

SUSTAINABILITY ANALYSIS OF BETTER COTTON: A CLEANER AND SUSTAINABLE PRODUCTION ALTERNATIVE IN PAKISTAN

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ABSTRACT

The Better Cotton Initiative (BCI) program is seen as a sustainable approach to cotton production in Pakistan. It trains its farmers to adapt to climate change and increase profits by efficient resource allocation. This paper analyses the resource allocation, profitability, and economic uplift of BCI farmers in comparison to non-BCI farmers. Primary data were collected from three districts of Punjab province. The results showed that the land area under cotton, land preparation cost, seed and sowing cost, irrigation cost, fertilizer cost, pesticide cost, thinning cost-plus weeding cost are positively associated with the profit of BCI farmers, whereas picking cost negatively affects the profit of BCI farmers. In the case of non-BCI farmers, the area under cotton and seed and sowing costs were positively associated with the profit. In contrast, land preparation costs, irrigation costs, fertilizer costs, and pesticide costs were negatively associated with the profit. Poverty incidence, depth, and severity among different socio-economic categories of farmers is lower among BCI farmers compared to non-BCI farmers. Therefore, the BCI program prevents overutilization of inputs by maintaining judicious use of resources. Supporting the Better Cotton Initiative (BCI) program can make better cotton a mainstream and long-term product in Pakistan.

Keywords: BCI, Sustainable cotton production, economic uplift, poverty incidence, impact analysis

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INTRODUCTION

Cotton accounts for approximately sixty percent of Pakistan's total exports (GOP, 2022; Abdullah and Khan, 2022). This makes Pakistan's economy dependent to a large extent on cotton (production, ginning, and textile), as a textile group. The cotton output reached 8.329 million bales in FY2022, compared to 7.064 million bales last year, showing a 17.9 percent increase (GOP, 2022). However, the production of cotton in Pakistan is not growing as much as in neighboring countries like China, though it was on the same footing in 1990 (Ahmed *et al.*, 2020). Most farmers in Pakistan tilt towards sugarcane or other substitute crops due to the high input costs of cotton, whose profitability declined (Abbas, 2020; Ahmad *et al.*, 2020). Overuse of chemicals and other traditional practices are among the major causes of low profits and poor socio-economic status for farmers (Ahmad *et al.* 2019b). About 8–10% of total pesticides produced in Pakistan are used only in the cotton crop (Khan and Damalas, 2015; Hina and Asad, 2019). Farmers who use too many chemicals and other inputs raise the economic and social costs of growing

cotton, which makes conventional cotton production impossible to keep up with.

Profitability is among the major economic incentives for farmers' adoption of sustainable cotton practices (Liu *et al.*, 2018). Farmers who adopt sustainable agricultural practices, including better cotton operations, make a fair profit by saving more money due to more efficient and timely irrigation, fertilizer, and pesticide use (Awan *et al.*, 2015). In Pakistan, the Better Cotton Initiative (BCI) is a prodigious platform that helps farmers achieve higher yields with lower input costs (Zulfiqar *et al.*, 2017) and leads to higher profits. To combat pests such as thrips, whiteflies, mites, jassid, and bollworms, BCI farmers made botanical insecticides with 500 liters of neem seed extract and 1200 liters of bitter melon extract (Radhakrishnan, 2017). For a pilot research project, farmers were provided biopesticides by BCI staff at no cost. Later, over 78,000 liters of bitter melon extract and other plant extracts were used on around 28,000 acres of cotton crop during the season (BCI, 2016c). These eco-friendly and cheaper practices, along with other climate-smart agricultural practices, make better cotton

production more profitable and sustainable than conventional ways of cotton production.

Cotton has the longest value chain, from the production of raw cotton to the manufacture of clothing. This value chain employs more than 50 percent of all industrial labor (Abbas and Waheed 2017), but unfortunately, most laborers and cotton farmers are poor. The prevalence of poverty ranges between 30 and 40% among the Pakistani population (UNDP-Pakistan, 2016). Poverty based on headcount was assessed at 38.8%, and poverty intensity was 50.9%; however, the multidimensional poverty index showed that 54.6% of people in rural areas are poor (UNDP-Pakistan, 2016). From agriculture to industry, the cotton sector has a wider scope for supporting poor people. Currently, the "Better Cotton" initiative is improving the socioeconomic status of farmers by reducing the costs of cotton production and allowing them to sustain the quality of their produce to receive a premium price (Zulfiqar *et al.*, 2017). The encouraging yield and low cost of production positively affect the income of better cotton farmers and help reduce poverty among farming communities. Kouser and Qaim (2014) said that more people are using better cotton because it helps with both income and poverty.

Though better cotton production is increasing in Pakistan, there is insufficient research on the difference in profitability between better cotton growers and conventional growers as well as the contribution of BCI to the economic uplift of farmers. A few studies on better cotton, like Zulfiqar *et al.* (2017); Zulfiqar *et al.*, 2017; Hina and Asad, 2019; etc., have been done, but the comparison of BCI and conventional cotton growers based on profitability and impacts on rural poverty are

not taken into account. Therefore, understanding the socio-economic and informational variables affecting better cotton profitability will help in the adoption of better cotton. The analysis of the impacts of BCI on cotton growers' poverty reduction is also unexplored, and this study has taken this aspect into account. So, the primary focus of this study is to investigate the economic impact of this program on BCI farmers compared to non-BCI farmers.

MATERIALS AND METHODS

Study area: The Punjab province is responsible for the cultivation of the majority (4.7 million acres, 7 million bales, and a lint yield of 283.4 kg per acre) of the nation's cotton crop and accounts for 79 percent of the total cotton produced in Pakistan (Government of Punjab, 2019). The study was conducted in Punjab, specifically in districts Bahawalpur (latitude: 39°54'26" N, longitude: 116°23'50" E), Rajanpur (latitude: 29° 06' 12.64" N, longitude: 70° 19' 30.14" E), and Bhakkar (latitude: 31°37'30" N, longitude: 71°03'56" E). In terms of climate (maximum 40 °C and minimum 26 °C), soil (loam, medium clay, sandy loam), and water (500–800 mm), Bahawalpur is the best region to grow cotton (Ahmad *et al.*, 2019a). Rajanpur is the most economically advantageous district, with the highest returns of 13,487 Rs/hectare (Ahmad *et al.*, 2019a). Bhakkar was chosen as the third district for the survey to find out how much money BCI and conventional cotton farmers make and how their economies improve.

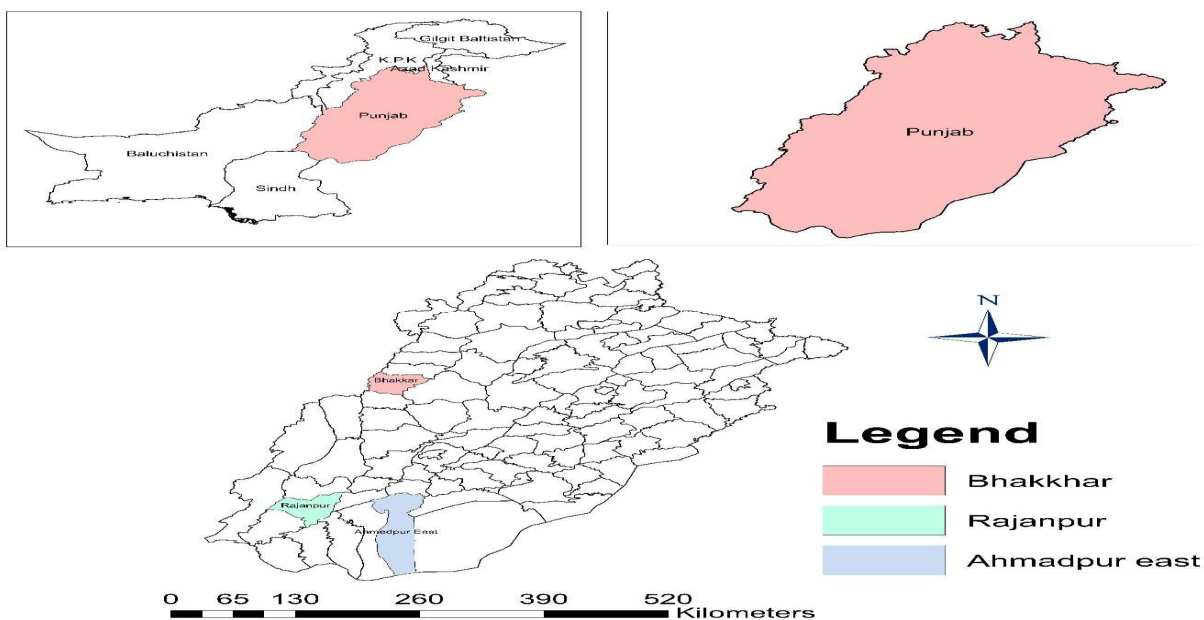


Figure 1: Map of the study area

Sample size: Yamane's formula was used to calculate the sample size (1967). This formula was commonly used by researchers to calculate sample size (Mehmood *et al.*, 2022; Ullah *et al.*, 2020; Zulfiqar *et al.*, 2017). It is dependent on the size of the population and the level of precision.

$$n = \frac{N}{(1+Ne^2)} \quad (\text{Eq. 1})$$

where "n" is the size of the sample, "N" is the total number of agricultural households in the study area, and "e," which was set at 5%, is the precision.

Sampling technique: A multistage random sampling method was utilized for the present study. In the first

stage, three districts, namely Bahawalpur, Rajanpur, and Bhakkar, were chosen. In the second stage, one sub-district (tehsil) was chosen at random from each district: Ahmadpur East (tehsil), Rajanpur (tehsil), and Bhakkar (tehsil). In the third stage, based on the total number of rural households in each tehsil, a proportionate sample of 188, 87, and 124 was taken from Ahmadpur East, Rajanpur, and Bhakkar, respectively. In the fourth stage, half of the farming households were chosen at random from the villages of BCI and non-BCI farmers, respectively. The sample framework of this study is best portrayed in Table 1.

Table 1. Sampling procedure.

Districts	Sub-Districts (Tehsils)	Total Rural Households	Sample
Bahawalpur	Ahmadpur East	138,432	188
Rajanpur	Rajanpur	63,769	87
Bhakkar	Bhakkar	90,823	124
Total	3	293,024	399

Source: Pakistan Bureau of Statistics, 2018

Econometric model used

Log-log model for profitability: A log-log model or log-log linear regression is a type of regression model in which the dependent variables are log-transformed. Transforming different variables in the regression models is a common practice to handle circumstances where we face a non-linear relationship between the outcome and predictor variables. Using the logarithm of one or more variables instead of an unlogged form makes the effective relationship nonlinear while preserving the linear model. Logarithmic changes are also an easy means of converting an extremely slanting variable into one that is more or less normal (Benoit, 2011). Therefore, a log-log form of the following econometric model was used for data analysis:

$$\ln\Pi = \alpha + \beta_1\ln TL + \beta_2\ln TLC + \beta_3\ln LPC + \beta_4\ln SSC + \beta_5\ln TWC + \beta_6\ln WC + \beta_7\ln FC + \beta_8\ln PC + \beta_9\ln PiC + \varepsilon, \quad (\text{Eq. 2})$$

Where $\ln\Pi$ = log of profit (PKR/acre)

$\ln TL$ = log of total land area of the respondent (acres)

$\ln TLC$ = log of land area under cotton production (acres)

$\ln LPC$ = log of land preparation cost (PKR/acre)

$\ln SSC$ = log of seed and sowing cost (PKR/acre)

$\ln TWC$ = log of thinning and weeding cost (PKR/acre)

$\ln WC$ = log of water/irrigation cost (PKR/acre)

$\ln FC$ = log of fertilizer cost (PKR/acre)

$\ln PC$ = log of pesticide cost (PKR/acre)

$\ln PiC$ = log of picking cost (PKR/acre)

ε = error term

Poverty line: The poverty line is a precise benchmark of the income of a respondent, or his or her value of consumption. It is described as a well-defined and

predetermined level of income or consumption of someone that is considered representative of the minimum income essential for a constructive and effective life of an individual for subsistence (Okunmadewa, 1999). Although numerous approaches have been employed by different researchers, such as the sum of dollars per day, total households' income, household per capita expenditure, and 2/3 of the mean household expenditure (per capita). In this study, we used the poverty line that was based on 2/3 of the per capita household's expenditure, due to the following reasons: Firstly, incomes vary from season to season or year to year because farmers are reliant on production at the farm, and the prices they receive. Secondly, most farming households are habitually unwilling to proclaim their real income. Thirdly, the volume of income is less important than the sum paid out for consumption, and finally, household consumption is mostly chosen as opposed to household income for analyzing income distribution because it is mostly stable due to more accurate data collected on consumption than income. Thus, an examination of poverty based on the income of the respondents may undervalue (if a respondent borrows to supplement consumption expenditure) or overvalue (if the respondent saves a large amount of his or her income, which may lead to increased well-being). The per capita expenditure approach has been employed in research on poverty in an African country, Nigeria, e.g., Okunmadewa, (2002). In this study, household spending accounted for 2/3 of the mean per capita expenditure (MPCHE), which was classified under the moderate poverty line, while the remaining 1/3 was considered the line of extreme poverty.

The categories of poverty were given as follows:

- Households spending \leq one-third of MPCHE is "extremely poor"
- Households spending \leq two-thirds of MPCHE are "moderately poor"
- Households spending $>$ two-thirds of MPCHE is not poor.

$$\text{Per capita expenditure (PCE)} = \frac{\text{Total Expenditure of Household}}{\text{Total Household Size}} \quad (\text{Eq. 3})$$

$$\text{MPCHE} = \frac{\text{Total household expenditure}}{\text{Total number of respondents}} \quad (\text{Eq. 4})$$

where MPCHE = mean per capita household expenditure.

Poverty profile: A random partition of poor and non-poor people is the poverty line. Every poverty assessment study involves forming a poverty line that is used in permutations with indicators of well-being. Foster *et al.* (1984) made the Foster Greer Thorbecke (FGT) poverty index and used it in their quantitative analysis of poverty. The index is shown in Eq. 5.

$$P_{\alpha} = \left[\frac{1}{N} \sum_{i=1}^q \left(\frac{Z-Y_i}{Z} \right)^{\alpha} \right] \quad (\text{Eq. 5})$$

where Z = poverty line, Y_i = per capita expenditure of i^{th} household, N = total no. of individuals in a population, q = number of people below the poverty line, and α = degree of aversion (it has values 0, 1, 2.)

The headcount index is often called the incidence of poverty. It can be thought of as the number of poor people or the percentage of the population that lives below a set line of poverty.

When $\alpha = 0$, then the equation for FGT will be as under

$$P_{\alpha} = \left[\frac{1}{N} \sum_{i=1}^q \left(\frac{Z-Y_i}{Z} \right)^0 \right] \quad (\text{Eq. 6})$$

As the value of α is zero, then $P_{\alpha} = n =$ headcount ratio or poverty incidence.

where "n" is the total number of individuals in the reference population and q is the number of individuals below the poverty line.

When the value of α is set equal to one, then FGT calculates the intensity (depth) of poverty in a population. Hall and Patrinos (2005) considered it the "poverty gap," i.e., the difference between the amount of income received by the poor and the line of poverty. The "poverty depth" particularly calculates the actual level at which the income of a poor person lies below the line of poverty. And the α value of 2 is used to measure the severity of poverty. The severity of poverty can be described as the square of the ratio of the poverty gap to the population. According to Foster *et al.* (1984) and Assadzadeh and Paul (2003), using FGT, one can find the distinction between the poor and the poorest in a population.

$$P_{\alpha} = \left[\frac{1}{N} \sum_{i=1}^q \left(\frac{Z-Y_i}{Z} \right)^2 \right] \quad (\text{Eq. 7})$$

FGT is an excellent measure of poverty that can measure incidence, depth, and intensity of poverty at the same time and is widely used by many researchers,

including Ijuo *et al.* (2020); Delamonica and Minujin (2007); Edoumiekumo *et al.* (2014); Akerele and Adewuyi (2011); Roelen *et al.* (2010); and Das (2015).

RESULTS AND DISCUSSION

Input usage by BCI and non-BCI Farmers: Table 2 presents a comparative analysis of input usage among cotton farmers, distinguishing between those registered with the Better Cotton Initiative (BCI) and those who are not. Across various agricultural activities, significant differences emerge in input utilization between the two groups. Notably, BCI farmers employ lower quantities of seed and utilize fewer land preparation activities such as ploughing, planking, and deep ploughing compared to their non-BCI counterparts. In terms of fertilizers, BCI farmers tend to use lesser amounts of Urea and DAP, indicating potential efficiency in nutrient management practices. Moreover, there is a discernible contrast in irrigation practices, with BCI farmers exhibiting lower frequencies of Tube Well (TW) usage compared to non-BCI farmers. In the case of pesticide and weedicide application, the BCI farmer utilizes lower quantities of both, indicating judicious use of resources. These disparities underscore the potential impact of BCI participation on optimizing resource allocation and sustainable farming practices within the cotton cultivation sector.

Factors affecting the profit: The results of the regression analysis indicate significant associations between various factors and the profit of both BCI and non-BCI cotton farmers. For BCI farmers, the land area under cotton, land preparation cost, seed and sowing cost, irrigation cost, fertilizer cost, pesticide cost, thinning and weeding cost show positive and statistically significant relationships with profit, indicating that higher investments in these inputs lead to increased profitability. Only picking cost is negatively associated with profits of BCI farmers because they incur higher picking cost due to the reason that Better Cotton requires labor after sunrise so that due subsidies, meanwhile conventional cotton growers engage labor in their picking early in the morning, so BCI farmers bear the extra cost of picking to bound labor for their picking. On the other hand, for non-BCI farmers, the 'land area under cotton' and 'seed plus sowing costs' demonstrate positive and significant impacts on profit, implying that larger cotton cultivation areas and higher investments in seed and sowing contribute to higher profitability. However, land preparation costs, irrigation costs, fertilizer costs, and pesticide costs are negatively associated with profit for non-BCI farmers, suggesting that increased expenditures in these areas may lead to reduced profitability. These results show that non-BCI farmers are incurring higher costs on inputs while BCI farmers have judicious use of inputs. Imran *et al.* (2019) also found that conventional

cotton farmers incur more costs on inputs and have weaker adoption of adaptation practices for reducing climate change effects. The regression models for both groups show variations in explanatory power, with R-squared values indicating moderate to strong explanatory abilities for profit variations among BCI farmers, while for non-BCI farmers, the explanatory power of the model is relatively weaker. These findings underscore the importance of efficient resource allocation and management strategies tailored to the specific contexts of BCI and non-BCI cotton farming practices in Pakistan.

These results also show that the BCI farmers have developed skills of efficient resource allocation which showcases the importance of this initiative for the betterment of cotton production in Pakistan. There is room for further improvements in the sustainable use of resources by BCI farmers. The picking cost can be lowered by contracting in advance with picking labor or picking machinery can be adopted. Non-BCI farmers can reduce their costs and increase profits by registering themselves with this initiative.

Table 2: Input use by BCI and non-BCI Farmers.

Input	Cotton farmers	
	BCI	Non-BCI
Seed (Kgs)	7.54**	9.60**
Land preparation		
Plough (No.)	2.01**	3.20**
Planking (No.)	0.67*	2.20*
Rotavator (No.)	0.71 ^{ns}	0.73 ^{ns}
Laser leveler (No.)	0.25 ^{ns}	0.10 ^{ns}
Deep plough (No.)	0.15*	0.01*
Fertilizer (one bag = 50 kg)		
Urea (Bags)	2.01*	3.98*
DAP (Bags)	1.07**	2.44**
NP (Bags)	0.09 ^{ns}	0.13 ^{ns}
Other (Bags)	0.08 ^{ns}	0.40 ^{ns}
FYM (No of trollies)	1.96**	0.52**
Irrigation (No.)		
Canal (No.)	5.51 ^{ns}	4.89 ^{ns}
TW (No.)	8.89**	11.16**
C+TW (No.)	2.07*	3.88*
Thinning (No.)	0.68 ^{ns}	0.72 ^{ns}
Spray		
Weedicide (No.)	0.75**	2.91**
Pesticide (No.)	3.57**	6.02**

Source: Calculations from the author's data collected through a survey of farmers. Note: ** $p \leq 0.05$, * $p \leq 0.10$, ns = non-significant respectively for paired sample t-test assuming unequal variances.

Table 3: Factors Affecting Profits

Model	BCI Farmers		Non-BCI Farmers	
	B	Std. Error	B	Std. Error
(Constant)	4.681**	1.181	4.414**	0.274
lnTL	0.010 ^{ns}	0.007	-0.008 ^{ns}	0.002
lnTLC	0.013**	0.001	0.002**	0.001
lnLPC	0.042*	0.008	-0.039*	0.003
lnSSC	0.017**	0.006	0.001**	0.041
lnTWC	0.011*	0.003	0.005 ^{ns}	0.005
lnWC	0.016**	0.001	-0.093**	0.007
lnFC	0.008**	0.005	-0.029*	0.028
lnPC	0.012**	0.010	-0.031**	0.004
lnPiC	-0.043**	0.004	0.038 ^{ns}	0.001
R ²	0.761		0.732	

Source: Calculations from the author's data collected through a survey of farmers. Note: ** $p \leq 0.05$, * $p \leq 0.10$, ns = non-significant respectively for paired sample t-test assuming unequal variances.

Derivation of the poverty line: The poverty line used was based on the mean per capita household expenditure (MPCHE), which was estimated at Rs. 3981.34 per month. Households with per capita expenditure less than Rs. 1327.11 (1/3 of 3981.34) were classified as being

extremely poor, while those with per capita expenditure less than Rs. 2654.23 ($\leq 2/3$ of 3981.34) were classified as being moderately poor, while those with per capita expenditure above Rs. 2654.23 ($> 2/3$ of 3981.34) were considered non-poor.

Table 4: Derivation of the poverty threshold

Variables	Per capita household expenditure/month
Mean per capita household expenditure	Rs. 3981.34
Core poverty line (one-third of MPCHE)	Rs. 1327.11
Moderate poverty line (two-thirds of MPCHE)	Rs. 2654.23
Non-poor poverty line ($>$ two-thirds of MPCHE)	$>$ Rs. 2654.23

Source: Calculations from the author's own data collected through a survey of farmers.

Distribution of respondents based on their poverty status: There was a considerable difference in the income earned by BCI and non-BCI farmers from cotton. Most of the farmers who adopted BCI practices (which help save resources) saved their costs and earned more income than non-BCI farmers. The results showed that more non-poor were found among BCI farmers, probably because they used resources efficiently and saved their money. The distribution of the respondents based on their poverty status, as shown in Table 5, indicates that 28.4% of BCI farmers were core poor, compared to 29.3% of core poor non-BCI farmers. In cases of moderate poverty, the

percentage of BCI farmers was lower than that of non-BCI farmers, which means non-BCI farmers were facing more poverty. Those who were classified as non-poor are composed of 27.4% BCI farmers and 26.8% non-BCI farmers. All three categories show that poverty is more prevalent among non-BCI or conventional farmers who have not adopted sustainable management practices due to not being members of the BCI program. In a study that was similar to this one, Ayuya *et al.* (2015) found that certified producers were less likely to be poor in more than one way than if they didn't take part in organic certification schemes.

Table 5: Distribution of respondents based on their poverty status

Poverty status	BCI		Non-BCI	
	Frequency	Percent	Frequency	Percent
Core poor	57	28.4	58	29.3
Moderately poor	89	44.2	87	43.9
Non-poor	55	27.4	53	26.8
Total	201	100	198	100

Source: The author's calculation from survey data

Distribution of indices of poverty among households by socioeconomic characteristics: A comprehensive analysis of households' poverty status among respondents can be done by disaggregating it into three indicators, i.e., headcount ratio, poverty depth, and poverty severity, usually demonstrated by P₀, P₁, and P₂, respectively. Table 6 exhibits the poverty profile and breakdown of the respondents across the socio-economic characteristics. The age of the respondent is grouped into different categories and is interlinked with poverty status. The age group of 18–30 contained 18% poor in BCI and 20% poor in non-BCI, which shows that the incidence of poverty in this age group was higher in non-BCI farmers than in BCI farmers. Poverty depth and severity were also higher among non-BCI farmers in this age bracket as compared to BCI farmers. In the age group of 31–43, poverty incidence was observed to be 9% and 10% in BCI farmers and non-BCI farmers, respectively. The

depth and severity of poverty were also greater for non-BCI farmers in this age group. The age group of 44–56 contained 32% poor in BCI and 33% poor in non-BCI, which shows that the incidence of poverty in this age group was higher in non-BCI farmers than in BCI farmers. Poverty depth and severity were also higher among non-BCI farmers in this age group as compared to non-BCI farmers. In the group of people aged 57–69 years, poverty incidence was 57% and 59% in BCI and non-BCI farmers, respectively. The depth and severity of poverty were also greater for non-BCI farmers in this age group. In the case of farmers equal to or older than 70 years, the poverty incidence was higher among BCI farmers, but the depth and severity of poverty were higher among non-BCI farmers. These results showed that young and middle-aged farmers who were also registered with BCI were practicing the principles and guidelines provided by the 'Better Cotton Initiative

Program" and were saved from poverty. BCI farmers with ages greater than 70 were unable to get through poverty incidence because they did not comply with the guidelines of the sustainable cotton production (BCI) program.

The education of the respondent was grouped into different categories, and its relation to their poverty status was calculated. Among the farmers with 0–8 years of schooling, 1% and 0.4% were poor in BCI and non-BCI, respectively, which shows that the incidence of poverty in this education group was higher in BCI farmers than in non-BCI farmers. Poverty depth was less in BCI farmers, while severity was more in BCI farmers for the education group of 1–8 years of schooling. In the education group of 9–12 years of schooling, poverty incidence was 24.3% and 25.0% in BCI and non-BCI farmers, respectively. The depth and severity of poverty were also lower among BCI farmers in this qualification range. The education group of 12–16 contained 43.9% poor in BCI and 45.1% poor in non-BCI, which exhibited that the incidence of poverty in farmers with 12–16 years of education was less in BCI farmers than in non-BCI farmers. The values of poverty depth and severity were also lower among BCI farmers in this education set as compared to non-BCI farmers. For farmers with more than 16 years of education, the poverty incidence was 20.0% and 23.1% for BCI and non-BCI farmers, respectively. For this education level, the depth and severity of poverty were also greater for non-BCI farmers. These results showed that educated farmers who had more than nine years of schooling and were registered with BCI were practicing the principles and guidelines provided by the 'Better Cotton Initiative Program" and were saved from spells of poverty. While BCI farmers who were not educated or educated up to nine years of schooling were incapable of overcoming poverty incidence, this may have been because they did not understand the guidelines of the sustainable cotton production (BCI) program. Apata *et al.* (2010) also found that education is one of the factors contributing to poverty reduction among farmers.

The farming experience of farmers was congregated into distinct categories, and its relation was computed with their poverty status. Among the farmers with experience of 0–10 years, 0.1% were poor in BCI and 0.3% were poor in non-BCI, which showed that the incidence of poverty in this experience group was higher in non-BCI farmers than in BCI farmers. For experience levels from 0 to 8 years, poverty depth and severity were also higher among non-BCI farmers. BCI and non-BCI farmers with an experience level of 11–20 years faced poverty incidences of 16.3% and 18.0%, respectively. The depth and severity of poverty were also higher in non-BCI farmers as opposed to BCI farmers in this qualification range. In the experience level of 21–30 years, 42.9% were poor in BCI farmers and 44.1% were

poor in non-BCI farmers, which exhibits that the incidence of poverty in farmers with experience of the "poor in BCI and 0.3% were poor in non-BCI, which showed that the incidence of poverty in this experienced group was higher in non-BCI farmers than in BCI farmers. For experience levels from 0 to 8 years, poverty depth and severity were also higher among non-BCI farmers. BCI and non-BCI farmers with an experience level of 11–20 years faced poverty incidences of 16.3% and 18.0%, respectively. The depth and severity of poverty were also higher in non-BCI farmers as opposed to BCI farmers in this qualification range. In the experience level of 21–30 years, 42.9% were poor in BCI farmers and 44.1% were poor in non-BCI farmers, which exhibits that the incidence of poverty in farmers with experience of the "years" was less in BCI farmers than non-BCI farmers, and the value of poverty depth and severity was also lower in BCI farmers as compared to non-BCI farmers. For farmers with more than 30 years of experience, the poverty incidence was 22.0% and 21.0% for BCI and non-BCI farmers, respectively. The depth and severity of poverty were also greater for non-BCI farmers in this group. These results showed that experienced farmers who had been farming for more than 11 years or more and were registered with BCI were practicing the principles and guidelines provided by 'Better Cotton Initiative Program" and were saved from the chants of poverty. Even though BCI farmers with less than 10 years of experience were less able to deal with poverty, this could be because they didn't have the skills to follow all the rules of the sustainable cotton production (BCI) program.

The household head has much influence on the decisions of a farm family; therefore, the link between the gender of the household head and poverty is analyzed in this study. Results showed that male-headed households had a lower incidence of poverty than female-headed households. The results for poverty depth and severity also show that female-headed households were facing greater severity and depth of poverty. The results of Apata *et al.* (2010) were also in line with this study, as they found that there is a greater prevalence of chronic poverty among female-headed households than male-headed households. The results showed that incidence, depth, and severity of poverty were lower in single respondents, moreover, poverty was more prevalent in those singles who belonged to a non-BCI group of farmers. Married people faced more poverty incidence, depth, and severity than singles, and BCI farmers were better off than non-BCI in all three forms of poverty. Widowed respondents were more poverty-stricken than both single and married respondents, particularly those who belonged to non-BCI farmers. Among divorced farmers, non-BCIs were a little better off than BCI farmers in terms of poverty incidence, but in terms of

poverty depth and intensity, the non-BCI farmers were worse off.

Household size had a detrimental effect on the income and expenditure levels of a household. This study categorized the size of households (for both types of farmers) into three categories and found the incidence, depth, and intensity of poverty among these groups. It was calculated that the percentage of poor people was

higher in households with 10 to 12 people, and among this group, non-BCI farmers had a higher frequency of poor people. For household sizes of 5–9 and 1-4 people, poverty was more prevalent in households with more family members and belonging to a non-BCI group. It can be said that farmers belonging to BCI were better off than those who had not adopted BCI.

Table 6: Distribution of indices of poverty among households by socioeconomic characteristics

Socio-economic characteristics	Group	Po		P1		P2	
		BCI	Non-BCI	BCI	Non-BCI	BCI	Non-BCI
Age	18-30	0.180	0.200	0.169	0.189	0.144	0.154
	31-43	0.090	0.101	0.019	0.027	0.007	0.009
	44-56	0.323	0.333	0.054	0.061	0.015	0.018
	57-69	0.571	0.591	0.159	0.140	0.066	0.069
	≥70	0.125	0.135	0.045	0.055	0.016	0.014
Education (Years)	0-8	0.010	0.004	0.005	0.006	0.002	0.001
	9-12	0.243	0.250	0.067	0.071	0.023	0.031
	12-16	0.439	0.451	0.060	0.071	0.030	0.031
	≥16	0.200	0.231	0.003	0.004	0.004	0.007
Farming experience (Years)	0-10	0.001	0.003	0.001	0.002	0.010	0.021
	11-20	0.163	0.180	0.067	0.071	0.035	0.038
	21-30	0.429	0.441	0.080	0.082	0.020	0.026
	≥30	0.220	0.210	0.006	0.009	0.007	0.009
Household head	Male	0.272	0.312	0.052	0.076	0.015	0.033
	Female	0.306	0.326		0.0816		0.040
Marital status	Single	0.000	0.005	0.000	0.001	0.000	0.000
	Married	0.263	0.280	0.077	0.067	0.033	0.040
	Widowed	0.429	0.441	0.070	0.081	0.020	0.001
	Divorced	0.200	0.190	0.003	0.005	0.006	0.005
Household size	1-4	0.167	0.187	0.043	0.049	0.031	0.030
	5-9	0.243	0.281	0.049	0.050	0.015	0.019
	10-12	0.539	0.601	0.198	0.218	0.092	0.098

Source: Calculations from the author's data collected through a survey of farmers.

Conclusion: Better cotton production program is considered a platform for cotton production with increased profits and socio-economic implications on farmers. This study explored the facts that support this thinking as land under cotton and fertilizers costs have a significant and substantial effect on profitability of BCI farmers. It means large cotton producers are at benefit to produce sustainable cotton. Total land preparation cost, seed and sowing cost, irrigation cost, pesticide cost and picking cost are negatively and significantly affecting profit of BCI farmers at 5% level of significance. This implies input overuse, therefore BCI farmers should be sensitized by BCI staff and extension workers to follow recommended BCI input dosage to get maximum benefits. Thinning and weeding cost is affecting profit of better cotton growers positively and significantly, hence increase in these inputs leads to increase in profit of BCI farmers. In case of non BCI farmers land under cotton and seed & sowing cost are positively and significantly

affecting profit while the land preparation cost, irrigation cost, fertilizer and pesticide cost affecting profit negatively. It means further increase in these variables decreases the profit of non-BCI farmers. It can be deduced that non-BCI farmers were overutilizing pesticides, fertilizers, irrigation and ploughings which is lessening their profits and ultimately economic wellbeing. Total land area and picking cost has no significant impact on the profit of conventional (non-BCI) farmers. Poverty incidence, depth, and severity results revealed that a lower percentage of BCI farmers faced poverty than conventional cotton producers. Thus, the BCI program is socially and economically sustainable, and the government should assist farmers and BCI experts in promoting BCI and establishing it as a future mainstream commodity.

Ethics approval and consent to participate: All the procedures performed in the studies involving human

participants were in accordance with the ethical standards of the institutional and/or national research committee. Informed consent was obtained from all the individual participants involved in the study.

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