and occupation etc.

In this study the below mentioned indicators of socio-economic status were used.

- Age
- Family size
- Family type
- Occupation
- Education
- Experience of agriculture
- Experience of cotton crop
- Experience of alternative crops
- Distance from main market
- Income

Age of respondent:

Age is one of the most important factors which help the researcher in finding about any specific problem. Age and yield also have a

relationship. The large age people are more mature and have more experience.

Distribution of respondents with respect to their age

Sr. No.	Group	Frequency	Percentage
1	Up-to 30	17	17%
2	31-50	62	62%
3	51-60	11	11%
4	Above 60	10	10%
	Total	100	100%

Source: Author's own calculation

From this data it was seen that 17% of the respondents belonged to the age group range up to 30 years. More than 50% of the respondent were between the age group of 31-50 years. And 21 respondents were falling in the age group of 51 and above.

6.4. Education of respondent

In understanding any specific social issue, education is the most important factor which helps the person. Education also affects the behavior and attitude of person. In using new techniques and latest technology education plays an important role. So, in this study asking about education of farmer is very important and to link this education with the efficiency of farmer. Through this one becomes able to know the efficiency of Illiterate and educated farmer.

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Respondent's distribution with respect to their education

Education	Frequency	Percentage
Illiterate	12	12%
Primary	32	32%
Middle	17	17%
Matric	20	20%
Intermediate	7	7%
Graduation or above	12	12%
Total	100	100%

Source: Author's own calculation

It was found that majority of respondents were primary pass. About 32% of farmers just got education of 5 years. Matric was on the 2nd rank. 20% of farmers out of total respondents got education up to 10th grade. Just 12% farmers got education up to graduation level or above. These percentages shows that the level of education among farmer is not high. And most of the farmers are illiterate or just get education up to middle. This greatly affects their agricultural efficiency.

6.5. Respondent's distribution with respect to family system

In understanding specific issues knowing about family system is very important. Mostly in extended family more members live together and the decision of elder family member is

followed by all other members. While in nuclear family the respondent is independent and makes his own decisions regarding crop production.

Respondent's distribution with respect to their family system

Family system	Frequency	Percentage
Nuclear	32	32%
Joint	52	52%
Extended	16	16%
Total	100	

Source: Author's own calculation

According to results of the study majority of respondents belong to the joint family out of 100 respondents 52 farmers belonged to joint family. Out of 100 respondents 32 farmers belonged to a nuclear family system and just 16 to extended family.

6.6. Respondent's distribution with respect to family size

Family size is one of the important factors which helps the researcher of social studies in finding about issues specifically related to distribution of resources. In case of big family size more resources are needed to fulfill the demands of family members and vice versa.

Respondent's distribution with respect to their family size

Sr. No.	Family size	Frequency	Percentage
1	Less than 4	1	1%
2	4 to 6	31	31%
3	7 to 9	38	38%
4	10 to 13	23	23%
5	More than 13	7	7%
	Total	100	

Source: Author's own calculation

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According to the results the respondents whose family size is less than 4 is just 1 percent. Out of 100 respondents 38% are those farmers whose family size is between 7-9. The respondents whose family size is more than 13 are 13%.

6.7. Respondent's distribution with respect to farm size

In Pakistan more than half of the cotton growers have area of their farm is less than 2 acres. And just 2% of cotton growers have land holding more than 20 acres (Nadeem et al., 2014). With respect to the production and yield of cotton, farm size is a main variable. The findings of this study explain that majority of farmers have land holdings in between 5-12 acres. Out of 100 farmers just 19% farmers have land holdings more the 18 acres. And 17% farmers are those whose land holdings are less than 5 acres. So, it is very difficult for small farmers to buy inputs on time and with cash. They mostly buy inputs on loan and their prices are higher than original rates (Table 4.2.5).

Respondent's distribution with respect to farm size

Sr. No.	Farm Size	Frequency	Percentage
1	<5	17	17%
2	5-12	47	47%
3	13-18	17	17%
4	>18	19	19%
	Total	100	100%

Source: Author's own calculation

6.8. Respondent's distribution with respect to tenancy Status

The findings of this study show that majority of farmers are the owner of the farm. And very few farmers are tenants or owner cum tenants. 89% of the farmers are those who are the owners and just 5% and 6% are those farmers who are tenant or owner cum tenant respectively (Table: 4.2.6).

Respondent's distribution with respect to tenancy Status

Sr. No.	Tenancy Status	No. of Farmers	Percentage
1	Owner	89	89%
2	Tenant	5	5%
3	Owner cum Tenant	6	6%
4	Rented Out	0	0
		100	100%

Source: Author's own calculations

6.9. Farming Experience of respondents

Agriculture experience plays a significant role in crop production. An experienced person becomes able to increase the yield of crops and ultimately the profit of crop increase. An experienced and trained farmer can reduce its input cost by managing them in an efficient way.

Respondent's distribution with respect to farming experience

Sr. No.	Experience	Frequency	Percentage
1	Up-to 5	4	4%
2	6-10	19	19%
3	11-15	13	13%
4	16-25	36	36%
5	Above 25	28	28%
	Total	100	100%

Source: Author's own calculations

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Table 4.2.7. show that out of 100 respondents 4% farmers had experience just less than 5 years. 19% farmers were felling in the range of 6-10 years' experience. Farmers in the range of 11 -15 years constituting 13% and 28 respondents were above 25 years of farming experience. And majority of farmers had experience in between 16-25 years constituting 36%.

6.10. Respondent's distribution with respect to experience of cotton crop

Sr. No.	Experience	Frequency	Percentage
1	Up-to 5	4	4%
2	6-10	19	19%
3	11-15	16	16%
4	16-25	37	37%
5	Above 25	24	24%
	Total	100	

Source: Author's own calculations

6.11. Experience of alternative crop

The main objective of this study is to find alternative crops which take the place of cotton. Out of 100 respondents just 3% farmers are those who don't replace cotton with other crops but other 97% replace cotton with other crops to some extent.

Respondent's distribution with respect to experience of alternative crops

Sr. No.	Experience	Frequency	Percentage
1	0	3	3%
2	Up-to 5	39	39%
3	6-10	43	43%
4	11-15	13	13%
5	16-25	2	2%
6	Above 25	0	0%
	Total	100	100

Source: Author's own calculations

Table 4.2.9 shows that 43% farmers have experience of 6-10 in alternative crops. 39% farmers have experience up to 5 years and just 2% farmers have experience above 25 years of alternative crops.

6.12. Respondent's distribution with respect to type of alternative crops

Sr. No.	Alternative crop	Frequency	Percentage
1	Maize	22	22%
2	Rice	35	33%
3	Citrus	12	12%
4	Vegetables	11	11%
5	Fodder	17	19%
6	Not replaced	3	3%

Source: Author's own calculations

Table shows that farmers grow maize, rice, citrus, vegetables and fodder as alternative crops. Rice is the major crop which replaces cotton. Out of 100 respondents 33 farmers replace rice with cotton and 22 farmers replace maize with cotton. 19% farmers replace fodder with cotton. They get more profit in fodder as well as they use this fodder for their own animals. The percentage of citrus is 12%. Citrus also replaces cotton quickly. And to some extent vegetables also replace cotton. In above table 11 respondents replace vegetables with cotton.

6.13. Respondent's seed variety of cotton

Seed is one of the most important and essential input which plays key role in production. Good seed leads to good yield and poor seed leads to economic loss. The findings of this study shows that most of the farmers use FH-142. The frequency of respondents who use this seed is 25. The second seed which is used mostly is NIYAB-878 and the percentage of this seed is 17%. There are also other seeds used by the farmers but the frequency of that type of seeds is low (Table4.2.11.).

Respondent's distribution with respect to the variety of seed they use

Seed name	Frequency	Percentage
MNH-886	11	11%
VH-305	9	9%
IUB-13	5	5%
VH-327	10	10%
BS-15	9	9%
NIYAB-878	17	17%
FH-142	25	25%
CIM-600	3	3%
CYITO-178	6	6%
CYITO-179	5	5%

Source: Author's own calculations

6.14. Descriptive analysis of Socio-Economic characteristics

Descriptive analysis is the way to represent data in an efficient manner. It shows and summarizes data points in a constructive manner so that patterns may emerge that satisfy all conditions of the data. Descriptive analysis helps you to determine how your data has been distributed and to identify outliers as well as similarities between variables. It helps preparing you for further statistical analysis.

Descriptive statistics of Socio-Economic characteristics of cotton growers

Factors	N	Minimum	Maximum	Mean	Std. Deviation
Age	100	20	70	43.26	12.028
Education	100	0	16	7.52	4.349
Family Size	100	2	16	8.18	3.0924
Farming Experience	100	5	50	22.45	12.698
Cotton Growing Experience	100	5	50	20.83	11.854
Distance from Main Road	100	0	9	3.01	1.833
Distance from Main Market	100	8	18	13.01	2.560
On-Farm Income	100	80000	7000000	1526700	1251700.302
Cultivated Area (Acres)	100	1	65	12.575	10.476
Cotton Area	100	1	30	4.52	4.864
Wheat Area	100	1	38	10.365	7.808

Source: Author's own calculations

Whole analysis of socio-economic characteristics shows that mean education was 7.52 years. The minimum years of education were 0 years and maximum years of education were 16 years. The standard deviation of this variable is 4.349. Whole descriptive analysis shows that mean cotton growing experience was 20.83 years. The minimum years of cotton growing experience was 5 years and maximum years of cotton growing experience was 50 years. The standard deviation of this variable is 11.854. table explained that mean cultivated area was 12.575 acres and mean cotton area was 4.52 acres. The minimum cultivated area was 1 acre and minimum cultivated area of cotton is also 1. The maximum cultivated area was 65 acres and maximum cultivated area of cotton was 30 acres. The standard deviation of cultivated area was 10.476 and the standard deviation of cotton area is 4.864.

6.15. Descriptive Statistics of Cost of Production of cotton

Factors	N	Minimum	Maximum	Mean	Std. Deviation
Total Land Preparation Cost	100	2500	4800	3360	455.937

Total Seed Cost/ Acre	100	1800	4800	3490	674.124
Total Fertilizer Cost	100	5900	12100	9425	1580.140
Total Irrigation Cost	100	8400	14400	11888	783.836
Total Hoeing Cost/Acre	100	2000	2800	2448	138.155
Total Spray Cost/Acre	100	3300	8800	5175	1198.263
Yield (Mounds)/Acre	100	15	29	21.98	3.623
Selling Price/Mound	100	3400	4000	3753	129.844
Total Revenue/Acre	100	55500	108000	82419	13485.25
Net Returns/Acre	100	-5800	47300	21567	12128.56

Source: Author's own calculations

Table explains the descriptive analysis of cost of production. It explains minimum, maximum, mean and standard deviation of different steps of production of cotton. The whole analysis of cotton showed that mean yield of cotton was 21.98 mound per acre. The minimum observed value of cotton yield was 15 mound per acre and maximum observed value was 29 mound per acre. The standard deviation for cotton yield was 3.623. Descriptive farm analysis of total land preparation cost illustrated that mean value for land preparation was 3360 Rs. / Acre. The minimum and maximum value of land preparation cost was 2500 Rs. / Acre and 4800 Rs. / Acre respectively. The standard deviation for land preparation cost was 455.937. Descriptive analysis illustrated that mean seed cost was 3490 Rs. / Acre. The minimum and maximum cotton seed cost was 1800 Rs. / Acre and 4800 Rs. / Acre respectively. The standard deviation for seed cost was 674.124. Descriptive analysis showed that mean fertilizer cost was 9425 Rs. / Acre. The minimum and maximum fertilizer cost was 5900 Rs. / Acre and 12100 Rs. / Acre respectively. The standard deviation for fertilizer cost was 1580.140. Whole descriptive analysis revealed that the mean net returns per acre were 21567 Rs. The results of net returns cleared the picture why farmer replaced other crop with cotton. The minimum value of net returns was -5800 Rs. / Acre. This shows that farmer bear huge loss in cotton. The production cost was more but the net returns were low or even negative. The maximum value of net returns was 47300. The standard deviation for this variable was 12128.56.

6.16. Comparison of cost of production of cotton with important alternative crops

This section explains the cost of production of cotton and then compare it with maize, rice and citrus. This was the third and main objective of the study. The cost of production of cotton and of alternative crop which they replace with cotton was taken from the farmers of study area. After gathering cost of production of cotton, rice, maize, citrus, vegetables their means were taken separately at each level. The value of means of cotton and alternative crops then presented in a table for comparison. And then at last stage BCR of both crops were fined and compare with each other.

Comparison of cost of production of cotton with maize

Operation/Inputs	No of operation/ Inputs	Price/ Unit	Cost/acre	Operation/ Inputs (Alternative Crop)	No of operation / Inputs	Price/Unit	Cost/acre
Land Preparation cost Cotton				**Land Preparation cost Maize**			
Ploughing	2.32	593	1375.76	Ploughing	3.12	584	1822.088
Rotavator	1.06	961	1018.66	Rotavator	1.09	864	941.76
Laser Leveling	0.7	1200	840	Laser Leveling	0.63	1200	756
Ridges Making	1	1200	1200	Ridges Making	1	1200	1200
Sub total			**4,434.42**	**Sub total**			**4,719.848**
Sowing cost Cotton				**Sowing cost Maize**			
Seed	7.94	438.5	3481.69	Seed	10	1000	10000
Seed treatment cost	7.94	66.52	528.16	Seed treatment cost	0	0	0
Sowing cost	1	800	800	Sowing Cost	1	1000	1000
Sub total			**4809.85**	**Sub total**			**11000**
Intercultural and plant protection measures (Cotton)				**Intercultural and plant protection measures (Maize)**			
Manual Weeding	1	2448	2448	Manual Weeding	0	0	0
Sub total			**2448**	**Sub total**			**0**
Fertilizer cost Cotton				**Fertilizer cost Maize**			
Urea	1.92	1832.5	3517.44	Urea	2.42	1832.5	4434.65

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DAP	1.53	3562	5449.86	DAP	1.51	3562	5378.62
NPK	1	2850	2850	NPK	1	2850	2850
Other/FYM	1.23	2300	2829	Other/FYM	1.23	2300	2829
Labor cost	5.68	200	1136	Labor cost	6.16	200	1232
Sub total			**15782.3**	**Sub total**			**16724.27**

Irrigation cost Cotton				**Irrigation cost Maize**			
Canal	3	66.66	199.98	Canal	3	66.66	199.98
Tube well	16	500	8000	Tube well	7	700	4900
Sub total			**8199.98**	**Sub total**			**5099.9**

Spray cost Cotton				**Spray cost Maize**			
Weedicide	1.86	616	1145.76	Weedicide	1.18	576	679.68
Pesticide	4.28	609	2606.52	Pesticide	2.08	558	1160.64
Fungicide	0	0	0	Fungicide	1	800	800
Labor Cost	6.14	200	1228	Labor Cost	3.26	200	652
Sub total			**4980.28**	**Sub total**			**3292.32**

Harvesting cost Cotton				**Harvesting cost Maize**			
Operation	**Mounds**	**Per Mounds cost**	**Total cost**	**Operation**	**No. of Acre**	**Per Acre cost**	**Total cost**
Harvesting cost	21.98	400	8792	Harvesting cost	1	4000	4000

Total			**8792**	**Total**			**4000**

Sale price/ Mounds	**Total Mounds**	**Total Revenue**	**Sale price/ Mounds**	**Total Mounds**	**Total Revenue**
3753	21.98	**82490.94**	1250	99	**123750**

Net Income (TR-TC)	33044.11	**Net Income (TR-TC)**	78913.582
BCR	1.66	**BCR**	2.71

Source: Author's own calculations

An indicator that shows the relationship between relative costs and benefits is called benefit-cost ratio (BCR). The current study shows that BCR of cotton is 1.66 while the BCR of maize is 2.71. The results clearly explain that maize is more profitable than cotton. That is why farmer replace cotton with maize.

6.16. Comparison of cost of production of cotton with rice

Operation/Inputs	**No of operation/ Inputs**	**Price/ Unit**	**Cost/acre**	**Operation/ Inputs (Alternative Crop)**	**No of operation/ Inputs**	**Price /Unit**	**Cost/acre**
Land Preparation cost Cotton				**Land Preparation cost Rice**			
Ploughing	2.32	593	1375.76	Ploughing	4.1	623	2554.3
Rotavator	1.06	961	1018.66	Rotavator	1	879	879
Laser Leveling	0.7	1200	840	Laser Leveling	0.69	1300	897
Ridges Making	1	1200	1200	Kadoo	1	1000	1000
Sub total			**4434.42**	**Sub total**			**5330.3**
Sowing cost Cotton				**Sowing cost Rice**			
Seed	7.94	438.5	3481.69	Seed	10	81.32	813.2

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Seed treatment cost	7.94	66.52	528.16	Seed treatment cost	0	0	0
Sowing cost	1	800	800	Sowing Cost	1	5000	5000
Sub total			**4809.85**	**Sub total**			**5813.2**

Intercultural and plant protection measures (Cotton)				**Intercultural and plant protection measures (Rice)**			
Manual Weeding	1	2448	2448	Manual Weeding	0	0	0
Sub total			**2448**	**Sub total**			**0**

Fertilizer cost Cotton				**Fertilizer cost Rice**			
Urea	1.92	1832.5	3517.44	Urea	2.13	1812.5	3860.625
DAP	1.53	3562	5449.86	DAP	1.03	3602.3	3710.369
NPK	1	2850	2850	NPK	1	2850	2850
Other/FYM	1.23	2300	2829	Other/FYM	1.09	2300	2507
Labor cost	5.68	200	1136	Labor cost	5.25	200	1050
Sub total			**15782.3**	**Sub total**			**13977.9**

Irrigation cost Cotton				**Irrigation cost Rice**			
Canal	3	66.66	199.98	Canal	3	66.66	199.98
Tube well	16	500	8000	Tube well	10	900	9000
Sub total			**8199.98**	**Sub total**			**9199.98**

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Spray cost Cotton				Spray cost Rice			
Weedicide	1.86	616	1145.76	Weedicide	2	873.39	1746.78
Pesticide	4.28	609	2606.52	Pesticide	1.86	558	1037.88
Fungicide	0	0	0	Fungicide	1	600	600
Labor Cost	6.14	200	1228	Labor Cost	4.86	200	972
Sub total			**4980.28**	**Sub total**			**4356.66**

Harvesting cost Cotton				Harvesting cost Rice			
Operation	**Mounds**	**Per Mounds cost**	**Total cost**	**Operation**	**No. of Acre**	**Per Acre cost**	**Total cost**
Harvesting cost	21.98	400	8792	Harvesting cost	1	2700	2700
Sub total			**8792**	**Sub total**			**2700**

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Sale price/ Mounds	Total Mounds	Total Revenue	Sale price/ Mounds	Total Mounds	Total Revenue
3753	21.98	**82490.94**	2062	46.62	**96130.44**

Net Income (TR-TC)	33044.11	Net Income (TR-TC)	54752.306
BCR	1.66	**BCR**	1.75

Source: Author's own calculations

The current study shows that BCR of cotton is 1.66 while the BCR of rice is 1.75. The results clearly explain that rice is more profitable than cotton. That is why farmer replace cotton with rice.

Table 4.3.3. Comparison of cost of production of cotton with citrus

Operation/Inputs	No of operation/ Inputs	Price/ Unit	Cost/acre	Operation/ Inputs (Alternative Crop)	No of operation/ Inputs	Price /Unit	Cost/acre
Land Preparation cost Cotton				**Land Preparation cost Citrus**			
Ploughing	2.32	593	1375.76	Ploughing	4	644	2576
Rotavator	1.06	961	1018.66	Rotavator	2	914	1828
Laser Leveling	0.7	1200	840	Laser Leveling	0	0	0
Ridges Making	1	1200	1200	Ridges Making	0	0	0
Sub total			**4434.42**	**Sub total**			**4404**
Sowing cost Cotton				**Sowing cost Citrus**			
Seed	7.94	438.5	3481.69	Seed	0	0	0
Seed treatment cost	7.94	66.52	528.16	Seed treatment cost	0	0	0
Sowing cost	1	800	800	Sowing Cost	0	0	0
Sub total			**4809.85**	**Sub total**			**0**
Intercultural and plant protection measures (Cotton)				**Intercultural and plant protection measures (Citrus)**			
Manual Weeding	1	2448	2448	Thinning	2	2500	5000

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Sub total			2448	**Sub total**			5000

Fertilizer cost Cotton				**Fertilizer cost Citrus**			
Urea	1.92	1832.5	3517.44	Urea	2	1826.2	3652
DAP	1.53	3562	5449.86	DAP	3	3642.1	10926.3
NPK	1	2850	2850	Potash	3	3000	9000
				NPK	3	2850	8550
Other/FYM	1.23	2300	2829	Other/FYM	1.42	2300	3266
				Micronutrients	2	2500	5000
Labor cost	5.68	200	1136	Labor cost	14.42	200	2884
Sub total			**15782.3**	**Sub total**			**43278.3**

Irrigation cost Cotton				**Irrigation cost Citrus**			
Canal	3	66.66	199.98	Canal	9	33.33	299.97
Tube well	16	500	8000	Tube well	10	1000	10000
Sub total			**8199.98**	**Sub total**			**10299.97**

Spray cost Cotton				**Spray cost Citrus**			
Weedicide	1.86	616	1145.76	Weedicide	0.69	656	452.64
Pesticide	4.28	609	2606.52	Pesticide	7.31	562	4108.22
Fungicide	0	0	0	Fungicide	2	850	1700
Labor Cost	6.14	200	1228	Labor Cost	10	200	1000
Sub total			**4980.28**	**Sub total**			**7260.86**

Harvesting cost Cotton				Harvesting cost Citrus			
Operation	**Mounds**	**Per Mounds cost**	**Total cost**	**Operation**	**No. of Acre**	**Per Acre cost**	**Total cost**
Harvesting cost	21.98	400	8792	Harvesting cost	1	34000	34000
Total			**8792**	**Total**			**34000**

Sale price/ Mounds	Total Mounds	Total Revenue	Sale price/ Mounds	Total Mounds	Total Revenue
3753	21.98	**82490.94**	1980	178.53	**353489.4**

Net Income (TR-TC)	33044.11	**Net Income (TR-TC)**	249246.27
BCR	1.66	**BCR**	3.33

Source: Author's own calculations

The current study (table 4.3.3) shows that BCR of cotton is 1.66 while the BCR of citrus is 3.33. The results clearly explain that citrus is more profitable than cotton. That is why farmer replace cotton with citrus.

6.17. Multiple linear Regression Model

Multiple linear regression model was used to determine the relationship between cotton yield and different explanatory variables. Different variables had their different impact on cotton yield. In this study multiple regression model was applied to find the factors affecting the cotton yield. The model's equation was given below

$Y = \beta 0 + \beta 1X1 + \beta 2X2 + \beta 3X3 + \beta 4X4 + \beta 5X5 + \beta 6X6 + \beta 7X7 + \mu_i$

Model Summery

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.354	.286	.159	3.5150	2.021

a. Predictors (Constant), Cultivated Area, Total Fertilizer Cost, Education (years), Land Preparation Cost, Age (Years), Total Income, Cotton Exp (years)

b. Dependent Variable: Yield/Acre Cotton

ANOVA

			Mean Square		

Model		Sum of Squares	df		F	Sig.
1	Regression	163.289	7	23.327	1.888	.080
	Residual	1136.671	92	12.355		
	Total	1299.960	99			

a. Dependent Variable: Yield/Acre Cotton
b. Predictors: (Constant), Cultivated Area, Total Fertilizer Cost, Education (years), Land Preparation Cost, Age (Years), Total Income, Cotton Exp (years)

For the estimation the effects of different explanatory variables on cotton yield, the study used Multiple Linear Regression Model. The relationship among dependent variable (cotton yield) and different explanatory variables (age, education, income, cotton growing experience, land preparation cost, fertilizer cost) were analyzed.

Coefficients

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	23.919	11.075		2.160	.033
Age (Years)	.008	.076	.026	.101	.920
Education (Years)	.048	.090	.058	.533	.596
Cotton Exp (Years)	.002	.077	.005	.020	.098
Total Income	4.958E	.000	.019	.081	.084
Land Preparation Cost	.006	.003	.206	1.983	.050
Total Fertilizer Cost	.002	.001	.344	3.179	.002
Cultivated Area	.034	.079	.099	.432	.667

a. Dependent Variable: Yield/Acre Cotton

The value of R^2 was estimated 0.286, which showed that 28.6 percent variation in cotton yield has been explained by the variation due to jointly effect of all explanatory variables. Age played an important role for decision making in any family. In this model the coefficient of age was found to be positive and un-significant. Value of coefficient of age showed that if age of the respondents were increased at the rate of one year, then yield of cotton crop will be increase at the rate of 0.008 mound. The coefficient of education was found to be positive and had un-significant impact. Coefficient value of education depicted that if the education of respondents increased by one year, then cotton yield of the respondents will

be increased at the rate of 0.048 mound. The coefficient of cotton growing experience was found to be positive and had highly significant impact. Coefficient value of cotton growing experience depicted that if the cotton growing experience of respondents increased by one year, then the cotton yield of the respondents will be increased at the rate of 0.002 mound. The value of coefficient of income was found to be positive and had highly significant impact on cotton yield at the 10 percent level of significance. The value of coefficient showed that if the income of the respondents increased by one rupee, then cotton yield of the respondents will be increased by .00004958 mound. The value of coefficient of land preparation cost was found to be positive and had significant impact on cotton yield at the 5 percent level of significance. The value of coefficient showed that if the land preparation cost of the respondents increased by one rupee, then cotton yield of the respondents will be increased by 0.006 mound. The value of coefficient of total fertilizer cost was found to be positive and had significant impact on cotton yield at the 1 percent level of significance. The value of coefficient showed that if total fertilizer cost of the respondents increased by one rupee, then cotton yield of the respondents will be increased by 0.002 mound. The value of coefficient of cultivated area was found to be positive and had un-significant impact on cotton yield. The value of coefficient showed that if the cultivated area of the respondents increased by one acre, then cotton yield of the respondents will be increased by 0.034 mound.

6.18. Constraints of cotton and percentage response of farmers

The results of research explained the constraints which hinders the high yield of cotton production. The percentage response of farmers was collected through questionnaires and presented in the table 4.5. The problems were categorized into 4 categories.

- Agronomic constraints
- Economic constraints
- Environmental constraints
- Marketing constraints

Table 6.19. Constraints observed and percentage response of farmers

Sr. No	Constraint belongs to	Constraint observed	Farmers reported
1.	Agronomic constraints	Uncertified seed	59%
2.		Non-Generic pesticides	41%
3.		Not good seed germination	23%
4.		Water Shortage	78%
5.		Pests Attack	100%
6.		Yield Variability	54%
7.	Economic Constraints	High-Cost of Production	70%

8.		Lack of Support Price	29%
9.		Cost of Picking	53%
10.	Environmental Constraints	Impact of Temperature	85%
11.		Impact of Humidity	85%
12.		Impact of Rainfall	29%
13.	Marketing Constraints	Quality of Lint	47%
14.		Less demand by local consumers	57%
15.		Time consuming	63%

Source: Author's own calculation

Table explained that the agronomic constraints faced by the farmers included uncertified seed (59%), non-generic pesticides (41%), not good seed germination (23%), water shortage (78%), pest attack (100%) and yield variability (54%). Economic constraints included high cost of production (78%), lack of support price (29%) and cost of picking (53%). Environmental constraints included impact of temperature (85%), impact of humidity (85%) and impact of rainfall (29%). Marketing constraints included quality of lint (47%), less demand by local consumer (57%) and time consuming (63%). In agronomic constraint the major constraints reported by farmer were pest attack especially whitefly and water shortage. The canal water was not able to meet the demand of farmer and the underground water in many areas was not good due to which farmer faced the issue of drought. In environmental constrains high temperature was the major cause of decline in cotton cultivation. High temperature increases humidity which provides favorable environment to whitefly and also due to high temperature premature falling of cotton bolls take place. Less demand by local consumer was also a big issue in study area. The consumer prefers to by imported cotton because on treatment of local cotton to make it white more resources wasted but the imported cotton is already white in color and less resources should be applied on it before using it for different purposes.

6.20. Advantages in alternative crops

This section explained the percentage response of farmer about each advantage due to which they replace to cotton crop. The advantages were categorized into 3 main categories.

- Agronomic advantages
- Socio-economic advantages
- Marketing advantages

Advantages in alternative crops and percentage response of farmers

Sr. No.	Advantage category	Advantages	Percentage response
1.	Agronomic advantages	Less effect from water shortage	55%
2.		Less effected by weed	49%
3.		More effectiveness of pesticides	56%
4.		Less effect of climate	70%
5.		Availability of certified seed	86%
6.		More availability of canal water	23%
7.		Less pest attack	48%
8.		Less yield variability	52%
9.		Seed germination	73%
10.	Socio-economic advantages	Less input prices	32%
11.		Off-farm employment opportunities	12%
12.		Less time taking	30%
13.	Marketing advantages	Less cost of production	44%
14.		More demand by local consumers	52%
15.		More profitable	90%
16.		Easy disposal	74%
17.		Less price fluctuation	39%

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Source: Author's own calculations

Table explained about the advantages farmers got in alternative crops. The agronomic advantages included less effect from water shortage (55%), less effected by weeds (49%), pesticides show more effectiveness on them (56%), less effect of climate (70%), availability of certified seed (86%), more availability of canal water (23%), less pest attack (48%), less yield variability (52%) and good seed germination (73%). Socio-economic advantages included less input prices (32%), off-farm employment opportunities (12%) and less time taking (30%). Marketing advantages included less cost of production (44%), more demand by local consumers (52%), more profitable (90%), easy disposal to market (74%) and less price fluctuations (39%). In agronomic advantages the main advantage due to which farmer replace cotton is availability of certified seed. The certified seed of maize is easily available. In case of citrus and rice also their certified seed are available.

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