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### Assessing the Impact of Better Cotton Production Initiatives Taken by Small Farmers in District Tando Allahyar, Sindh, Pakistan within the Context of the Circular Economy

Umair Khan, Hakimzadi Wagan\*

#### Chronicle

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**Umair Khan and Hakimzadi Wagan** are currently affiliated with Department of Agricultural Economics, FASS, Sindh Agriculture University, Tando Jam, Pakistan.

**Email:** [umairnahiyoonss164@gmail.com](mailto:umairnahiyoonss164@gmail.com)

**Email:** [hakimzadi@gmail.com](mailto:hakimzadi@gmail.com)

#### Abstract

Cotton is an important source of income for small farm holders in India and Pakistan. Production of cotton in Pakistan is lesser than potential due to different socio-economic factors, effective decision-making, lack of proper marketing, high insect/pests attack and less use of fertilizer (Abbas, et al 2017). Present study was carried out to study the impact of Better Cotton (BT) production initiatives taken by small farmers in district Tando Allahyar Sindh Pakistan. Results show that the Farmer Field School (FFS) training in cotton is very beneficial for farmers by creating awareness regarding the proper use of pesticides, fertilizers there by increasing cotton yield and reducing farmer's exposure to use poisonous pesticides which in turn decrease, human and animal health hazards. Results revealed that average revenue per acre was Rs.93800 while the average cost of production was 38635.81 per acre. Average net income per acre stood at Rs.55165.19 for small farmers who adopted better cotton production initiatives in district Tando Allahyar. Government should arrange such training programs at the national level, take actions against distribution and usage of banned and un-registered pesticides and incorporate the same at policy level.

**\*Corresponding Author:**

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## INTRODUCTION

Pakistan is the third largest consumer of cotton, the fourth largest producer of cotton and the most important cotton growing country in the World. Agriculture and cotton is the backbone of Pakistan economy. After wheat crop fiber is the most important cash crop of Pakistan (Naveed et al., 2023). According to Bhutto et al., (2018) demand for cotton is increasing day by day as population is also increasing. Cotton crop is grown by different farm holders mostly small, under climate conditions and different areas of Pakistan. In recent years need for better cotton production techniques is rising as Pakistan is facing the issue of decrease in cotton production (Mukhtar 2024). One of the major challenges that Pakistan is facing now days is with respect to changing climatic conditions Pakistan is experiencing such as low rainfall or heavy rainfall and even irregular rain fall during the year furthermore farmers lack basic information regarding pesticide and fertilizer use which in turn impact the overall yield of cotton in the country. Often term of smallholder is interchangeably used small-scale, resource poor, and sometimes peasant farmers. In general term, smallholder only refers to their limited resource endowment relative to others farmers. Smallholder farmers defined as those farmers owning small-based plots of land on which they grow subsistence crops and one or two cash crops relying almost exclusively on family labor

(Aaron, 2012). The majority of the cotton farmers are smallholders and most of them are tenant farm household resident. Frequent pest outbreaks since early 1990 have induced pesticide based agrarian economy in Pakistan (Khan, 2005). The scientific name of cotton is the (*Gossypium hirsutum* L) the genus of cotton is *Gossypium* and Malvaceae is the family of cotton is cultivated in Panjab, Sindh Khyber Pakhtoon (KPK), Balochistan provinces (Nabi, 2012). Cotton known as white gold being the most important cash crop, it is the major source of income for growers of cotton. After introduction of *Bacillus thuringiensis* (Bt) cotton in 2002 there was decrease in the usage of pesticides. Though pink bollworm damage have decreased, the change in pest management systems with reduction in pesticide usage and, introduce of several new *Bacillus thuringiensis* (Bt) hybrids most of which were highly susceptible to insect and diseases, has resulted in increased damage by sucking pests such as jassid, aphid, whiteflies, mealy bugs and thrips (Pallavi, 2017).

Pakistan is the third largest cultivator in the area of better cotton, and total 90441 better cotton initiatives farmers are registered in Pakistan. Total 316000 MT of better cotton lint is produced in Pakistan. From 2016 to 2017, the maximum number of small holders' farms 1,29,5814 are registered in the world. However small holders farms 31 percent of better cotton were produced and medium farms which accounts for 2981 are registered which produce only 4 percent better cotton, and large farms 444 are registered which produce 65 percent better cotton in the world (BCI, 2017). Cotton is the most important economical crop grown in more than 70 countries of the world, cotton is the primarily grown for fiber but it is also the main cause of edible oil, protein and cottonseed meal for animals. The cotton fiber in the old world and the production of the new world has dominated the economy of developing and developed countries. History of Pakistan cotton production dates back to the civilization of the Mohen -Jo- Daro as depicted by excavation (Khan, 2003).

Cotton is the most important agricultural, industrial and consumer commodity in Pakistan and the world. Cotton based industries are really depending upon the cotton crop. It is a major source of raw martial for fabric manufacturing (Abbas et al., 2017). We use many items of the product of cotton in our daily lifecycle. Cotton artifact such clothing and bed sheet to socks and t-shirts cotton also used in fishnets, towels, and bank notes, fiber is essential in our life. Cotton is major source of the raw material for fabric manufacturing industries (Solidaridad et al., 2017). Low yield of cotton in Pakistan is due to many factors such as climate change, demographic characteristics, high price of inputs, improper decision-making, the lake of marketing, insect pest attract and improper use of fertilizer etc. (Abbas., et al 2017)

Worldwide, cotton is cultivated on about thirty million hactres and which is more than two percent of total arable land, and bring into being about twenty-five million metric tonnes (MT) of fiber annually. From clothing and bed sheet to socks and t-shirts cotton is also used in fishnets, towels, and bank notes, fiber is essential in our life. Cotton is grown-up in about 80 nations, more than one hundred million families around the world are directly involved in cotton farming for their income (Solidaridad et al., 2017). Cotton is a dynamic source of income for small farmer in India, to counteract major problems such as environmental degradation and financial dependency due to high input cost organic cotton cultivation is being encouraged by non- government organizations in the country (Altenbuchner et al., 2017). Crop protection increases with the growing use of synthetic chemicals and fertilizer in cotton crop and results in an overall increase in yield of the cotton crop (Damalas and Eleftherohorinis 2011). Poor weather conditions, insect attack and incomplete awareness of insect, and lack

of pest management options for improved cropping pattern results in low yield of cotton (Siddiqui and Rind 2012). Research suggests that farmers field school (FFS) training in cotton can produce a benefit for farmers. The finding suggests that generally the program results in decline in pesticide use (Panaturak et al., 2008). A number of global initiatives have been taken for better cotton production by different organizations such as organic cotton, the fair trade cotton, the cotton made by Africa (CmiA) and Pakistan cotton ginner association (PCGA) the Better Cotton Initiative (BCI) is a voluntary program launched in 2005. The determination of better cotton initiative (BCI) is to encourage strong supply chain linkages with measurable improvements in output and decrease in the cost of cultivation without adversely affecting the environment and social impact. The learning groups were empowered thorough farmers field school to reduce the harmful impact of chemicals, banned pesticides and to improve the water conversation, soil health management. The 'Better Cotton' production focuses on improvement of crop protection, efficient use of water and soil management, protection of natural habitat, upgrading in cotton value, well-mannered work (BCI, 2013).

There has been a significant dearth of studies, which focus on the increase in cotton the productivity, reduction in the insecticide application and good return to farm level etc as a result of trainings done under better cotton production initiatives. Focus on high yield production, without taking agriculture and environmental sustainability into consideration has become standard practice. Thus this study tries to fill this research gap by examining the impact of the better cotton production initiatives taken by small farmers of district Tando Allahyar. Following are the objectives of the study:

- To examine socio-economic characteristics of better cotton (BC) farmers and control farmers in the study area.
- To assess the impact of training provided to Better Cotton (BC) farmers in the area of synthetic pesticides / botanical pesticide use.
- To determine the average total cost and net profit of better cotton (BC) farmer.

## **LITERATURE REVIEW**

This section presents a review of the previous studies regarding the different methods used in previous research on the production of cotton, the background of the problem. Previous research may provide valuable information and insight to research technique. Siddiqua et al., (2021), examined the impact of different farm management practices on reducing the impact of climate on cotton yield by using multinomial endogenous switching in Sindh and Punjab. They documented negative impact of climate change on cotton yield and affirmed the importance of various climate change techniques in increasing cotton yield. Shahzad, et al., (2021) documented the impact of climate smart agricultural techniques such as changing cropping pattern, using different varieties of seeds, water conservation techniques on cost benefit returns of cotton and other crops. Ali et al., 2023 examined that the input trend in the cotton production applies in Pakistan, cotton crop is necessary to grow for an agricultural country, cotton production repetition involves many inputs from seed pesticide, fertilizer, fuel energy, soil preparation to harvesting and market, the inputs involved are cost intensive and over time the cost of production has increased. Chaudhry et al., (2009) reported that factor affecting fiber production in Pakistan. The primary data was collected from 60 respondents through interviews. The sample size of 60 farmers, twenty were smallholders' respondents, twenty-five medium

respondents and fifteen were large respondents. Data were randomly selected district of Multan. The Cobb-Douglas shows that the coefficient for farming 0.113 and seed 0.103 was found statistically significant at 1 percentage level. Nazli et al. (2010) reported the performance of Bt cotton varieties in Pakistan. The data was collected from the two district Bahawalpur and Mirpur Khas of Pakistan. Data were collected by face-to-face interview of examining the economic performance of Bt cotton. He has observed the seed cost increased in Bahawalpur and Mirpur Khas district, however, decrease in bollworms spray and therefore in the cost for insect killer chemical also decline, and total pesticides costs for bollworm and non-bollworms decline in both district. The total production cost was high in Mirpur Khas but low in Bahawalpur. The yield was high in Mirpur Khas. Mujeyi (2013) conducted study on cotton producing small farmers under agreement farming in Zimbabwe. He conducted relative price investigation using secondary data to identify farm level returns and explore the impact of different contract structures on farmers' profit. He finds that non-contracted farmers enjoy better earnings than contracted farmers' due to saving from obtaining of interest-free and cheaper inputs other choices, however scarcity of resources was major issue for the non-contracted farmers to minimize production costs, unlike the contracted farmers.

Raza and Ahmed, (2015) reported the impact of the temperature change on production of fiber in Sindh and Punjab province of Pakistan. The result indicates a significant impact of temperature and precipitation on cotton yield. Rehman et al., (2016) investigated the relationship between fertilizer utilization and agricultural gross domestic product area under cotton crop production in Pakistan. The data were collected from various sources and annual reports. The data was analyzed by (ADF) test and cointegration test and (OLS) method. The result of the co-integration test shows that there exists a long-term connection between the productivity of cotton crop, area fertilizer utilization and agriculture in the GDP of Pakistan. The results indicate that production of cotton and manure utilization has a positive relationship with the agricultural gross domestic product of Pakistan while the area under cotton crop has a negative relationship with agriculture (GDP), of Pakistan. Sahito, et al (2016) studied relative usefulness of novel pesticide on cotton crop under field situation at district Khairpur in Pakistan. He selected five pesticides and one control plot. The data was collected through pre-tested questionnaire face to face collected the data, one way ANOVA was used to find a significant variation.

They concluded that the insect killer Nitenpyram give a better decrease of against the jassid under field condition. Saravana and Mohanasundram. (2016) examined the growth and acceptance of *Bacillus thuringiensis* (Bt) cotton in India, financial issues, surroundings and health issue. The results suggested that plant has the natural ability to create *Bacillus thuringiensis* (Bt) protein within their body and protect themselves from pink bollworms and American bollworms. No use of pesticides uses for bollworm or any others technology utilize. However, after the introduction of Bt cotton, it brought into focus variety of issues like the financial side, atmosphere, and health and it has an argument against to accept it. Zulfiqar et al., (2016) reported that the farming and non-farming of better cotton originated on farmer's socio-economic features and their conservative answer to related questions. The result shows that the better cotton best than traditional cotton in terms of inputs efficiency use and economical profit. Abbas et al., (2017) investigated sustainable cotton initiatives in the Panjab. The primary data collection comprised of 400 farmers. Registered sustainable cotton initiative sample was selected randomly from two cotton growing districts of

Panjab (Tek Singh and Bahawalpur). The result revealed the important role of training concerning insect pests hazard management. Maximum 70.5 percent of respondents having good knowledge about pest control. They have applied control pest strategies to control the pests. They found that decrease in uses of pesticides is indeed an important success providing protection to cotton crops and human being health as well as to animal. Bakhsh (2017) studied that impact of Bt cotton profitable, productivity farm input in Pakistan, for this study he used panel model. He concluded the average special effects of Bt fiber expertise on short-run profits, yield, and farm inputs. He found that for bias farmers reached 9 percent higher yield for each hectare ha, and decrease per- ha pesticides use by 21.7 percent and increase per – ha use of irrigation water by 6 percent. His estimate of the elevation in cotton production is far below estimate from earlier studies conducted in India and Pakistan. Jamro et al., (2017) examined different cotton varieties such as haridost, koonj, and sindh1 on the enlargement and yield .at Sindh Agricultural University Tando Jam. They concluded that cotton growers must not delay than 10th May. They suggested that these varieties, haridost and Sindh-1 are better for achieving higher seed cotton yields.

Muddassir et al., (2017) reported the study on pattern adoption for Bt cotton growers from non-Bt cotton growers in Pakistan. They collected data from 120 Bt-cotton growers by random sampling technique and developed pre-tested questionnaire. The data was analyzed by SSPS. Results show that the maximum farmer's comprised of middle age group, agriculture, and livestock farming were their major source of income and maximum cultivation was under Non-Bt cotton. They found that most of the grower were dependent on pesticide companies for agricultural information. The higher crop yield was a major factor, which shifted the farmers to grow better cotton. Non-availability of seed were the threatening factors.

Rani et al., (2017) reviewed the growth rate uncertainty and annual fluctuations of cotton during last thirty years in Pakistan. They collected secondary data from 1981 to 2015. The growth rate of cotton yield in Pakistan was 2.65 followed by 0.88 in the area of cotton. They found that low cotton production was due to insect and pest attack on crop. Especially during 1981 to 1990 annual variation in cotton production is high and not consistent during the study period. The fluctuation highly declines in during 1995 to 1996 and variation highly raised from 1984 to 1985. Pallavi et al., (2017) performed study at Karimnagar district of Telangana state. The sample of 100 respondents (50 beneficiaries and 50 non- beneficiaries) were selected for the study. They examined, cost of cultivation, yield, market value from the year of implementation of better cotton initiative from 2012-13 to 2015-16 for both of beneficiaries and non- beneficiaries. The statistical test Z test was applied to find out the difference between of beneficiaries and non- beneficiaries and to know the impact cotton initiative program each year. Significant difference was observed between beneficiaries, and non- beneficiaries with respect to reduction in cost of cultivation.

## **MATERIALS AND METHODS**

### **Study area**

This study was carried out to evaluate the effectiveness and impact of Centre for Agriculture and Bioscience International (CABI) led training in relation to Better Cotton Production Principles and Criteria adopted by small farmers at five villages of two union Councils of Tahsil Tando Allahyar, and Chambar in district Tando Allahyar, Sindh



Pakistan. This study was carried out mainly on cotton crop and the establishment of Farmer Field School (FFS) in Better Cotton Initiatives Growth Innovation Fund (BCI-GIF) Project by Centre for Agriculture and Biosciences International (CABI) motivates the selection of district Tando Allahyar.

### **Sampling technique and sample size**

Two Union Councils of Tahsil Chambar, Tando Allahyar (Chamabr and Pak Senghar) of District Tando Allahyar were selected, from where five Farmer Field Schools (FFS) were selected purposively, from each FFS 18 farmers were selected, total sample size was 160 farmers. 80 registered farmers were selected as Better Cotton (BC) farmers from Farmer Field Schools 80 unregistered control farmers for this study were selected. A control group, who had not undergone training planned in order to distinguish the impact of training.

### **Questionnaire development**

Interview were based on a well-designed and pretested questionnaire, a list of constraints faced by cotton growers was developed. The main questions were related to general information, synthetics pesticide, fertilizer, profitability, and productivity. Complete information was obtain face to face farmers interviewed involved in Cotton agribusiness and agreed by the interviewer. The survey document was prepared in the English language whereas the interview was taken in the Sindhi language.

### **Data analysis**

The data were analyzed and tabulated in Micro soft excel sheet. The data tabulated than summarized and analyzed and interpreted to meet the object of this study. Demographic variables were discussed in detail. Descriptive statistics such as average, frequency and percentages were the major statistical tool to be applied to show the results in a comprehensive manner.

### **Results**

This study was conducted to examine the impact of better cotton production initiatives taken by small farmers Sindh at district Tando Allahyar Sindh. Tando Allahyar is one of the richest agricultural area of Sindh Pakistan. The main purpose was to study socio economic characteristics of better cotton farmers and control farmers in the study area and to assess the impact of training provided to better cotton farmers in the area of synthetic pesticide and botanical use. In addition, to determine the average total cost and net profit of better cotton respondent in district Tando Allahyar. The obtained accurate data were subjected to appropriate statistical tests and were averaged in the form of tables.

Socio-economic characteristics

#### **Age**

Age is an important characteristic of farmers community as it indicates that the mental maturity of an individual to take decisions for achieving his objectives. The distribution of age Better Cotton Farmers and Control Farmers are presented in the following table.

**Table No. 1.****Age of the respondent Control farmers and Better Cotton farmers.**

Age of Control farmers			Age of Better Cotton farmers		
Age (years)	Frequency	Percentage	Age (years)	Frequency	Percentage
15-25	7	8.75	18-25	9	11.25
26-35	30	37.5	26-35	35	43.75
36-45	33	41.25	36-45	20	25
46-55 or Above	10	12.5	46-55 or Above	16	20
Total	80	100	Total	80	100

Table – 1 presents the age of control farmers and better cotton respondents in the study area. It shows that the majority 41.25% of the control farmers between the age group of 36-45 years, while 43.75% of Better cotton farmers were between the age group of 26-35 years. The minimum age of control farmers falls between the age group of 15-25 years (8.75%) whereas minimum age groups of Better cotton farmers fall between 18-25 years (11.25%).

### Education

Education plays a vital role in enhancing knowledge, and skills of farmers. It plays an important role in developing better understanding of new ideas, learning new skills. Following table show the education level of Control farmer and Better Cotton (BC) farmers.

**Table No. 2.****The education level of Control and Better Cotton BC farmers**

Education level Control farmers			Education level BC farmers		
Education	Frequency	Percentage	Education	Frequency	Percentage
Illiterate	43	53.75	Illiterate	35	43.75
Primary	12	15	Primary	22	27.5
Middle	8	10	Middle	5	6.25
Matriculation	9	11.25	Matriculation	6	7.5
Intermediate	6	7.5	Intermediate	7	8.75
Graduate	2	2.5	Graduate	5	6.25
Total	80	100	Total	80	100

Source: Primary survey of BC farmers 2022-2023

The data in the table- 2 revealed that the education level of the Control respondents and Better Cotton respondents. The majority of Control respondents i.e. 53.75% were illiterate followed by 15% of the respondent having education level up to primary, and 11.25% were educated up to matriculation, 10 % of the respondent education level was up to the middle 2.5% were graduates and 7.5% have intermediate attended level of education. However, the majority of Better Cotton respondents i.e. 43.75 % were illiterate followed by 27.5% of the respondent having education level up to the primary, 6.25% was educated up to the middle, and 8.75% have attended education level intermediate, 7.5% have education level up matriculation, and while minimum 6.25 % graduates education level Better Cotton respondents.

### Farm size

In table. 3 the farm size of control farmers and Better cotton farmers shows that 70% of control farmers have 1-3 acres, of land, while 50% of Better Cotton Farmers have between farm size 1-3 acre. 10% have the minimum size of land while Better Cotton farmers' farm size i.e.7-9 acres, was the minimum 8.75% farm size 7-9 acre land.

**Table 3.****Farm size of cotton growers Control farmers and Better Cotton (BC) farmers.**

Farm size Cotton CF			Farm size Cotton BC		
Farm size of cotton Respondents	Frequency	Percentage	Farm size of cotton Respondents	Frequency	Percentage
1-3 acre	56	70	1-3 acre	40	50
4-6 acre	16	20	4-6 acre	33	41.25
7-9 acre or above	08	10	7-9 acre or above	07	8.75
Total	80	100	Total	80	100

Source: Primary survey of BC farmers 2022-2023

In table. 3 the farm size of control farmers and Better cotton farmers shows that 70% of control farmers have 1-3 acres, of land, while 50% of Better Cotton Farmers have between farm size 1-3 acre. 10% have the minimum size of land while Better Cotton farmers' farm size i.e.7-9 acres, was the minimum 8.75% farm size 7-9 acre land.

### Farming experience

Farming is an art, it is said that experience makes the men perfect so the experience of cotton growers in the cultivation of land is always counted as an important tool. Farmers have experience in growing various crops in the season they have good knowledge about the season of cops, which help them to develop socio-economic conditions of the family.

**Table 4.****Farming Experience of respondent Control Farmers and Better Cotton farmers**

Farming Experience CF			Farming Experience BC		
Farming experience of Respondents (years)	Frequency	Percentage	Farming experience of Respondents (years)	Frequency	Percentage
1-10	38	47.5	1-10	26	32.5
11-20	22	27.5	11-20	37	46.25
21-30	11	13.75	21-25	12	15
31-40 or Above	9	11.25	26-35 or Above	5	6.25
Total	80	100	Total	80	100

Source: Primary survey of BC farmers 2022-2023

The data in table - 4 shows the farming experience of Control Farmers and Better Cotton respondents. Farming skill is always regarded as an asset in the farmer's society. The majority of the Control respondents (47.5%) have between 1-10 years farming experience, 27.5% have farming experience between 11-20 years and 13.75% have experience between 21 -30 years, while 11.25% have experience between 31-40 years. On the other hand, majority (46.25%) of Better Cotton respondents have experience between 11-20 year followed by (32.5%) of the respondents have farming experience between 1-10 years and (15%) of respondents have between farming experience 21-25 years however the minimum (6.25%) of respondents having farming experience between 26-35 years.



## Source of income

Mostly small farmers depend on Agriculture. There have no other resources to generate their income they can generate there income only through cultivation of crops, but few families to support their livelihood do some others or part-time jobs.

**Table 5.**

**Source of income of Control Farmers (CF) and Better Cotton (BC) farmers.**

Source of income of Control farmers (CF)			Source of income Better cotton (BC) farmers		
Occupation	Frequency	Percentage	Occupation	Frequency	Percentage
Agriculture	64	80	Agriculture	69	86.25
Agriculture + shops	0	0	Agriculture +shops	5	6.25
Agriculture hotels	1	1.25	Agriculture hotels	0	0
Agriculture + trade	15	18.75	Agriculture + trade	6	7.5
Total	80	100	Total	80	100

Source: Primary survey of BC farmers 2022-2023

The data in table 5 indicates the source of income of control farmers and better cotton respondents. The major source of income of the control respondents was agriculture: 80%, depending mainly on Agriculture, however, 18.75% of control respondents doing agricultural+ trade of animals, and the minimum 1.25% of control respondents depended on agriculture plus hotels. In the case of Better Cotton respondents primary source of income was agriculture: 86.25%, of 7.5% of Better Cotton farmers source of income was Agriculture + trade however of minimum 6.25% Better Cotton farmers' source of income was Agriculture +shops.

## Family size

**Table 6.**

**Family size of Control farmers and Better Cotton farmers**

Family Control farmers			Family BC farmers		
Family size	Frequency	Percentage	Family (members) size	Frequency	Percentage
4	23	28.75	4	15	18.75
5-8	45	56.25	5-8	48	60
9-12 or Above	12	15	9-12 or above	17	21.25
Total	80	100	Total	80	100

Source: Primary survey of BC farmers 2022-2023

The family size of Control farmers and Better Cotton respondent revealed that in Table-6 the majority family size of the control respondents 56.25% have family size between 5-8 , 28.75% of the Control Farmers (CF) respondents have 4 family members, 15% "between" 9-12 or above family size of control respondent in study area. While majority family of Better Cotton respondents was 60% between having 5-8 family size, 21.25% have family between of 9-12, or above family size, and minimum 18.75% family better cotton (BC) respondent having 1-4 family members.

## Male family members in the study area

The data in table-7 indicates male family members of Control farmers and Better Cotton respondents. The majority of the control farmers i.e. 48.75% male belong to 3-

4 male member family while In the case of Better Cotton farmers, the 57.5% male belong to 3-4 male member family.

**Table 7.**

**Male family members of Control and Better cotton (B.C) respondents**

Male family members of Control formers			Male family of members BC farmers		
Male in family	Frequency	Percentage	Male in family	Frequency	Percentage
1-2 male	21	26.25	1-2 male	17	21.25
3-4 male	39	48.75	3-4 male	46	57.5
5-6 male	16	20	5-6 male	11	13.75
7-8 or above	4	5	7- 8 male	6	7.5
Total	80	100	Total	80	100

Source: Primary survey of BC farmers 2022-2023

**Female family member**

Females play an important role in the agriculture sector. They work in the fields to help their families.

**Table 8.**

**Female family members of Control and Better cotton (B.C) respondents**

Female family members of Control farmers			Female family members of B.C farmers		
Female member	Frequency	Percentage	Female member	Frequency	Percentage
1-4 female	63	78.75	1-4 female	60	75
5-8 female	17	21.25	5-8 female	20	25
Total	80	100	Total	75	100

Source: Primary survey of BC farmers 2022-2023

The data in table-8 shows the female family members of Control farmers and Better Cotton respondents. The majority female family members of the control respondents were 78.75% i.e. between 1-4 members and minimum 21.25% female have between 5-8 cotton farmers respondent. Moreover, the majority of female family members of Better Cotton respondents were 75% i.e. between 1-4, and the minimum 25% have female of between 5-8 in the study area.

**Married family members in study area**

Tble no 9 indicates married family members of Control farmers and Better Cotton respondents. The majority of family members of control respondents were married 51.25% i.e. is 1-2, 32.5% i.e. 3-4 were married, 7-8 family members, which accounts for 11.25% and minimum married family members were 5% which accounts for 5-6 married members. While the majority-married family members of the Better Cotton respondents were 48.75% while minimum married family members were 6.25%.

**Table 9.**

**Married family members of Control farmers and Better Cotton BC farmers**

Married family members of Control farms			Married family members of Better Cotton farmers		
Married members	Frequency	Percentage	Married members	Frequency	Percentage
1-2	41	51.25	1-2	39	48.75
3-4	26	32.5	3-4	29	36.25
5-6	4	5	5-6	5	6.25
7-8 or above	9	11.25	7-8	7	8.75
Total	80	100	Total	80	100

Source: Primary survey of BC farmers 2022-2023

**Unmarried****Table 10.****Unmarried family members of respondents of control farmers and better cotton.**

Unmarried family members of Control farmers			Unmarried family members of BC farmers		
Unmarried	Frequency	Percentage	Unmarried	Frequency	Percentage
1-4	55	68.75	1-4 unmarred	58	72.5
5-8	25	31.25	5-8unmarred	22	27.5
Total	80	100	Total	75	100

Source: Primary survey of BC farmers 2022-2023

The data in table 10 shows unmarried family respondents of control famers (CF) and Better Cotton (BC) respondents of district, Tando Allahyar, among control farmer respondents 68.75% were unmarried, those control famers having 5-8 family members married accounts to 31.5%. Moreover, of the better cotton respondent's maximum 72.5% were unmarried. Botanical pesticides and chemical pesticides used for controlling insects by Better Cotton (BC) farmers in the study area.

Training provided to Better Cotton BC farmers provided them awareness regarding the use of botanical pesticides, which previously were not used by them. Botanical pesticides are organic pesticides that usually come from plants used for protection. These types of pesticides have become more popular as they do not release toxin because insects become more resistant to chemical insecticides and therefore, they decompose and are more useful conventional insecticides. Plant use pesticides of their own production to protect them from diseases, herbivores, and insects. Such plant insecticides include chemicals such as nicotine and oils such as citrus oils. Made from natural insecticides, this insecticide minimizes toxic effects on environment and quickly acts on insects.

**Table 11.****Farmers views regarding the use of botanical pesticides after getting training.**

Views of respondents	Frequency	Percentage
Botanical pesticides are less costly.	80	100
They does not harm beneficial insects	60	75
Botanical pesticides does not cause skin disease	55	68.75

Table no.11 shows the perception of botanical pesticide which made by traditional methods these pesticides botanical pesticides made by farmers. 100% of respondent botanical pesticides are less costly compare chemical pesticide. 75% respondents were views botanical pesticides dose not harms beneficial insect. 68.75% Better Cotton farmers reported that using of botanical pesticides does not effect on skin disease.

In the table 12 results shows views of farmers regarding's changes in use of chemical pesticides after trainings. 87.5% respondents reported that not uses of unregistered pesticides are and used registered pesticides. 86.25% respondents reported that multinational pesticides are more effectives but they are more costly. 81.25% respondents training provided awareness regarding banned national or multinational chemical pesticides. 68.75% respondents reported that they get training about classes of poison.

**Table 12.**  
**changes in the use of chemical pesticides after training**

Views of respondents	Frequency	Percentage
Unregistered pesticides are not used and registered pesticides are used.	70	87.5
Multinational pesticides are more effective.	69	86.25
Multinational pesticides are costly.	69	86.25
Training provided awareness regarding banned national / international chemical pesticides.	65	81.25
Training provided awareness regarding the classes of i-e I A, I B and II, III and O	55	68.75

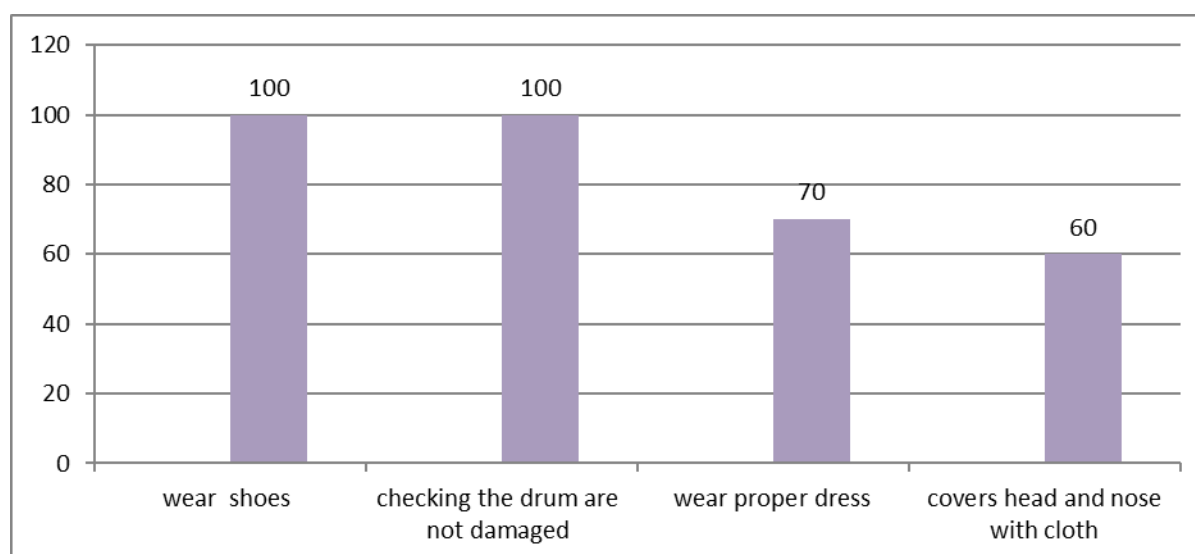
**Table 13.**  
**Biological control of better cotton crops by using and Pheromone traps, light traps, yellow sticky steps, and natural enemies field reservoirs (NEFR) technologies in the study area.**

Biological methods used	Frequency	Percentage
Neem spray	25	31.25
Tooh spray	20	25
Light traps	7	8.75
Pheromone traps	10	12.5
Yellow sticky steps	15	18.75
NEFR technology	3	3.75
Total	80	100

Source. Primary survey of BC farmers 2022-2023

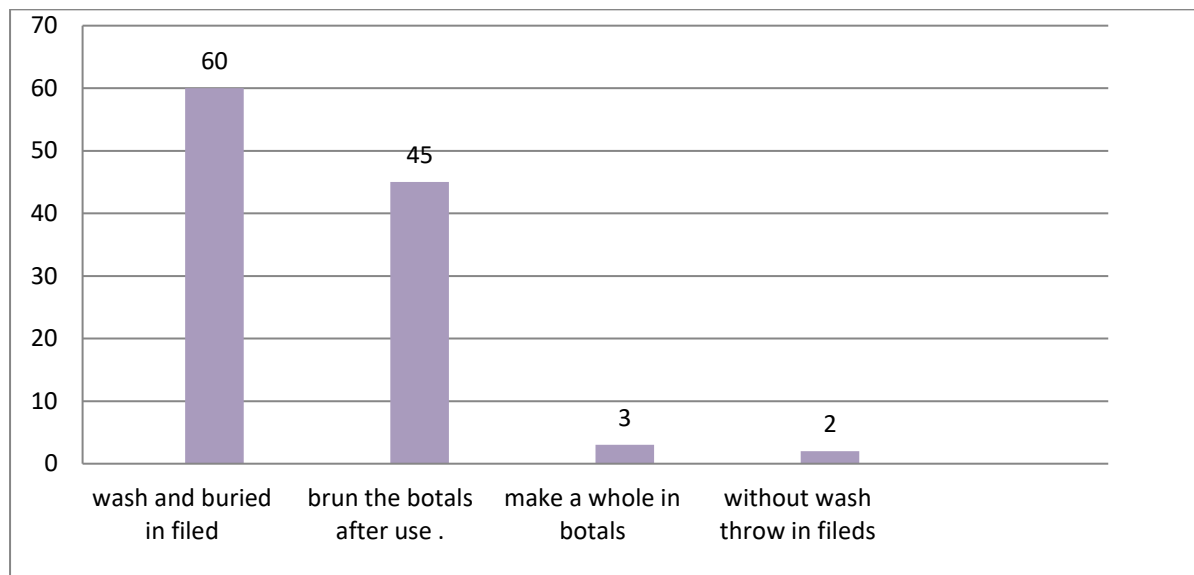
Table no.13 revealed the biological control used by BC farmers for controlling in present field pests. The maximum 31.25% control for aphids and jassid and all others sucking insect pest by using Neem spray. 25% used the Tooh spray, and 18.75% used biological control applying yellow sticky steps used for thrips affhid and jassid, 12.5% farmers are using pheromone traps to control pink bollworms moreover results reveal that 8.75% of respondents use light traps to control adult pink bollworms, 3.75% used natural enemies field reservoirs (NEFR) technology as biological control of mealy bug.

**Precautionary measures taken by Better Cotton farmers**



**Figure 1.**  
**Respondents' perceptions about precautionary measures of pesticides.**

Figure 1 shows the precautionary measures taken by BC farmers while applying pesticides. 100% of respondents were of the opinion that wearing safety shoes protect them from harmful effects pesticides, 100% of respondents checked before applying that the drum is not damaged. 70% of the respondents were properly dressed when they applied the pesticides. 60% of the respondents cover head cover with a cloth and masked when applied pesticide.



**Figure 2.**  
**Perception about after use of pesticide bottles.**

Figure 2 shows the effectiveness of the awareness training about pesticide application, 60% of respondents washed and buried in land. 45% of respondent empty pesticide bottles were burnt and only 3% of respondents were making wholes in bottles. 2% respondents without washing threw them in the open field.

**Total fixed cost of Better Cotton farmers of study area.**

The fixed cost is simply the summation of the several types of fixed costs (Ronald, 1996). In this study the total fixed cost includes rent of land and land taxes. These types of costs are called sunk costs.

**Table 14.**  
**Average per acre land tax realized of better cotton farmers.**

Components	Average per acre	Minimum per acre	Maximum per acre
Land tax	500	500	500
Grand total	500	500	500

Table no-14 shows average per acre fixed cost including land tax. Result revealed that an average per acre cost of Rs.500 was paid as land taxed.

**Land preparation**

Land preparation is required before planting so get best soil condition the same time enable planting to establish easily cotton is a deep-rooted crop which needs fine good tilth and well ready for positive propagation and growth of crop. To get this, plough the field with deep plough then harrowed with planking each time to make the loam movable, fine smoothed and crushed. Eliminate all the growths of the previous crop left in the field.



Table 15.

**Land preparation cost of Better cotton farmers.**

Better cotton farmers			
Land preparation costs	Frequency	Percentage	Costs (Per acre) in Rs.
Disc Harrow	80	100	2300
Laser leveler	80	50	1200
Cultivator	80	100	1100
Ridges	80	100	1000
Band maker	80	100	500
Total cost			6100

Source: Primary survey of BC farmers 2022-2023.

Table no. 15 reveals the better cotton farmers land preparation cost in study area district Tando Allahyar. Different land have required different operation of land preparations. The all farmer are doing these type of activities for land preparation deep plow per acre charges 2300 rupees laser level or land leveler charge also 1200 Rs and cultivators charges 1100 per acre and ridges charges 1000 Rs while the bank maker also 500 Rs charges.

### Capital inputs

Capital inputs are defined as that the part of wealth which is used for further production of wealth. Capital is a factor of production, which possesses some distinct characteristics. The volume of capital inputs can be increased or decreased. Capital plays a strategic role in booting up of productivity. Capital has been defined a material good used in further production. Capital determines the role of technological innovation in agriculture which results in the increase of output, decrease in cost.

Table no. 16.

**Average capital input cost per acre.**

Cost Component	Unit	Average	Minimum	Maximum	
Seed cost	Seed	Kg	6	5	8
	Price / Unit	Rs	260	250	300
	Total seed cost	Rs	1560	1250	2400
Fertilizer cost	No. of DAP	Qty	1	1	1
	Price / Bag	Rs	3200	3200	3300
	Cost of DAP	Rs	3200	3200	3300
	No. of Urea	Qty	3.75	3	5
	Price / Bag	Rs	1295.43	1350	1450
	Cost of Urea	Rs	4857.86	4050	7250
	Total fertilizer cost	Rs	8057.862	7250	10450
Irrigation cost	No. of canal irrigation	Qty	7	6	8
	Cost of irrigation	Rs.	234.47	130	303
	No. of tube well irrigations	Rs	1.5	2	3
	Per irrigation cost of tube well	Rs.	1200	1400	1400
	Cost of tube well	Qty	1800	2800	4200
	Total irrigation cost	Rs	2034.47	2930	4503
Pesticide cost	No. of spray	Qty	6	5	7
	Price/ spray	Rs	1100	900	1150
	Total pesticide cost	Rs	6600	4500	8050
Over all capital inputs cost	Rs	18252.34	15930	25403	

Table no.16 shows the average input cost of per acre of Better Cotton includes seed cost, fertilizer cost irrigation cost and pesticides cost. Rs.18252.34 the average input cost of Better cotton respondents the maximum Rs.25403 capital input cost, however minimum Rs.15930 capital input cost per acre of Better Cotton farmers.

Table 17.

**Average Labors inputs cost per acre**

Components of cost	Unit	Average	Minimum	Maximum
Sowing cost labors	Rs	1413.12	1350	1500
Thinning cost	Rs	328.75	350	400
Picking or harvest cost	Rs	8362.85	6760	11500
Hand hoeing cost	Rs	1373.75	1350	1450
Over all labors inputs cost	Rs	11478.47	9810	14850

Table 17 shows average labor input cost per acre of sowing cost, thinning cost, and picking cost and hand hoeing cost. The average labor input cost was Rs.11478.47 minimum labor input cost were Rs.9810 while the maximum labor input cost was Rs.14850 respectively.

**Marketing Costs**

Marketing costs are those expenses that are incurred on growers when once agriculture commodities move from the manufacturing center (farm gate) to the customers for the clearance of their production. The growers had to incur variety of expenses on transportation, loading, unloading and commission charges. All these expenses paid based on per unit

Table 18.

**Average per acre marketing costs of Better Cotton farmers.**

Component	Average	Minimum	Maximum
Loading cost	355	300	350
Un loading	200	150	300
Transport cost	1450	1300	2000
Commission agent	300	250	350
Total Marketing cost	2305	2100	3000

Table no.18 shows the average marketing costs of Rs. 2305 per acre spent on cotton crop, in which includes loading charges, un loading charges, and transport charges and commission agent charges. Further data in same table reveals that the total range of marketing cost is Rs. 2100 to 3000.

**Total cost of production**

A firm combine four factors of production i.e. land labor capital and organization to produce goods and services. Total cost production can be divided into two parts fixed cost and total variable cost.

Table19.

**Average total cost of production per acre**

Cost components	Averages	Minimum	Maximum
Fixed cost	500	500	500
Land preparation cost	6100	6100	6100
Capital inputs cost	18252.34	15930	25403
Labour inputs cost	11478.47	9810	14850
Marketing cost	2305	2100	3000
Total cost of production per acre	38635.81	34440	46853

Table no 19 reveals average total cost of production of cotton including fixed cost land preparation cost and capital inputs cost, labor input cost as well as marketing cost. The total average cost of production was Rs.38635.81 per acre. However the

minimum cost of production was Rs.34440 per acre while the maximum cost of production per acre was 46853 per acre of Better cotton farmers.

### Cotton yield

**Table 20.**

**Average yield per acre in mounds for Better Cotton farmers.**

Yield	Average	Minimum	Maximum
Cotton production mounds per acre	28	25	39

The data in table no- 20 shows average production of cotton 28 mounds per acre and maximum production of cotton was 39 mounds and minimum 25 mounds per acre production of cotton in the study area of district Tando Allahyar.

### Profit

**Table 21.**

**Average per acre profit of better cotton farmers in Rs:**

Profit	Average	Minimum	Maximum
Profit per acre for better cotton farmers	93800	83750	130650

Table no.21 shows the average profit per acre. The average profit of Better cotton is 93800 and the range of profit between 83750 to 130650 per acre of Better cotton respondents.

### Net profit

**Table 22.**

**Average net profit per acre of B.C farmers in district Tando Allahyar.**

Particular	Average	Minimum	Maximum
Gross income (a)	93800	83750	130650
Total cost of production (b)	38635.81	34440	46853
Net profit = a-b	Rs.55165.19	RS.49310	Rs.82807

Table -22 shows the average net profit per acre is Rs.55165.19, however maximum net profit Rs.82807 per acre while the minimum Rs.49310 net profit per acre of better cotton farmers.

**Table 23.**

**Average yield, price, revenue, cost of production, net income per acre.**

Average Yield per acre in mounds (A)	Average Price of per 40 kg (B)	Average Revenue per acre (B) (A*B)	Average cost of production per acre (C)	Average Net income per acre (B-C)
28	Rs.3350	Rs.93800	Rs.38635.81	Rs.55165.19

Table no- 23 shows the average yield, average price, average revenue and average total cost of production and average net income of Better cotton farmers. The average yield was 28 mounds per acre while the average price of cotton per mounds was Rs.3350. Above table show that average revenue was Rs.93800 per acre while the average cost of production was 38635.81 per acre. Average net income per acre was Rs.55165.19 of Better cotton farmers in the study area.

## DISCUSSION AND SIGNIFICANCE OF THE STUDY

This study of the impact of better cotton production initiatives taken by small farmers was conducted at District Tando Allahyar during 2022-2023. For this study, primary data were collected from Farmer Field School established by CABI (Center for Agriculture and Bioscience International) in District Tando Allahyar. The total numbers of the respondents were 160 and the respondents are divided into two groups, one is Better cotton farmers and others is control farmers group for this study. This study contributes to the strand of literature related to sustainable cotton production initiatives which are environment friendly and improves farmer's livelihood. Better cotton production initiatives taken in this regard may significantly reduce the issues related to low production, proper use of pesticides, proper use of fertilize, proper timing of spray of pesticides and measures taken related to health and safety. Keeping in view objectives of the present study main purpose was to know socio economic characteristics of better cotton farmers and control farmers in the study area and to assess the impact of training provided to better cotton farmers in the area synthetic pesticide and botanical use. In addition, to determine the average total cost and net profit of better cotton respondent in district Tando Allahyar. In the study area socio economic characteristics of control farmers and better cotton farmers such as age, educations, source of income, farm size, farming experience family size, marital status and male and female populations were studied. Awareness regarding botanical pesticide use and chemical pesticide use because of the impact of training is also examined, net profit total inputs costs, labors input, are mentioned in this study.

The majority i.e. 41.25% of the control farmers were between the age group of 36-45 years, while 43.75% of Bette cotton farmers were between the age group of 26-35 years. However, education level the majority of control farmers (53.75%) were illiterate, however, the majority of Better Cotton respondents i.e. 43.75 % were illiterate. The farms size of control farmers respondent's maximum 70% of control farmers having between 1-3 acres while 50% of Better Cotton Farmers between farms size 1-3 acre. Farming skill is always regarded as an asset in the farmer's society; control farmers have farming experience 47.5% respondents between 1-10 years. While the Better Cotton farmers have farming experience majority (46.25%) of Better Cotton respondents have experience between 11-20 year. Control farmers main source of income is agriculture control respondents was 80%, depending only Agriculture while the Better cotton respondent's main source of in also agriculture 76.25% respondents depends on agriculture. The result shows that impact of training provided to Better Cotton (BC) farmers provided them awareness regarding the use of botanical pesticides, which previously were not used by them.

Botanical pesticides are organic pesticides that usually come from plants used for protection. These types of pesticides have become more popular as they do not release toxin because insects become more resistant to chemical insecticides. Therefore they decompose and are more useful conventional insecticides. The botanical pesticide are made by traditional methods are made by farmers. 100% of respondents agree that botanical pesticides are less costly compare chemical pesticide. 75% respondents were of the views that botanical pesticides do not harm beneficial insects. 68.75% of Better Cotton farmers reported that use of botanical pesticides do not effect on skin disease. Views of farmers regarding changes in use of chemical pesticides after trainings. 87.5% respondents reported do not use unregistered pesticides and used registered pesticides. 86.25% respondents reported

that multinational pesticides are more effective but they are more costly. 81.25% respondents agreed that training provided awareness regarding banned national or multinational chemical pesticides. 68.75% respondents reported that they got training about classes of poison.

Land preparation is required before planting so get best soil condition the same time enable planting to establish easily cotton is a deep-rooted crop which needs fine good tilth and well ready for positive propagation result reveals that the Better cotton farmers average land preparation cost Rs.6100 per acre in the study area district Tando Allahyar. The average fixed cost 500 Rs charges per acre the total fixed cost of land. Capital has been defined a material good used in further production, the average input cost of per acre of Better Cotton farmers includes various cost such as seed cost, fertilizer cost irrigation cost and pesticides cost. Rs.18252.34 the average input cost of Better cotton. The results shows average labour inputs cost per acre of Better cotton farmers includes various labour inputs, cost of sowing cost, thinning cost, and picking cost and hand hoeing cost. The average labour inputs cost was Rs.11478.47. Result shows the average marketing costs of Rs. 2305 per acre spent on cotton crop, in which includes loading charges, un loading charges, and transport charges and commission agent charges. Better cotton farmers total cost of production results reveals that average total cost of production of cotton including fixed cost land preparation cost and capital inputs cost, labour input cost as well as marketing cost are respectively. The total average cost of production was Rs.38635.81 per acre. However, the minimum cost of production was Rs.34440 per acre while the maximum cost of production per acre was 46853 per acre of respondents. The yield of cotton results show average yield of cotton 28 mounds per acre while the average price of cotton per mounds is Rs.3350. and average revenue was Rs.93800 per acre while the average cost of production was 38635.81 per acre. Average net income per acre was Rs.55165.19 Better cotton farmers in the study area district Tando Allahyar.

## **SUMMARY**

Pakistan is the third largest consumer of cotton, the fourth largest producer of cotton and the most important growing of cotton country in the global. Agriculture and cotton is the backbone of Pakistan economy. Its contribution 23.60% account value addition of agriculture sector and 4.45 % in gross domestic product and others crop added in value addition only 10.80% while the 2.4% in GDP of Pakistan (GOP, 2016) Pakistan is the third largest cultivation in the area of better cotton, and total 90441 better cotton initiatives farmers registered in Pakistan (BCI, 2017). This study was carried at five villages of two union Councils of Tahsil Tando Allahyar, and Chambar in district Tando Allahyar was selected, from where five Farmer Field Schools (FFS) were selected randomly. Total 80 registered farmers were selected as better cotton farmers from Farmer Field Schools and 80 control farmers groups for this study.

Most of cotton growers focus on high yield production, without taking into consideration agriculture and environmental sustainability in to account. Ever since the introduction of cotton in district Tando Allahyar there has been significant dearth of studies which focus on increase in cotton productivity, reduction in the pesticide use, environmental sustainability and good return at farm level. Better cotton production initiatives taken in this regard may significantly reduce these issues. Hence this study examined the impact of better cotton production initiatives taken by small farmers in district Tando Allahyar Sindh, Pakistan to analyze their impact on use of pesticide productivity and return.



## CONCLUSION

This study concludes that BCF farmers were able to increase cotton yield due to training regarding pesticide and fertilizer use and how to achieve sustainable cotton production in the face of climate change. Decrease in the use of extremely poisonous pesticides and improvement in ecology and farmer environment quotients in the plausible outcome of the farmers filed school training. Human and animal health hazards were reduced because of use of biological control and less use of chemicals. The health precaution score for pesticide spraying workers improved slightly and needs special consideration during farmers filed school follow up activities. Average net income per acre was Rs.55165.19 Better cotton farmers in the study area district Tando Allahyar.

## RECOMANDATIONS

- Government should take action to provide these types of training programs at the national level in Pakistan. Government should take action against distribution and usage of banned pesticides and those which are un-registered.
- Extension workers should visit and help farmers regularly. Create awareness about new technology programs and provide training to farmer field schools.
- Government and Agriculture Seed Corporation should introduce high yield variety of cotton with low cost of seed for small holders.
- Use of non-chemical means of controlling disease include birds and bat species that act as predators to cotton. Use of pheromones traps is proposed. Use of border crops (e.g. maize sorghum around the field to provide a physical barrier to pests is proposed.

## SUGGESTIONS FOR FUTURE RESEARCH

- Present study can be extended to medium and large farmer field schools and further study can be performed on provincial level.
- A SWOT analysis may be carried out of the training group (better cotton farmers), to find out the strength of the training program and to improve future trainings.
- The problems faced by farmers should be taken into consideration and to formulate strategy for resolving those issues.

## DECLARATIONS

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**Availability of data and material:** In the approach, the data sources for the variables are stated.

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**Consent to Participate:** Yes

**Consent for publication and Ethical approval:** Because this study does not include human or animal data, ethical approval is not required for publication. All authors have given their consent.

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