PROFITABILITY AND TECHNICAL EFFICIENCY OF HYBRID AND LOCAL VARIETY COTTON PRODUCTION IN SELECTED AREAS OF KUSHTIA DISTRICT

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CERTIFICATE

*This is to certify that thesis entitled, **"PROFITABILITY AND TECHNICAL EFFICIENCY OF HYBRID AND LOCAL VARIETY COTTON PRODUCTION IN SELECTED AREAS OF KUSHTIA DISTRICT"** submitted to the Faculty of Agribusiness Management, Sher-e-Bangla Agricultural University, Dhaka, in partial fulfillment of the requirements for the degree of **MASTER OF SCIENCE IN AGRICULTURAL ECONOMICS,** embodies the result of a piece of bona fide research work carried out by **Nabila Hossain**, Registration No. **13-05505** under my supervision and guidance. No part of the thesis has been submitted for any other degree or diploma.*

I further certify that such help or source of information, as has been availed of during the course of this investigation has duly been acknowledged.

Dated: , 2020

Place: Dhaka, Bangladesh

Dr. Fauzia Yasmin
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DEDICATED

TO

MY BELOVED PARENTS

ABSTRACT

Cotton plays a key role in the national economy in terms of generation of direct and indirect employment in the Agricultural and Industrial sectors mainly textile and Clothing industries constitute the largest manufacturing sub-section in Bangladesh's economy. The present study was designed to measure the profitability and technical efficiency of hybrid and local Cotton farmers in selected areas of three upazillas namely Bheramara, Daulatpur, Mirpur under Kushtia district. Primary data were collected from randomly selected total 70 farmers from the study area. Both tabular and functional analyses were applied in this study. The major findings of the study reveal that Cotton production is profitable. Total cost of production of Hybrid Cotton and Local Cotton were Tk. 208399.60 and Tk. 205845.62 per hectare respectively. Gross return of Hybrid Cotton and Local Cotton were Tk. 455000 and Tk. 340500 per hectare respectively and net returns of Hybrid Cotton and Local Cotton were Tk. 246600.40 and Tk. 134654.38 per hectare respectively. Benefit Cost Ratio (BCR) was found to be 2.18 in Hybrid Cotton Production which implies that one-taka investment in Hybrid cotton production generated Tk. 2.18. Benefit Cost Ratio (BCR) was found to be 1.65 in Local cotton Production which implies that one-taka investment in Local Cotton production generated Tk. 1.65. The Cobb-Douglas stochastic frontier production function was used for this study to measure technical efficiency of Cotton farmers. In Hybrid Cotton Production, the coefficients of parameters Urea, MoP and Insecticide was negative. Where Human Labour, TSP, Gypsum and Irrigation was found positive and significant at 10 percent level of significant. In Local Cotton Production, the coefficients of parameters Urea, MoP, Gypsum and Insecticide was negative. Where Human Labour, TSP and Irrigation was found positive and significant at 10 percent level of significant. In the technical inefficiency effect model for Hybrid Cotton Production, farm size, training and experience have negative coefficients indicating that this helps in reducing technical inefficiency of Cotton farmers. In the technical inefficiency effect model for Local Cotton Production, farm size has negative coefficients indicating that this helps in reducing technical inefficiency of Cotton farmers. Cotton is a necessary raw material for maintaining Bangladesh's current flow of garments export. However, although the demand of cotton is steadily increasing, there is hardly any supply from within the country. The study also identified some problems and constraints faced by the Cotton farmers and suggested some recommendations to improve the present production situation so that yield of Cotton would possibly be increased.

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ABBREVIATIONS AND ACRONYMS

BRRI	: Bangladesh Rice Research Institute
BBS	: Bangladesh Bureau of Statistic
BCR	: Benefit Cost Ratio
BDT	: Bangladeshi Taka
BER	: Bangladesh Economic Review
CDB	Cotton Development Board
DAE	: Department of Agricultural Extension
et al.	: and others (at elli)
GR	: Gross Return
gm	: Gram
HIES	: Household Income and Expenditure Survey
HYV	: High Yielding Variety
IOC	: Interest on Operating Capital
kg	: Kilogram
MoP	: Muriate of Potash
mt	: Metric Ton
NGO	: Non-Government Organization
SRC	: Spices Research Center
t	: Ton
TC	: Total Cost
TFC	: Total Fixed Cost
Tk.	: Taka
TSP	: Triple Super Phosphate
TVC	: Total Variable Cost
US	: United States
USDA	: United States Department of Agriculture
$	: Dollar

CHAPTER-1

INTRODUCTION

1.1 General Background

Cotton, unique among agricultural crops, is second important cash crop followed by jute, among all the fiber crops in Bangladesh. Along with food and shelter, clothing is one of the primary requirements of human beings, which are provided by cotton in various means. Cotton is major natural fiber crop and also provides edible oil and seed by-products for livestock food. After harvest of cotton, the plant is widely used as fuel wood that is scarce in Bangladesh. Cotton is cultivated in tropical and subtropical regions of more than seventy countries of the world, which represents 2.5% of the all cultivated land. But among these, the major producers of cotton are China, India, USA, Pakistan, Uzbekistan, Argentina, Australia, Greece, Brazil, Mexico and Turkey where it is called 'White Gold'.

The finest cotton fiber-Moslin once produced in medieval Bengal was famous throughout the world. The cotton for producing Moslin was grown on highlands around Dhaka where most Moslin handlooms were located. However, the production and trading of Moslin gradually declined during the British rule ultimately resulting to closure of the industry by early nineteenth century. Later on, the British Government attempted revival of cotton production in India and introduced American variety of cotton (Gossypium hirsutum) but the farmers didn't accept cotton as a commercial crop in Bengal.

Two types of cotton are grown in Bangladesh namely (i) American upland cotton (Gossypium hirsutum) and (ii) Hill cotton (Gossypium arboreum). Upland cotton is cultivated in the south western region, northern region and central region covering more than 32 districts out of 61 plain districts, mainly Kushtia, Chuadanga, Jhenaidah, Meherpur, Magura, Jashore, Rangpur and Thakurgaon of Bangladesh. After introduction of Chinese hybrid, cotton is the most economic crop in those areas. Now the total production is 150000 bales per year.

The course type hill cotton, on the other hand, is grown in 3 hill districts. G. arboreum, locally called Comilla Cotton, is grown in hilly regions of Chittagong, and the Chittagong hill tracts. Hill cotton is an indigenous variety and cultivated in Jhum system as mixed crop but as it is grown in Jhum with many crops, it gives very low yield and less economic benefit. To increase yield and economic benefit, the American upland cotton has been introduced in 3 hill districts recently as rice-cotton intercropping, an alternative option for the hill farmers. Cotton is grown in around 42 thousand hectares of land with a yearly production of nearly 0.15 million bales which is only 3 percent of the total quantity demanded by the textile and garments industries of Bangladesh. About 97% of the total requirements are managed by importing raw cotton from Uzbekistan, India, Pakistan, Turkmenistan and some cotton growing Sub-Saharan (African) countries (Uddin and Mortuza, 2015). Technology, including yield monitors, remote sensing and computer-assisted irrigation control, is helping farmers across the Cotton Belt increase yields, reduce expenses and improve efficiency.

Bangladesh has become the largest cotton importer in the world, as China stopped importing the fiber in recent years. According to BTMA sources, Bangladesh requires 4-4.5 million bales (1bale = 182 kg or 400 pounds) of raw cotton in Bangladesh. Cotton consumption in Bangladesh rose 4.91 percent year-on-year to 6.4 million bales in 2016 due to higher demand from spinners and garment makers, according to the US Department of *Agriculture*. It imports most of the cotton required by the spinning mills.

Bangladesh is the 5th largest raw cotton consumer and second largest apparel producer in the world. The most important source of earning foreign currency is exporting of textile and garments products. Raw cotton is the main raw material of textile industry to produce fabric yarn and textile & this raw cotton is imported from-Uzbekistan, India, USA, other CIS and some African countries. The CDB hopes to produce 2.5 lakh bales of *cotton* by 2021, which would meet nearly 5-7 percent of the annual demand for the fiber. There is a striking gap between the supply and demand of *cotton* in *Bangladesh*. According to data from the Department of Agriculture, in the list of consumer countries for cotton, Bangladesh comes in at fourth place.

In 2016, Bangladesh's demand for cotton was 6.81m bales. In 2017 it grew to 7.51m bales. By 2018, the demand grew to 8m bales. There is a striking gap between the supply and demand of cotton in the country. In 2018, Bangladesh produced only 150,000 bales of cotton. Even though a substantial amount of cotton is required to run its flourishing export sector, Bangladesh needs to import over 98% of the cotton needed, as less than 2% is supplied from within the country. Currently, land in 35 districts of Bangladesh are suitable for cotton farming. Scientists in Bangladesh have given farmers 17 types of high quality cotton to farm. Now the Government is going for crop diversification which is more profitable for the farmers. Cotton is now one of the high value crops by introducing hybrid and Bt hybrid production. It is thus obvious that according to 'Bangladesh Journal of Agriculture and Environment for International Development' (- JAEID - 2016, 110 (2)326 J. R. Sarker and Md F. Alam), efficiency and economics in cotton production of Bangladesh needs an all and out effort to expand the cotton production very rapidly.

1.2 Origin and Distribution of Cotton

The English word cotton (*Gossypium hirsitum*) comes from the Arabic word *Qutun* or *Kutun*. Cotton is the most important of all fibrous plants used by man for clothing. The time cotton fibre was first used by man is not known. The oldest archaeological record of cotton textile dated back to about 3,000B.C which was found in the valley of the Indus River in West Pakistan (Fisher, 1969). Americans grew their own species of new world cotton. Majority of the true-to-type cotton are cultivated and most of those found wild can be identified as escapes from cultivation. The earlier botanist regarded the cultivated forms as having been domesticated from wild cotton species (Prentice, 1972). The exact origin of the crop is not known with any degree of certainty. According to Cooper (1990), cotton might have originated from Central and South America. Globally, cotton is the most important commercial crop and plays key role in economic, political and social affairs of the world (ICAC, 2013). It is cultivated in about 60 countries of the world and 10 countries, namely USA, former USSR, China, India, Brazil, Pakistan, Turkey, Mexico, Egypt and Sudan, account for nearly 85 percent of total production.

1.3 Economic Importance of Cotton

In producing cotton, the main product is lint. For purpose of processing into usable items, cotton seed is divided into five main products namely- cotton lint, cotton seed, cotton seed oil cotton seed cake or meal and cotton seed hulls. In Bangladesh, cotton plant is used as fuel wood as known as "lakri". The lint is the soft hair around the seed called floss. It is made of cellulose which serves as raw material in the textile industries for the manufacture of large proportions of adsorbent fabric for clothing as a natural textile fibre. Despite the declining trend of cotton share in textile fibres since 1970s, cotton still remains the most important natural fibre of the 20th century and represents 30% of the fibre market in the early 2000s(Horton and Mackoy, 2003). The lint is used extensively to produce thread after spinning. This forms the basis of the textile and fabric industries which depend on mass utilization of thread to weave and produce fabric and cloths.

Moreover, cotton is a fibre which is highly valued for apparel. Another aspect of cottons versatility lies in its adoptability for use to manufacture wears suitable for warm as well as cold weather (Maigizoh, 1981). Cotton is also used widely in hospitals, medical centres and clinics for cleaning and dressing of wounds in surgical operation and other orthopaedic uses. At home, it is used domestically as bedding and cushioning materials. The lint is also used as wick when soaked in oil to serve as illuminant in the rural areas. More than half of the cotton lint produced is used to make clothing and household textiles. The reminder is used in industry to make bag, belts, twins, and tyre-cords. The short lint is used in carpet, batting and as filling materials for pads and cushions. The fuzz (linters) on the seed is used to make felts, upholstery, mattresses, twin, carpets, surgical cotton, and in chemical industries for the production of rayon, plastics, paper and photographic film.Cotton seed contains 30% hulls, 60% kernels or meats, 5% fuzz and 5% waste. The chemical composition of cotton seed is 30% starch, 25% semi-drying oil, and 16-20% protein (Huseyn, 2014).
Cotton seed is processed to produce cotton seed oil, one of the most important of the world's nondrying oils. After it has been refined, the oil is used for cooking, in the manufacture of lard substitutes and margarines, and for making soap.

Cotton- seed meat, containing up to 41% protein by weight, is now used as protein supplement in human diet (Fortucci, 2012).Cotton-seed cake, containing 21% protein, constitutes a high protein feed for ruminants. It is somewhat toxic for poultry unless it is treated to eliminate the toxin, gossypol (ICAC, 2013). It may also be used as a nitrogenous fertilizer. Cotton-seed hulls are used as roughage for livestock and as livestock bedding, fertilizer and fuel. The dried plant is used as fuel. Textile mills are considered apart from other employment opportunities created by industries such as tailoring, hospital dressing producers, oil mills, specialty paper mills, and insulation and packaging companies and feed mills which use cotton as primary raw materials.

Uses of Cotton

Cotton is known for its versatility, performance and natural comfort. It's used to make all kinds of clothes and homewares as well as for industrial purposes like tarpaulins, tents, hotel sheets and army uniforms. Cotton fibre can be woven or knitted into fabrics such as velvet, corduroy, chambray, velour, jersey and flannel. In addition to textile products like underwear, socks and t-shirts, cotton is also used in fishnets, coffee filters, book binding and archival paper. Cotton is a food AND a fibre crop. Cotton seed is fed to cattle and crushed to make oil. This cottonseed oil is used for cooking and in products like soap, margarine, emulsifiers, cosmetics, pharmaceuticals, rubber and plastics. Linters are the very short fibres that remain on the cottonseed after ginning. They are used to produce goods such as bandages, swabs, bank notes, cotton buds and x-rays.

1.4 Cotton production in the world

Cotton is a natural plant fiber which grows around the seed of the cotton plant. Fibers are used in the textile industry, where they are the starting point of the production chain. First, the cotton fiber is obtained from the cotton plant and then spun into yarn. From there, the cotton yarn is woven or knitted into fabric.

The use of cotton has a long tradition in the clothing industry due to its desirable characteristics. Cloths made of this fiber are moisture-absorbent, have a good drape and are known for their long durability. Consumers continue to purchase large amounts of cotton products as they prefer cotton's light and comfortable qualities.

Products made out of cotton range from highly absorbent bath towels over bed linens to basic clothes such as t-shirts, underwear or socks. The top cotton producing countries include China, India and the United States respectively. Within the United States, the Southern states traditionally harvest the largest quantities of cotton. This region was formerly known as the 'Cotton Belt', where cotton was the predominant cash crop from the 18th to the 20th century. Due to soil depletion and social and economic changes, cotton production has declined and acres in this region are now mainly used for crops such as corn, soybeans and wheat. Current estimates for world production are about 25 million tonnes or 110 million bales annually, accounting for 2.5% of the world's arable land. India is the world's largest producer of cotton. The United States has been the largest exporter for many years. In the United States, cotton is usually measured in bales, which measure approximately 0.48 cubic meters (17 cubic feet) and weigh 226.8 kilograms (500 pounds).

Table 1.1: Top 10 Countries by Cotton Production

Rank	Country	Production (Tons)
1	India	6,188,000
2	China	6,178,318
3	United States of America	3,593,000
4	Pakistan	2,374,481
5	Brazil	1,412,227
6	Uzbekistan	1,106,700
7	Australia	885,100
8	Turkey	846,000
9	Argentina	327,000
10	Greece	308,000

Source: https://www.atlasbig.com/en-us/countries-cotton-production

1.5 Cotton Production in Bangladesh

Cotton cultivation in Bangladesh Cotton is growing mainly in south eastern zone. middle zone and northern part of Bangladesh. It covers 32 districts of Bangladesh mainly Kushtia, Chuadanga, Jhenaidah, Meherpur, Magura, Jessore, Rangpur and Thakurgaon.

After introduction of Chinese hybrid, cotton is the most economic crop in those areas. Now the total production is 150000 bales per year.In MY 2018/19 (Aug-July) planted area is forecast to rise to 44,000 hectares (HA) and production is raised by 2.4 percent to 128,000 bales assuming yield remains the same. More farmers in the cotton producing areas are slowly but steadily gaining interest in growing cotton as the prices are favorable.

The major constraint of cotton cultivation is the six months crop season. Farmers prefer short season crops which enables them to harvest more crops in a year. Although many farmers produce three crops in a year, some progressive farmers in different locations produce four crops in one crop calendar year. Therefore, selecting cotton for cultivation is not widely popular in Bangladesh. The Cotton Development Board (CDB) in Bangladesh is the only responsible organization to work with farmers on cotton area expansion through the provision of various supports, such as the production and distribution of seed, technology transfer through training, and research development. In MY 2017/18, cotton planted area is revised down to 43,000 hectares (HA), and production is forecast to reduce to 125,000 bales as some areas didn’t have suitable weather and/or land condition for planting at the right time. Bangladesh primarily produces American Upland (*Gossypium hirsutum*) and Tree (*Gossypium arboreum*) cotton that represent 95 and 5 percent of total production, respectively. Upland cotton is cultivated in the southwestern, northern, and central regions, while tree cotton is grown in three southeastern hill districts. The average length of Upland cotton is greater than 28 millimeters (mm); Tree cotton is less than 10 mm. Contacts report that American Upland cotton is currently growing in the hill region where food crop cultivation is limited. With the help of CDB, farmers are cultivating cotton along with rice and very slowly shifting from tobacco to cotton cultivation.

Table 1.2 Bangladesh: Area and Production of Raw Cotton

Fiscal Year*	Area Harvested (Hectare)	Production (Bales**)	Production (Tons)
2005/06	49,770	77,000	14,000
2006/07	42,100	70,530	12,824
2007/08	28,707	42,380	7,705
2008/09	32,600	50,600	9,200
2009/10	31,500	66,000	12,000
2010/11	33,500	80,000	14,545
2011/12	36,000	103,000	18,727
2012/13	39,000	129,000	23,455
2013/14	42,000	144,000	26,182
2014/15	42,700	152,534	27,675
2015/16	42,800	153,280	27,869
2016/17	42,850	156,509	28000

Source: Cotton Development Board (CDB), Government of Bangladesh
*Fiscal Year (July-June)
**1 bale = 400 lb

The Cotton Development Board (CDB) received approval from the National Committee on Biosafety to import a biotech (Bt) cotton variety and begin contained trials of four *Bt* cotton hybrid varieties. Bangladesh is almost entirely dependent on raw cotton imports. More than 40 percent of imported raw cotton and 80 percent of imported yarn and fabrics are used by spinning mills and the RMG sector to meet export demand. Makers of woven garments can add value ranging from 35 to 40 percent; value added in knitwear is even higher, but exports of woven garments earn a higher amount of foreign currency. Bangladesh has no import duties for polyester, viscose, acrylic, synthetic, and mod acrylic staple fibers.

Bangladesh cotton: Current scenario

- Second largest apparel producer of the world
- Bangladesh is the 5th largest raw cotton consumer in the world
- 2nd countries highest raw cotton importer of the world
- Raw cotton import from-Uzbekistan, India, USA, other CIS and some African
- Quality of domestic cotton is equivalent to CIS and Indian cotton
- Hybrid cotton has been introduced and Bt cotton introduction is under process (Global Cotton Summit Bangladesh 2015).

1.6 Justification of the study

The Cotton Development Board (C'DB) has plans to increase the area planted to 50.000 hectares by the year 2005. Potential yields are not yet obtained and the current cotton production output can only meet about 10 - 15% of the requirements of the domestic market. It is stated that cotton is the valuable cash and fiber crop of Bangladesh. In Bangladesh, approximately 80.000 small-scale farmers with average holdings of 0.5 hectare produce cotton. Almost all cotton is grown as rain fed crop. In 1999. The total cotton areas reached 36,450 hectares. In the world, Bangladesh is the second largest country in textile sector. To fulfill the demand of these huge textile sector, Cotton Development Board, the only Government body for providing technological support to the cotton farmers is capable a little to supply raw cotton(2-3%) of the total demand. So, Bangladesh expends a huge money (12-15 thousand crore Tk.) to collect raw cotton from foreign countries. To save this huge money, cotton cultivation in Bangladesh must be increased. But increasing of cotton cultivation depends on raising the yield per unit area. Because yield is the most important parameter to sustain the long durable crops, cotton.

So the research thinking and effort is determined to produce more cotton by increasing its yield from less land. Thus, area of cotton should be increased. In this way the farmers will not only be benefited, but also they would be able to play a vital role in the national economic development. But different problems act adversely in the cultivation of cotton. It is therefore, urgently necessary to devise ways and means to increase cotton cultivation through identifying the problems and by minimizing the problems.

The findings of the study are expected to be useful to the planners, research personnel and extension workers in planning and execution of cotton extension programs in a better way.

1.7 Specific Objectives

- To study the socio-economic status of cotton cultivators status of Bangladesh
- To estimate the profitability & technical efficiency of varieties of cotton
- To observe recent developments in cotton production and protection technologies and take necessary initiatives
- To identify the production constraints associated with production of cotton

1.8 Limitation of the study

In this study, no reference is made for factors like risk and uncertainties. Only those factors have been considered which are under the control of the entrepreneurs and contribute significantly towards the returns.

The study is limited to Kushtia district, comprising of limited selected farmers. This was due to the fact that large area was beyond the capacity and control of the investigator; hence, it may be treated as micro study. The primary data collected for the study are entirely based on memory of the respondents, as they do not keep any records regarding the farm practices. It is only micro study; so generalized results could not fulfill to solve the constraints of cotton production in wider cotton producing areas.

1.9 Setup of the thesis

This thesis has been divided into five chapters including the present chapter which consists of introduction and objectives of the study. A review of literature of work done in the past is given in Chapter- II, Chapter-III deals with material and methods. The results and discussion are presented in Chapter- IV and Chapter- V includes summary, conclusion and suggestions for future research work.

CHAPTER-2
REVIEW OF LITERATURE

This section deals with a brief review of previous studies relating to the present investigation. In Bangladesh, considerable numbers of research studies were conducted on cotton farming. Nevertheless, very few systematic and comprehensive studies were conducted on cotton IPM both in nationally and internationally. This point played a contributory role to the researcher to conduct a study on the economic and at the same time on the environmental impact of cotton IPM farming. However, the related findings directly or indirectly allied were carefully reviewed for strengthening the results of the study.

Odedokun (2014) in his study on economic analysis of cotton production and supply trend estimation in Zamfara State, Nigeria using net farm income method revealed that the net farm income realized was N64,419.33 when only hired labour was valued. When both family and hired labour were valued the estimated net farm income becomes reduced to N51, 414.51.

Odedokun (2014) derived the sum of elasticity from Cobb-Douglas equation as 0.791 in Zamfara State, Nigeria. This is positive decreasing return to scale at stage II of production process where every farmer strives to maximize profit and minimize cost of production. On cotton farmers‟ technical efficiency indices, the result from the study in Zamfara State showed the maximum technical efficiency score index was 0.97 with a mean technical efficiency index of 0.67. This showed that output falls by 23% due to farmers‟ technical inefficiency similarly, the result revealed a maximum allocative efficiency score index was 0.97 and the mean allocative efficiency score index was 0.64 in cotton production This implied that cotton farmers‟ output fall by 36% due to farmers‟ allocative inefficiency in Zamfara State. The farmers‟ mean economic efficiency score index was 0.44 with the minimum being 0.01 while the maximum economic efficiency score was 0.81. The result showed that farmers‟ output fall by 56% due to economic inefficiency.

Engla (2013) reported that cost of cultivation of cotton was estimated and found that the average cost and the other measurement of farm profit like net income was found to be an average of Rs.12358 per hectare in case of cotton in India.

Khadi (2010) reported that India holds the unit distinction of being the only county in the world that grows all the four cultivated species of cotton and there hybrids in the vast divers agro-climatic situations prevailing across the length and breadth of the country cotton is grown in the country on different holdings with varied planting dates, soil and water conditions largely under rainfed situations. Sustainability of production, requisite quality standards and rising cost of cultivation, pest management and environmental implications, defective irrigation practices, unstable production and widespread complains on deterioration of fiber quality are some of the serious challenges for the scientist, developmental staff, field functionaries and the cotton growers to achieve this, scientists worldwide are working to meet serious scientific challenges.

Kumar (2010) reported that cotton is the major fiber crop of the world. Cotton is well known for the excessive consumption of pesticides used to manage a plethora of insect pests and also because of the commercial importance of the crop. A variety of lepidopteron pests attack the crop, the major ones being cotton bollworm (Helicoverpa armigera), pink bollworm (Pectinophora gossypiella), spotted bollworm (Earis spp.) and tobacco caterpillar (Spodoptera litura). It is imperative to adopt ecofriendly technologies to manage insect-pest and drastically reduce the consumption of pesticides towards a safe and sustainable agriculture. Such technologies should be very effective against target pests at low concentrations and concomitantly innocuous to mammals, other vertebrates and environment in general.

Narayanamoorthy (2010) reported that there is a need to find out the ways and means to convince the farmers about the economic and social feasibility of micro-irrigation for cotton cultivation.

Allawa (2008) reported that the study shows that cost A1, the average cost of Bt.cotton cultivation per hectare found to Rs.12389.00. The lowest cost A1 was found in low adoption level of technology, due to minimum use of operational inputs in the production process. This cost was gradually increased with the increase in the different level of technology on sample respondent’s farms respectively. The minimum average cost A1 found to Rs.9943.0 for low level technological status followed by Rs. 12387.0 for moderate and Rs.14837.0 for high technological adoption level per hectare respectively.

Singh and Sidhu (2007) reported that a good marketing system is essential for the success of the cotton production program. The production of quality seed will be of no use if it dose not reach the farmers in time.

Palvi (2006) reported that the overall profitability (input output ratio) of Btcotton obtained on the three categories of farm, large farms were observed to be more profitable because of their most favourable input output ratio, at 1:1.87 small farms received lowest profit and could achieve the input output ratio of only 1:1.74 among the two varieties (Rasi-2 and mahyco-162) of Bt-cotton Rasi-2 was found to be most profitable when compared with the Mahyco-162 varieties .The overall profitability for Rasi-2 and Mahyco-162 was estimated,1:1.80 and 1:1.65 respectively.

Visawadia *et al.* (2006) revealed that the total cost per hectare is higher in Bt.cotton than hybrid cotton. The cost of seed has been found higher in Bt.cotton whereas hybrid cotton growers incur more cost on insecticides/ pesticides. This shows the effectiveness of the new technology (Bt.cotton) for insect resistance. The average total costs of production as well as the bulk line cost have been found lower in Bt.cotton. This depicts a reduction in the unit of cost of Bt.cotton, which is the distinct advantage of the new technology. A higher yield of 29 per cent has been obtained by the Bt.cotton farmers over the hybrid cotton growers. The study has identified the constraints in production, and marketing of Bt.cotton in the area. Bt.cotton has been found a superior technology to hybrid cotton, as it gives higher yield and has low cost of production.

Carriere *et al.* (2005) revealed that fitness costs associated with insect resistance to transgenic crops producing toxins from Bacillus thuringiensis (Bt) reduce the fitness on non-Bt refuge plants of resistant individuals relative to susceptible individuals. Because costs may vary among host plants, choosing refuge cultivars that increase the dominance or magnitude of costs could help to delay resistance. Specifically, cultivars with high concentrations of toxic photochemical could magnify costs.

Naik *et al.* (2005) observed that the technology generates overall economic benefits on average, but heterogeneity among farmer needs to be accounted for. The study also finds that germplasm effects can play an important role. For example, if the germplasm into which the Bt gene is incorporated is more susceptible to drought than a locally adapted cultivar, the Bt hybrid will underperform in a dry spell.

Bennett *et al.* (2004) reported substantial and significant financial benefits to smallholder cotton growers of adopting Bt. cotton in terms of increased yields, lower insecticide spray costs and higher gross margins.

Bennett *et al.* (2003) revealed that cost savings emerged in the form of lower requirements for pesticide, but also important were reduced requirements for water and labour. The increasing adoption rate of Bt.cotton appears to have a health benefit measured in terms of reported rates of accidental insecticide poisoning. Bt.cotton growers emerge as more resilient in absorbing price fluctuations.

Gouse *et al.* (2003) stated that both large-scale and small-scale farmers enjoy financial benefits due to higher yields and despite higher seed costs. In addition, those who adopted the technology appear to be more technically efficient than those who do not adopt, indicating that it is perhaps the better farmers who spot the potential benefits of the Bt cotton seed.

Beyers *et al.* (2002) observed that average yield per hectare and per kilogram of seed was higher for adopters than for non-adopters. Bt. adopters suffered far less of a fall in yields than those who did not adopt. As yields and gross margins are partial measures of efficiency, deterministic and stochastic efficiency frontiers were measured. Both methods confirm the farm accounting results, showing that Bt.cotton adopters were more efficient.

David and Sai (2002) revealed that considerations of yield are still the primary concern in Bt.cotton adoption; damage to crop due to bollworm is considerably less in Bt.cotton than in non-Bt.cotton only under severe past attack; there is not much reduction in pesticide expenditure because farmers still do not distinguish between

Bt and non-Bt.cotton; none of the farmers are opposed to Bt.cotton on technical considerations.

Ismael *et al.* (2002) revealed that average yield per hectare and per kilogram of seed was higher for adopters than for non-adopters of Bt.cotton. The increase in yields and reduction in chemical application costs outweighed the higher seed cost, so that gross margins were also considerably higher for adopters. The farm accounting results, showing that the Bt.cotton adopters were considerably more efficient than those who used the non-Bt varieties.

Ismael *et al.* (2002) suggested that Bt.cotton had higher yields than non-Bt varieties and generated greater revenue. Seed costs for Bt.cotton were double those of non-Bt, although pesticide costs were lower. On balance, the gross margins (revenue minus costs) of Bt growers were higher than those of non-Bt growers.

Pray *et al.* (2002) revealed that over 4 million smallholders have been able to increase yield per hectare, and reduce pesticide costs, time spent spraying dangerous pesticides, and illnesses due to pesticide poisoning. Returns are high for adopters of Bt.cotton to make substantial gains in net income.

Yousouf *et al.* (2002) explored the economic benefits of the adoption of Bacillus thuringiensis (Bt) cotton for smallholder farmers in the Republic of South Africa. The study found reason for cautious optimism in that the Bt variety generally resulted in a per hectare increase in yields and value of output with a reduction in pesticide costs. They suggest that Bt.cotton is good for smallholder cotton farmers and the environment.

Hubbell *et al.* (2000) examined the potential demand for Bt.cotton in the Southeast from information gathered in the first year of commercialization. It combines revealed preference (RP) data on adoption of Bt.cotton varieties with stated preference (SP) data on willingness to adopt to estimate demand using a double-bounded maximum likelihood procedure. Using estimated demand equations, the costs of reducing conventional insecticide application through, the cost subsidization of Bt.cotton are simulated. Results indicate that reducing cotton insecticide applications by 40 per cent in Southeast USA Would require a $ 53 million and $ 60 million.

Bell ***et al.*** **(1999)** observed that insect populations generally increased in the absence of insecticide sprays. Bt.cotton worked well to control tobacco budworm [Heliothis virescens] and performed well against bollworm. The pyrethroid treatment significantly reduced the bollworm population. In addition, Tracer and the pyrethroid treatments numerically reduced the fall armyworm populations.
Capps *et al.* (1999) reported that Bt.cotton (transgenic Bacillus thuringiensis) varieties are becoming a very important part of the cotton industry. Understanding this technology and knowing how to manage Bt. cotton varieties could improve cotton pest management and increase both profits and yields. Timely insecticide treatments to Bt.cotton when insect pests reach economically damaging levels provide yield protection.

Farkade ***et al.*** **(1999)** studied the constraint for the biological control of cotton pests in Marathwada, Maharashtra, India, in 1997-98 by surveying cotton growers in the area, lack of knowledge about natural enemies of insect pests present in the cotton filed was expressed by 74.17 per cent of cultivators. About 50 per cent of respondents were constrained by the low price of cotton, non-availability of labour and lack of knowledge about bio-agents/parasites for the control of particular insect pests.

Morris et.al. (1996) showed that when inputs and outputs were assigned economic prices,
wheat production represents the most efficient use of domestic resources in most nonirrigated zones and in one irrigated zone in Bangladesh. Shahabuddin (2000) concluded that Bangladesh had comparative advantage in the production of most of the crops.

Basu ***et al*****. (1992)** reported that the cotton is a labour intensive crop. Risks are high in rainfed cotton from unfavorable rainfall distribution and drought and input use related to field increase influenced by weather factors. Cotton crops are affected serious from pests and diseases, which cause 20-30 per cent loss annually.

They also revealed that seed cost of hybrid cotton’s is high. Rainfed cotton yield are far lower compared to irrigate. Average plant protection costs on total cultivation charges is estimated at 25-40 per cent in irrigated crop and about 10-15 per cent in rainfed cotton depending on pests incidence, management strategies, input cost and cotton prices.

Biswas (1992) in his study identified farmers' problems in cotton cultivation. Non availability of quality seed in time, unfavorable and high cost of fertilizer and insecticides, lack of operating capitals, not getting fair weight and reasonable price according to grade, lack of technical knowledge, lack of storage facility, stealing from field, and late buying of raw cotton by Cotton Development Board were identified as major problems of cotton in Jashore District.

Mannikar *et al.* (1992) examined the low productivity of cotton in rainfed regions of India. Study reported the cause of low productivity of cotton and classified as follows poor climate, unsuitable soils, inferior plant type and under cultivation of certified seed, plant population, limited weed control, nutrients management high incidence of pest and diseases, non-availability if input and storage, price and marketing inadequacies policies are suggested in the light of the analysis.

Chander and Sharma (1990) revealed that the main problems of potato cultivation were ignorance about improved cultivars and cultivation practices, ignorance about scientific method of sowing, lack of guidance of marketing potato, high cost of improved cultivars, high cost of fertilizers, pesticides and irrigation, lack of enough space for storing potatoes scientifically.

Ramamoorthy (1990) reported that the farmers are highly price responsive. Therefore, a stable cotton price policy holds the key for cotton production and productivity. In order to increase the profitability of the cotton-crops, steps may be taken to reduce the cost of production by increasing the yield. The efficiency of vital input like seed, fertilizer and pesticides may be improved as to reduce the cost through increased yield. The overall average yield per hectare was 8.18 quintals and cost of production rupees per hectare and cost of production rupees per quintals of seed cotton in India were Rs.6,100 and Rs. 753 respectively in 1986-87. Low income discourages the use of modern production technologies and act as disincentive to produce more

.

Kher and Halyal (1988) regarding cotton cultivation technology were an irregular and insufficient electricity supply, small size of holding for green manuring, inconvenience of intercropping due to weeds, high cost of farm fuel, scare irrigation facilities. absence of location, specific recommendations for ear thing up, lack of drought resistant varieties and lack of technical knowledge about plant protection and chemical fertilizers.

Talukder et. Al. (1985), Wheat, mustard and cotton were more profitable than pulses, gram etc. in Jashore. But tobacco is more profitable than cotton though its cost of production is more than double compared to cotton.

Reddy (1997) conducted a study in Guntur District Andhra Pradesh, India to investigate yield gaps and the economics of cotton cultivation on small, medium and large farmers and 126 sample farms for the agricultural year 1993-94. The findings indicate that: (1) Farm size was positively related to total costs and net returns; (2) The yield gap between the research station farms and sample farms was the highest, followed by the yield gap between demonstration farms and sample farms and research station farms and demonstration farm and these were also related to farm size" (3) large farmers have benefited more from the adoption of technological innovation than small and medium farmers; (4) the major factors contributing to yield gap were the gap in the use of nitrogen, phosphorus, human labour, bullock labour and seeds, and excessive use of pesticides; and (5) the major constraints for exploitation of yield potential were identified as lack of technical guidance, pest incidence, lack of owned capital, high cost of inputs and non-remunerative, lack of owned capital, high cost of inputs and non-remunerative prices. The results imply that the yield on actual farms could be increased by 50 per cent over its existing level (12Q/ha) by supplying key inputs at subsidized rates, providing technical guidance's and institutional credit at reasonable interest rates, making available irrigation water based on regional crop planning remunerative output pricing, and streamlining the existing extension system for effective transfer of technology. These strategies could also reduce income inequalities among the various size groups of farms.

Research Gap

To build a hunger and poverty free Bangladesh has given high priority to both agriculture and industrialization. These vision was that apart from poverty alleviation, agriculture would also provide raw materials for the industrial sector. Rightly realized that the cotton-based industry would play a vital role in Bangladesh economy in present to future.In order to support the textile industries, established the Cotton Development Board on December 14, 1972. Cotton value chain, linking from farm to fashion, in Bangladesh is now well established. Ginners' procured seed cotton from the farmers. Seed cotton contains seed and fiber. In the ginning process seed and fiber are separated. Fiber used in the spinning industries for making yarn and seed is crushed to edible oil and oilcake. Oilcake used for animal/poultry feed. Indeed, cotton became a model crop in Bangladesh considering the agriculture contribution to industry which also created employment opportunities for millions of people particularly for the women. The demand of cotton fiber for mill use in Bangladesh is increasing day to day. To meet the ever increasing demand of cotton fiber by our textile sector, technological innovation is utmost necessary for bridging the gap in cotton research and development needs.

CHAPTER 3

METHODOLOGY

3.1 Introduction

The word method originates from the Greek words meta and hodos which mean "a way" and methodology is thus defined as "the underlying principles and rules of organization of a philosophical system and inquiry procedure" (Amin, 2013). The methodology of the study is adopted by various steps to select the best method fit to attain the set objectives of research. Methodology is not a formula but set of practices. This chapter deals with the methodology used for the study which included the selection of study area, selection of samples, collection of data and analytical techniques. The farm management study usually involves with the collection of information on individual farmers. The reliability of a scientific research depends to a great extent on the appropriate methodology used in the research. The design of any survey is pre-dominantly determined by the nature, aims and objectives of the study. This study was based on field level data where primary data were collected from different cotton producers. There are several methods of collecting this basic information. For the present study farm survey method was adopted for collecting the primary data. The word "survey" refers to a method of study in which an overall picture of a given universe is obtained by systematic collection of all available data on the subject. There are three methods by which farm survey data can be gathered (Dillon and Hardaker 1993). These are:

i. Direct observation

ii. Interviewing respondents, and

iii. Records kept by the respondents

Since the farmers of Bangladesh do not usually maintain records and accounts of their farm operations, the second method was followed to achieve the objectives of this study. The survey method has advantages over other methods. This method is less expensive and its coverage is much wider. However, survey method is not free from drawbacks.

The drawback of this method is to rely on the memory of the respondents. To overcome this problem, repeated visits were made to collect data in the study area and in the case of any omission or contradiction; the farmers were revisited to obtain the missing and/or correct information. The selection of the study area, period of the study, sampling technique and sample size, preparation of the survey schedule, data entry and processing, and analytical techniques are given in the following section:

3.2 Selection of the Study Area

The selection of the study area is an important step for farm management or production economics study and such a study usually requires selection of an area for collecting data in accordance with the objectives set for the study. The area in which a farm business study is to be made depends on the particular purposes of the survey and possible cooperation from the farmers.

The present study was conducted in Kushtia district. As Kushtia is my birthplace so I had selected this area for easy accessibility, time and resources constraints. Apart from these, although a lot of production economics studies were conducted on different region of Bangladesh specially on Jessore,S atkhira, Narail,Jhenidah,Meherpur,Rajbari, Chuadanga and CHITTAGONG HILL TRACTS etc. There were hardly any research conducted on Kushtia district. So I made an attempt to analyze the profitability of cotton production and socio economic condition of cotton growers. Eight villages of 3 upzila under Kushtia district namely Bheramara, Daulatpur and Mirpur were selected. The main reasons for selecting the villages were as follows:

i. These villages had some identical characteristics e.g. homogeneous soil type, topographical and climatic conditions those are favorable for producing cotton

ii. The study areas were well communicated with researcher's house that helped her in data collection. It was also easier and less expensive to collect data from that area

iii. The large number of respondents and reliable sources of data were expected to

Obtain under these study areas

iv. Accessibility to the area is good due to developed communication system. Before selection of the study areas, the researcher made a few visits in these villages to get her acquainted with the characteristics of the farmers and more specially to know the cultural practices of cotton production.

3.3 Selection of Sampling Technique

The main purpose of sampling is to select a small group which will represent a reasonably true picture of the population. In selecting samples for a study two factors need to be taken into consideration. The sample size should be as large as to allow for adequate degrees of freedom in the statistical analysis. On the other hand, administration of field research, processing and analysis of data should be within the limitation imposed by physical, human and financial resources (Mannan, 2001). Because of diversity in the technical and human environment, it is necessary to several numbers of the population before any conclusion can be drawn. Therefore, the purpose of sampling is to select a sub-set of the population that is representative of the population (Rahman, 1993). The term 'population' refers to the households, the farms etc. where a sample is representative under a study. In this study a purposive random sampling technique was applied. At first, Kushtia district which is in Khulna division of Bangladesh was selected purposively. After that, among 3 upazillas in Kushtia district namely Bheramara, Daulatpur and Mirpur were selected through purposive random sampling. These upazillas are divided into several unions. Union wise information for the specified vegetable of each union have been taken from the upazilla office of the DAE for selecting the union. The unions have also been selected based on the highest concentration of cotton production, among highly concentrated cotton produced villages under some unions were randomly selected.

3.4 Sample Size

It was not possible to include all the farmers in the study area due to limitation of time, money and personnel. Here a reasonable size of sample was taken into account to satisfy the objectives of the study. In total 30 for each variety total 60 farmers were selected to achieve the ultimate objective of the study. To get the desired sample at first the list of cotton producers were collected from the agricultural extension officer of the selected upazilla agricultural office. It was found that more than 250 farmers of the selected study area had grown cotton. The next task was to identify small farmers (having land 0.05 to 2.49 acres) who cultivated cotton minimum for three years. Out of 200 farmers

100 farmers were identified as small farmer who cultivated cotton minimum for 3 years. Then a total of 60 farmers were randomly selected from the selected villages.

Table 3.1 Sample Distribution

SL. No,	Variety	Number of Respondents
1	Hybrid	30
2	Local	30

Source: Field Survey, 2020

3.5 Preparation of Survey Schedule and Pre-testing

Preparation of the survey schedule is very important in any farm management or production Economics study (Amin, 2013). The main consideration in this respect is to obtain reliable data from the respondents for the preparation of a suitable survey schedule. In conformity with the objective of the study a draft survey schedule was prepared in such a way that reliable data could be collected from the farmers. Then the draft schedule was tested and attention was paid for inclusion of new information which was not included in the draft schedule. The draft survey schedule was pre-tested by researcher herself. The draft survey was conducted among 5 cotton producers of small farmers in selected area. Thus the draft schedule was improved, rearranged and modified in the light of the actual and practical experience gained during the pretest. After making necessary adjustment a final survey schedule was developed in logical sequence.

The final schedule included the following information parts:

i. General information of respondents
ii. Respondent's socio-demographic information
iii. Farm holding status of the respondents
iv. Information about cotton production
v. Respondent's opinion

The first part of the questionnaire contained respondent's identification, village and union name. Second part contained information about respondent's socio-economic conditions, their age, sex, education, occupation, income etc. Different code was used for this purpose. This part also contained questions about respondent's family member's source of income, education, occupation etc. The third part provided the farm holding status of the farmers such as the information on homestead land, owned land, land given to others, land taken from others etc. The fourth part contained the cotton production related information such as the unit cost of inputs and the price and quantity of output. The last part of the questionnaire contained respondent's perception regarding impact of cotton production in socio economic status of the farmers and constraints faced by them to cotton production.

3.6 Period of the Study

The researcher herself collected necessary data through personal interviews with the selected farmers. Data were collected during the period from **1 March to 15 April 2020**.Data relating to inputs and outputs involved in the production of cotton were collected by visiting the study area during this period.

3.7 Collection of Data and Accuracy of Data

Collection of accurate and reliable data and other necessary information from the field is not an easy task. It must be done properly since the success of the survey depends on the reliability of data. The researcher herself collected the relevant data from the farmers through face to face interview. Data was collected according to the structured questionnaire and face to face interviews had been carried out by paper and pencil.

After fixing the survey schedule, the researcher herself stayed in the respective area and collected the primary data from individual households. Before conducting actual interviews, the whole academic purpose of the present study was clearly explained to the respondents. Initially, the farmers hesitated to answer the questions but when they were assured that the study was purely an academic one and it would not affect them adversely then they were cooperative with the researcher. Farmers were requested to provide correct information as far as possible. Usually, the respondents do not keep records of daily/ annual transactions of their activities. Hence, it was very difficult to collect actual data and the researcher has to rely on the memory of the respondents. Questions were asked systematically in a simple manner and explanation was made whenever felt necessary. After each interview was over, the schedule was checked so as to ensure that information to each item had properly recorded. If there were such items which was over looked or contradictory were corrected by another interview. In order to minimize the errors, data were collected in local unit and later those were converted into standard international units. In the case of any inconsistency and lapses, the neighboring farmers were asked for necessary verification and data were checked and corrected through repeated visits.

3.8 Entry and Processing of Data

For the sake of consistency and completeness each survey schedule was verified after data collection. For proper editing the filled interview schedules were sorted, scrutinized and checked to avoid inconsistency. The data were then transferred from the interview schedule to MS Excel sheet and analysis was done.

3.9 Analytical Technique

Data were analyzed with a view to achieving the objectives of the study. Several analytical methods were employed in the present study. Tabular method was used for a substantial part of data analysis. This technique is intensively used for its inherent quality of purporting the true picture of the farm economy in the simplest form. Relatively simple statistical techniques such as percentage and arithmetic mean or average were employed to analyze data and to describe socioeconomic characteristics of cotton growers, input use, costs and returns of cotton production and to calculate undiscounted benefit cost ratio (BCR).

In order to estimate the level of technical efficiency in a manner consistent with the theory of production function, Cobb-Douglas type stochastic frontier production function was used in the present study.

3.9.1 Profitability Analysis

The net returns of cotton were estimated using the set of financial prices. The financial prices were market prices actually received by farmers for outputs and paid for purchased inputs during the period under consideration in this study. The cost items identified for the study were as follows-

- ✓ Land preparation
- ✓ Human labor
- ✓ Seedlings

- ✓ Urea
- ✓ TSP
- ✓ MoP
- ✓ Gypsum
- ✓ Zinc
- ✓ Liam
- ✓ Insecticide
- ✓ Irrigation
- ✓ Interest on operating capital
- ✓ Land use

The returns from the crops were estimated based on the value of main products. In this study variable cost, fixed cost and total cost had been described. Total variable cost (TVC) included land preparation, human labor, seedlings, organic manure, urea, TSP, MoP, insecticides, irrigation and interest on operating capital. Fixed cost (FC) included only rental value of land. Total cost (TC) included total variable cost and fixed cost.

Cost of Land Preparation

Land preparation considered one of the most important components in the production process. Land preparation for cotton production included ploughing, laddering and other activities needed to make the soil suitable for planting seedling. It was revealed that the number of ploughing varied from farm to farm and location to location.

Cost of Human Labor

Human labor cost was considered one of the major cost components in the production process. It is generally required for different operations such as land preparation, sowing and transplanting, weeding, fertilizer and insecticides application, irrigation, harvesting and carrying, threshing, cleaning, drying, storing etc. In order to calculate human labor cost, the recorded man-days per hectare were multiplied by the wage per man-day for a particular operation.

Cost of Seed

Cost of seed varied widely depending on its quality and availability. Market prices of seeds of respected cotton were used to compute cost of seed. The total quantity of seed needed per hectare was multiplied by the market price of seed to calculate the cost of seeds for the study areas.

Cost of Urea

Urea was one of the important fertilizers in cotton production. The cost of urea was computed on the basis of market price. In order to calculate cost of urea the recorded unit of urea per hectare were multiplied by the market price of urea.

Cost of TSP

The cost of TSP was also computed on the basis of market price. In order to calculate cost of TSP the recorded unit of TSP per hectare were multiplied by the market price of TSP.

Cost of MoP

Among the three main fertilizers used in cotton production, MoP was one of them. To calculate the cost of MoP per hectare, the market price of MoP was multiplied by per unit of that input per hectare for a particular operation.

Cost of Gypsum

The cost of gupsum was also computed on the basis of market price. In order to calculate cost of gypsum the recorded unit of gypsum per hectare were multiplied by the market price of gypsum.

Cost of Zinc

The cost of Zinc was also computed on the basis of market price. In order to calculate cost of Zinc the recorded unit of Zinc per hectare were multiplied by the market price of Zinc.

Cost of Liam

The cost of Liam was also computed on the basis of market price. In order to calculate cost of Liam the recorded unit of Liam per hectare were multiplied by the market price of Liam.

Cost of Insecticides

Farmers used different kinds of insecticides for 5-7 times to keep their crop free from pests and diseases. Cost of insecticides was calculated based on the market price of the insecticides which was used in the study areas per hectare.

Cost of Irrigation

Water management helps to increase cotton production. Cost of irrigation varies from farmers to farmers. It was calculated based on how many times irrigation was needed per hectare and what was its cost.

Interest on Operating Capital

Interest on operating capital was determined on the basis of opportunity cost principle. The operating capital actually represented the average operating cost over the period because all costs were not incurred at the beginning or at any single point of time. The cost was incurred throughout the whole production period;

Hence, at the rate of 12 percent per annum interest on operating capital for four months was computed for cotton. Interest on operating capital was calculated by using the following formula:

IOC= AIit

Where,

IOC= Interest on operating capital

i= Rate of interest

AI= Total investment / 2

t = Total time period of a cycle

Land Use Costs

Land use cost was calculated on the basis of opportunity cost of the use of land per hectare for the cropping period of four months. So, cash rental value of land has been used for cost of land use.

Calculation of Returns

Gross Return

Per hectare gross return was calculated by multiplying the total amount of product and by-product by their respective per unit prices.

Gross Return= Quantity of the product * Average price of the product + Value of by-product.

Gross Margin

Gross margin is defined as the difference between gross return and variable costs. Generally, farmers want maximum return over variable cost of production. The argument for using the gross margin analysis is that the farmers are interested to get returns over variable cost. Gross margin was calculated on TVC basis.

Per hectare gross margin was obtained by subtracting variable costs from gross return. That is,

Gross margin = Gross return – Variable cost

Net Return

Net return or profit was calculated by deducting the total production cost from the total return or gross return. That is,

Net return = Total return – Total production cost.

Undiscounted Benefit Cost Ratio (BCR)

Average return to each taka spent on production is an important criterion for measuring profitability. Undiscounted BCR was estimated as the ratio of total return to total cost per hectare.

BCR = Total return (Gross return)/ Total cost

3.9.2 Technical Efficiency Analysis

Technical efficiency refers to the ability of a firm to produce the maximum possible output from a given set of inputs and given technology. A technically efficient farm will operate on its frontier production function. Given the stated relationship the firm is technically efficient if it produces on its outer-bound production function to obtain the maximum possible output which is feasible under the current technology. Putting it differently a firm is considered to be technically efficient if it operates at a point on an isoquant rather than interior to the isoquant. The homogeneity of inputs is a vital factor for achieving technically efficient output.

No one would dispute that the output produced from given inputs is a genuine measure of efficiency, but there is room for doubt whether, in a particular application, the inputs of a given firm are really the same as those represented by the corresponding point on the efficient isoquant. But it is important to note that mere heterogeneity of factors will not matter, as long as it is spread evenly over firms, it is when there are differences between firms in the average quality (or more strictly, in the distribution of qualities) of a factor, that a firm's technical efficiency will reflect the quality of its inputs as well as the efficiency of its management.

3.9.2.1 The Stochastic Frontier Models

The most widely discussed, theoretically reasonable and empirically competent method of measuring efficiency is the stochastic frontier model. It is an improvement on the traditional average production function and on all types of deterministic frontiers in the sense that it introduces in addition to one-sided error component a symmetric error term to the model. This permits random variation of the frontier across farms, and captures the effects of measurement error, other statistical noise arid random shocks outside the firm's control. A one-sided component captures the effects of inefficiency relative to the stochastic frontier. The stochastic frontier model is also called the 'composed error' model introduced by Aigner, Lovell and Schmidt (1977). It was later extended and elaborated by Jondrow *et al*. (1982).

The notion of a deterministic frontier shared by all farms ignores the very real possibility that a farm's performance may be affected by factors entirely outside its control (such as poor machine performance, bad weather, input supply breakdowns, and so on), as well as by factors under its control (inefficiency). But stochastic frontiers consider all the factors while estimating the model and accordingly it separates firm-specific efficiency and random error effect. Thus, the efficiency measurements as well as the estimated parameters are unbiased.

3.9.2.2 The Stochastic Frontier with Cobb-Douglas Production Function

The Cobb-Douglas production function is probably the most widely used form for fitting agricultural production data, because of its mathematical properties, ease of interpretation and computational simplicity (Heady and Dillion, 1969; Fuss and Mcfadden, 1978).

The Cobb-Douglas function has convex isoquants, but as it has unitary elasticity of substitution; it does not allow for technically independent or competitive factors, nor does it allow for Stages I and III along with Stage II. That is, MPP and APP are monotonically decreasing functions for all X- the entire factor-factor space is Stage II- given $0 < b < 1$, which is the usual case.

However, the Cobb-Douglas may be good approximation for the production processes for which factors are imperfect substitutes over the entire range of input values. Also, the Cobb-Douglas is relatively easy to estimate because in logarithmic form it is linear in parameters; it is parsimonious in parameters (Beattie and Taylor, 1985).

A stochastic Cobb-Douglas production frontier model may be written as

$$Y_i = f(X_i,\beta)\ \exp.(V_i-U_i)\quad i = 1, 2, 3, \ldots\ldots\ldots.., N \quad \text{----------------- (1)}$$

Where the stochastic production frontier is f(Xi,β)exp.(Vi), Vi having some symmetric distribution to capture the random effects of measurement error and exogenous shocks which cause the placement of the deterministic kernel f(Xi,β) to vary across firms.

The technical inefficiency relative to the stochastic production frontier is then captured by the one-sided error component $Ui > 0$.

The explicit form of the stochastic Cobb-Douglas production frontier is given by

$$Y_i = \alpha X_{1i}^{\beta1}\ X_{2i}^{\beta2}\ X_{3i}^{\beta3}\ X_{4i}^{\beta4}\ X_{5i}^{\beta5}\ X_{6i}^{\beta6}\ X_{7i}^{\beta7}\ e^{ui} \quad \text{------------------- (2)}$$

Where Y is the frontier output, X is physical input, b the elasticity of Y with respect to X, a is intercept and Ɛ = V-U is a composed error term as defined earlier. For simplicity, we have ignored the subscript.

3.9.2.3 Specification of Production Model

We have specified the Cobb-Douglas Stochastic Frontier Production Function in order to estimate the level of technical efficiency. The functional form of stochastic frontier is as follows:

$$\text{In } Y = \ln a + b_1\ln X_1 + b_2 \ln X_2 + b_3\ln X_3 + b_4\ln X_4 + b_s\ln X_5 + U_i \quad \text{-------------- (3)}$$

The above function is linearized double-log form:

Y = Return per hectare (Tk/ha);

In a = Intercept of the function;

X_1 = Cost of human labor (Tk/ha)

X_2 = Cost of Urea (Tk/ha);

X_3 = Cost of TSP (Tk/ha);

X_4 = Cost of MoP (Tk/ha);

X_5 = Cost of Gypsum (Tk/ha);

X_6 = Cost of Irrigation (Tk/ha);

X_7 = Cost of Insecticide (Tk/ha);

b_1, b_2 .... b_7= Coefficients of the respective input to be estimated; and

Ui = Error term.

The model of the technical inefficiency effects in the stochastic production frontier equation is defined by

$Vi = \delta_0 + \delta_1 Z_1 + \delta_2 Z_2 + \delta_3 Z_3 + \delta_4 Z_4 + \delta_5 Z_5 + \delta_6 Z_6 + W_i$ ----------------------- (4)

Where,

Z_1…….. Z_6 are explanatory variables.

The equation can be written as:

$V_i = \delta_0 + \delta_1$ Farm size + δ_2 Respondent Age + δ_3 Respondent Education + δ_4 Training + δ_5 Cotton farming experience + δ6 Market distance+ W_i

V is two-sided uniform random variable beyond the control of farmer having N (0, σ 2) distribution, U is one-sided technical inefficiency effect under the control of farmer having a positive half normal distribution $\{V_i \sim |N(0, \sigma u2)|\}$ and W_i is two-sided uniform random variable. W is unobservable random variable having a positive half normal distribution. The model was estimated simultaneously using STATA and MS excel.

CHAPTER 4
DESCRIPTION OF THE STUDY AREA

4.1 Introduction

This chapter presents a brief description of the study area. Knowledge of the study area is very essential to understand the location, physical features and topography, soil type, temperature, rainfall, agricultural and economic condition, population, education and other socioeconomic infrastructure available in the area. This chapter aims at present the above-mentioned characteristics of the study area.

4.2 Location

Kushtia is a district of Khulna Division and is situated on the western part of Bangladesh. Before the partition of India, Kushtia was a part of Nadia District under Bengal Province. The district was created in 1947 with the partitioning of India and Pakistan. At that time, Kushtia was consisted of the Kushtia Sadar (Kushtia City), Chuadanga and Meherpur subdivisions.Later on,each of these subdivisions was converted to a separate district. It is generally believed that the District Kushtia might have derived its name from the word ‘Kushta’ meaning Jute which was abundantly grown in this area. Geographic Area and Location: Kushtia is bounded on the north by Rajshahi, Natore and Pabna districts, on the east by Pabna and Rajbari Districts, on the south by Jhenaidah, Chuadanga and Meherpur Districts and on the west by Chuadanga and Meherpur Districts and India. It lies between 23°42´ and 24°12´ north latitude and between 88°42´ and 89°22´ east longitudes. The total area of the district is 1621.15 sq.km (625.93 sq.miles).

4.3 Physical Features, Topography and Soil Type

Kushtia district is situated about 277-km southwest off the capital city. It lies between 23.29-24.13 North latitude and 88.34-89.22 east longitude. It is bounded in the North by Pabna, Natore and Rajsahi, in the South by Jhenidah, Chuadanga and Meherpur, In the East by Rajbari and in the West by Chuadanga, Meherpur and west Bangia of India

. It comprises a total area of 1682.28 Sq.Km. The district is a plain land of Ganges basin. It has the country's largest irrigation project an irrigation project -----Ganges-Kabadak project that supply water flows from Ganga basin covering 1.96 lakh hectares. Its south and southwestern parts are formed with alluvial soil. Its western area is slightly higher level than eastern and northern part.

The Kushtia district is consist of *High Ganges River Floodplain* agro-ecological zone. *High Ganges River Floodplain* (13,205 sq km) this region includes the western part of the Ganges river floodplain which is predominantly highland and medium highland. Most areas have a complex relief of broad and narrow ridges and inter-ridge depressions. The upper parts of high ridges stand above normal flood level. Lower parts of ridges and basin margins are seasonally shallowly flooded. General soil types predominantly include calcareous dark grey floodplain soils and calcareous brown floodplain soils. Organic matter content in the brown ridge soils is low but higher in the dark grey soils. Soils are slightly alkaline in reaction. General fertility level is low.

Figure 4.1: Map of Kushtia District

4.4 General Information of study area

Table 4.1: Broad classification of Study area (In sq. km.)

Upazila	Total area	Land area
Bheramara	153.71	135.43
Daulatpur	468.76	408.7
Mirpur	305.06	262.45

Table 4.2: Number of household, population and density of study area

Upazila	House hold	Population (000)			Sex ratio (M/F)	Average size of household	Density per sq. km
		Male	Female	Total			
Bheramara	47586	103	105	208	98	4.2	1302
Daulatpur	115715	236	237	473	100	3.93	974
Mirpur	82783	172	171	343	101	3.98	1082

Table 4.3: Population and literacy rate of study area

Upazila	Population (000)			Literacy rate (%)		
	2001	2011	2018	2001	2011	2018
Bheramara	144	176	200	28.1	42.5	58.7
Daulatpur	361	444	456	27.5	45.59	51.3
Mirpur	248	285	330	21.3	37.1	51.9

Source: Population census 2011 and Economic census 2019

4.5 Climate

The hot season lasts for *2.6 months*, from *March 19* to *June 7*, with an average daily high temperature above *91°F*. The hottest day of the year is *April 15*, with an average high of *96°F* and low of *75°F*.

The cool season lasts for *1.9 months*, from *December 8* to *February 5*, with an average daily high temperature below *77°F*. The coldest day of the year is *January 12*, with an average low of *53°F* and high of *73°F*.

To show variation within the months and not just the monthly totals, we show the rainfall accumulated over a sliding 31-day period centered on each day of the year. Kushtia experiences extreme seasonal variation in monthly rainfall.

The *rainy* period of the year lasts for *8.5 months*, from *March 2* to *November 17*, with a sliding 31-day rainfall of at least *0.5 inches*. The *most rain* falls during the 31 days centered on *July 5*, with an average total accumulation of *7.5 inches*.

The rainless period of the year lasts for 3.5 months, *from* November 17 to March 2. The least rain falls around January 8, with an average total accumulation of *0.2 inches* and annual average rainfall is 1467 mm.

Table 4.4: Temperature, rainfall, humidity of Kushtia

Years	**Temperature (centigrade**		**Rainfall (millimeter)**	**Humidity (%)**
	Maximum	**Minimum**		
2016	35.2	9.6	1834	79.0
2016	37.4	11.4	1224	75.0
2017	34.7	8.7	587	63.8
2018	23.3	8.6	1620	78.0

Source: Bangladesh Meteorological Department

4.6 Agriculture and Economic Condition

Economic condition of the district is well. The economy of the district is mainly agro-based in character. The district has 1, 15, 978 crop land. Total 41.5% people are involved in agriculture, 13.9% labourer and 8.53% are in service. The district yields surplus food grains. Kushtia is now well known as a tobacco yielding zone. The district has become the country's center for Virginia Tobacco manufacturing. At least 22, 000 hectares of land in the district are used in tobacco production. Different industries are also contributing the economy of the district. A number of industries have been developed in the district in recent years. It has 15 big industries, 38 middle industries and 5212 are small scale industries.

Main Crops: Paddy, tobacco, cottion, jute, sugarcane, pulses oil seed etc. are main crops of this district Main Fruits: Mango, banana, jackfruit, lichi etc.are main fruits of this district.

4.7 Transportation

This district headquarter is well connected with the capital city and other parts of the country. The basic means of transport available in the district are train, bus, truck, motorcycle, car, tempo, rickshaw, boat, bi-cycle and other locally made vehicles. The district has 469.92-km metalled road, 250.50 km half-metalled, and 540. 8 Km semi-Kutcha, 20.31 km Kutcha, 201 km navigation and 42.5 km rail road linkage.

4.8 NGO Activities

Operationally important NGOs of this district are Setu, Joy, Desha, Pipasha, Jagarani, CDL, BRAC, Mukti, Swanirvar Bangladesh, ASA, Drishti, Bodhodaya and Karmei Mukti.

4.9 Concluding Remarks

From the above discussions it is found that the location of the study area near to the district. Physical features and topography, soil type, temperature and rainfall are favorable for cultivating cotton. This district is well transport system over marketing to others Bangladesh. Therefore, various types of agricultural crops were cultivated in the study area. Communication are good for marketing of agricultural crops.

CHAPTER 5
SOCIO-ECONOMIC PROFILE OF HOUSEHOLD POPULATION

5.1 Introduction

The point of this part is to present a brief description of the socio-economic characteristics of the growers delivering cotton. Socioeconomic l parts of the growers can be viewed from various perspectives relying on various factors identified with their degree of living, the financial condition where they live and the nature and the degree of the growers ' support in national advancement exercises. It was impractical to gather all the data with respect to the financial attributes of the example growers because of confinement of time and assets. Financial state of the example growers is significant in the event of research arranging in light of the fact that there are various interrelated and constituent qualities describes an individual and significantly impacts advancement of his/her conduct and character. Individuals contrast from each other for the variety of financial perspectives. Nonetheless, for the present research, a couple of the financial qualities have been contemplated for exchange.

5.2 Composition of the Family Size

Family size is significant in connection to generation of enough nourishment grain for ranch family. In this study family has been characterized as the all-out number of people living respectively and taking meals from a similar kitchen under the influence of one leader of the family. The relatives considered as spouse, children, unmarried little girl, father, mother, sibling and different relatives who live for all time in the family.

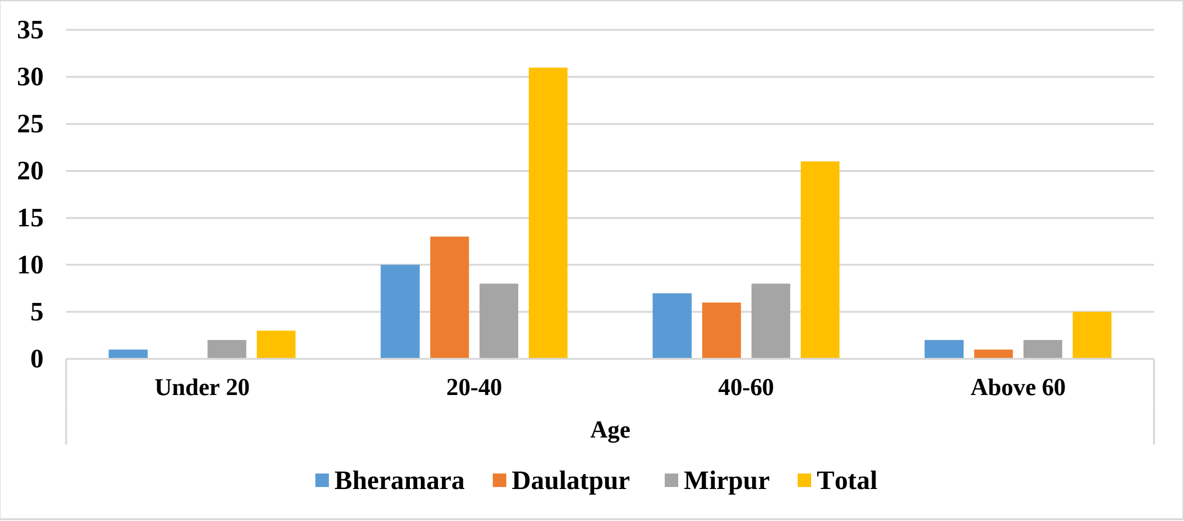
Table 5.1: Average Family Size and Distribution of Members According to Sex of the Sample Farmers

Particulars	Bheramara Upazila		Daulatpur Upazila		Mirpur Upazila		All Farmers		**National Average Family Size**
	Number	Percent	Number	Percent	Number	Percent	Number	Percent	
Male	3.56	62.24	3.15	53.94	2.97	53.23	3.23	56.47	4.06
Female	2.16	37.76	2.69	46.06	2.61	46.77	2.49	43.53	
Total	5.72	100	5.84	100	5.58	100	5.72	100	

Source: Field Survey, 2020

5.3 Age

There are 20, 20, 20 samples are collected from three upazila named respectively Bheramara, Daulatpur and Mirpur represented the total population. In Bheramara upazila, 50 percent of the sample populations were 20-40 years, 35 percent were 40-60 years and 10 percent were above 60 years old. In Daulatpur upazila, 65 percent of the sample populations were 20-40 years, 30 percent were 40-60 years and have 10 percent found sample were above 60 years old. In Mirpur upazila, 40 percent of the sample populations were 20-40 years, 40 percent were 40-60 years and 20 percent sample found who were above 60 (Figure 5.1**)**. In this figure we saw most of the people age between 20 to 40 years in every upazila.

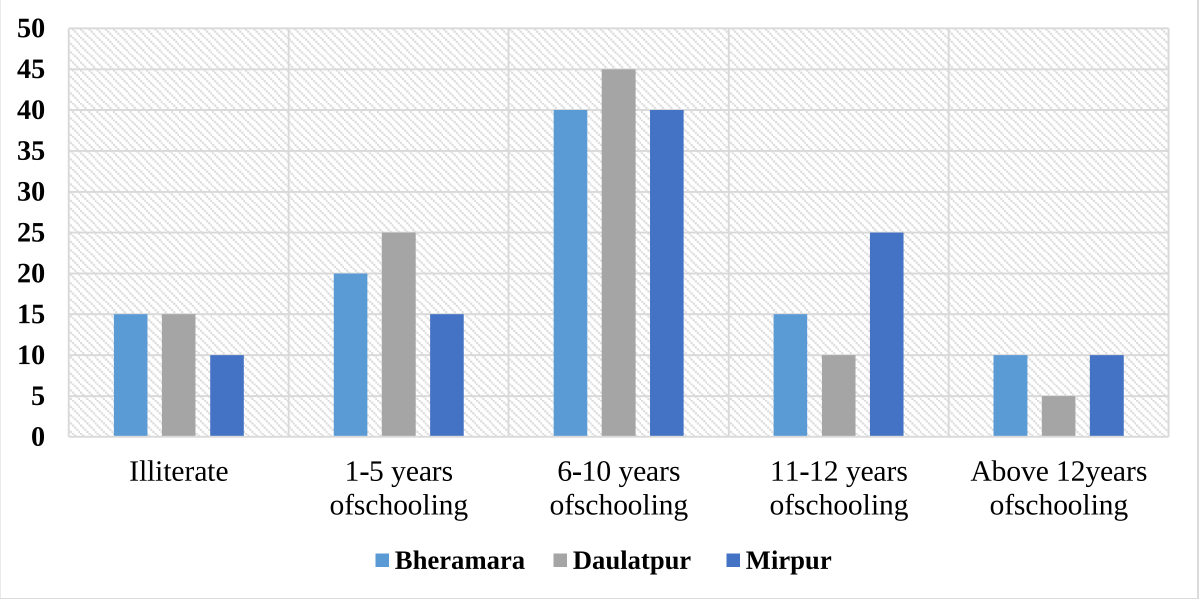


Source: Field survey, 2020

Figure 5.1: Age of the respondent by Study Area

5.4 Education

Figure 5.2 showed that, in Bheramara upazila, about 15 percent of the study population aged 5 years or more were found to have no education and/or read/write, about 20 percent were found to have primary level education, about 40 percent were found to have secondary and/or higher secondary level education and 10 percent people were found to have attained/completed graduation level of education. In Daulatpur upazila, about 10 percent of the study population aged 5 years or more were found to have no education and/or read/write, about 15 percent were found to have primary level education, about 45 percent were found to have secondary and/or higher secondary level education and 5 percent people were found to have attained/completed graduation level of education. In Mirpur upazila, about 10 percent of the study population aged 5 years or more were found to have no education and/or read/write, about 15 percent were found to have primary level education, about 40 percent were found to have secondary and/or higher secondary level education and 10 percent people were found to have attained/completed graduation level of education.



Source: Field survey, 2020

Figure 5.2: Education of the Household Members by Study Area

5.5 Annual Family income

a) Agricultural work

Table 5.2: Agricultural Work

Sector	Average annual Income	Mean
Crops	60897.87	158365.67
Poultry	34989.8	
Livestock	36800	
Fisheries	25678	

Source: Field survey, 2020

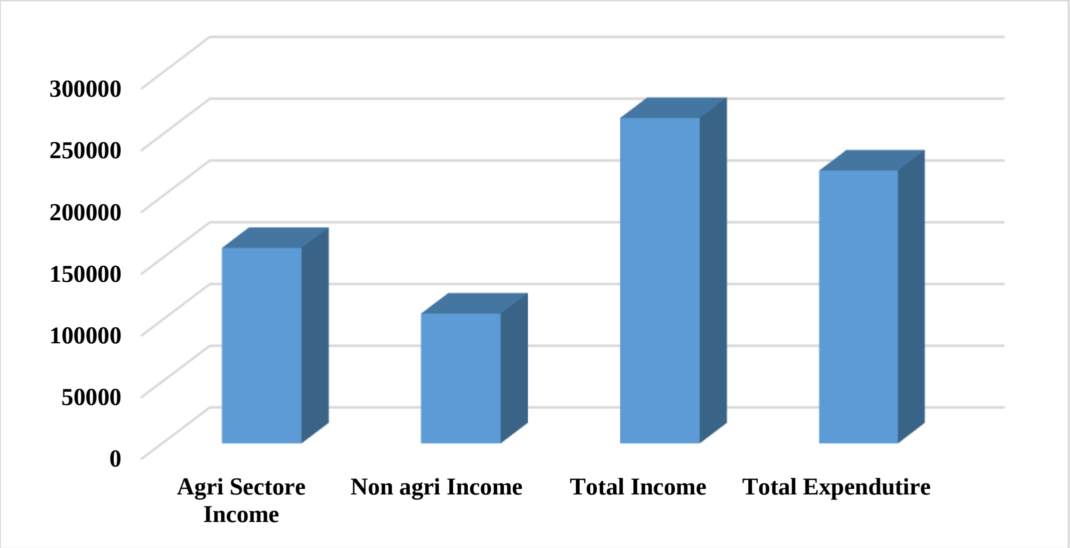
Crops, poultry, livestock and fisheries are the main agricultural income source of the sample. Most of the framer generate income by agriculture sector. Crop production was the main source of income among them average yearly income from crop production found TK 60897.87. Now a day's poultry and dairy farm have been developed in the study area. Farmers Tk 34989.8 yearly income from poultry. The mean value of annual family income by agriculture was Tk 158365.67.

b) Non-Agriculture work

Main non agriculture was found day labor, Auto driver, Truck driver, domestic worker, small business, foreign remittance, services. Annual average income by non-agriculture source was found Tk 1,05,171.4. The total average annual income was found Tk 2,63,537.07.

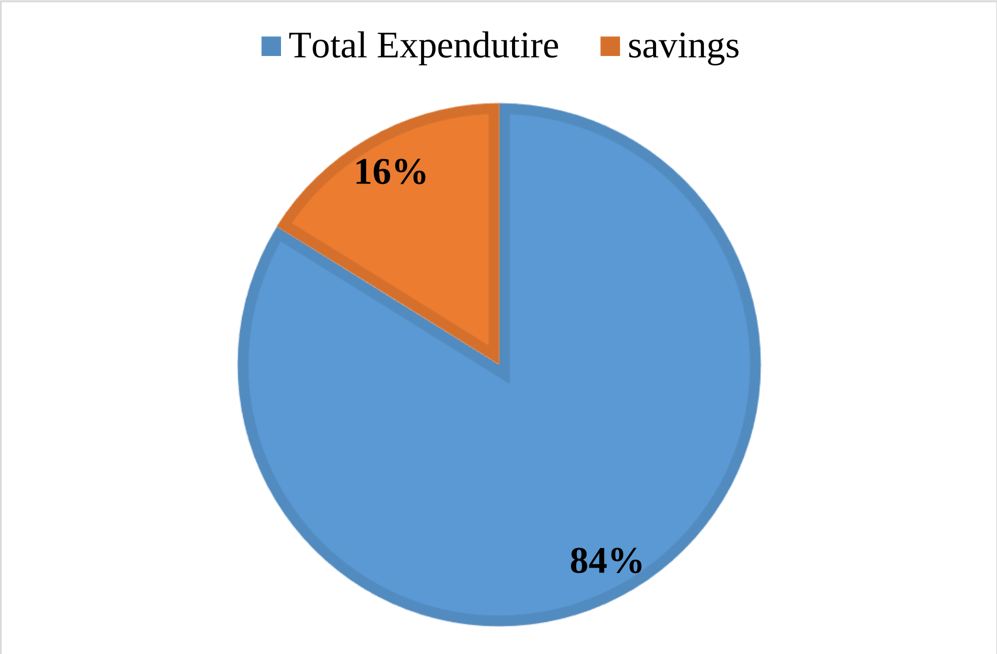
5.6 Annual Family Expenditure

Sample farmer, annual average expenditure was found Tk. 2,20,989.6. Main family expenditure was use for food consumption. Others main cost were child's education cost, clothing cost, medicine cost transportation, festival cost, entrainment cost etc Average annual family savings was found Tk 42547.



Source: Field survey, 2020

Figure 5.3: Annual Family Income and Expenditure by Study Area



Source: Field survey, 2020

Figure 5.4: Annual Family Expenditure and Savings by Study Area

5.7 Agricultural Training

Among the respondent farmers in Bheramara upazila, only 90 percent farmer's got training of cotton cultivation whereas, 85 percent farmers got training in Daulatpur upazila, 85 percent farmers got training in Mirpur upazila (Table 5.4). These training have improved their perceptions of good seed use, use of resistant varieties, application of insecticides and pesticides, water management, and so on. Most of the training conducted by Cotton Development Board (CDB) and BADC.

Table 5.3: Agricultural Training of the respondent by Study Area

Training Received	Bheramara Upazila		Daulatpur Upazila		Mirpur Upazila	
	No.	**%**	**No.**	**%**	**No.**	**%**
Yes	18	90	17	85	17	85
No	2	10	3	15	3	15
Total	20	100	20	100	20	100

Source: Field survey, 2020

5.8 Membership of any social organization

Among the respondent farmers in Bheramara upazila, 75.00 percent cotton growers were found to have membership in different NGOs and/or farmers' organizations whereas Daulatpur upazila 80 percent of cotton grower's farmers had membership in different NGOs and/or farmers' organizations and 60 percent of cotton farmers had membership in different social organization in Mirpur upazila (Table 5.5).

Table 5.4: Membership in any organization of the respondent by Study Area

Membership	Bheramara Upazila		Daulatpur Upazila		Mirpur Upazila	
	No.	**%**	**No.**	**%**	**No.**	**%**
Yes	15	75	16	80	12	60
No	5	25	4	20	8	40
Total	20	100	20	100	20	100

Source: Field survey, 2020

5.9 Variety adaptation

Among the respondent of 30 hybrid cultivator, they adapted some different variety all are hybrid Varity. It was found that 39 percent farmers of that sample were adapted CB-10 variety and 28% percent of farmer were adapted CB-11 and 33% of farmer adapted CB-12. Mainly most of the seed produced and distributed Cotton Development Board (CDB) and BADC in including subsidy.

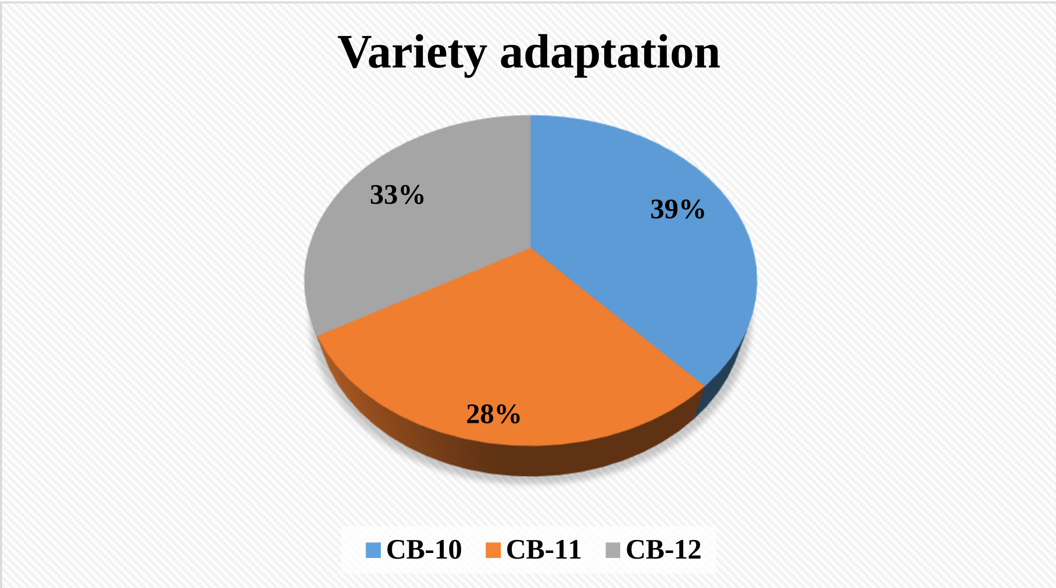


Figure 5.5: Variety adaptation by Study Area
Source: Field survey, 2020

5.10 Concluding Remarks

From the above discussions it is clear that there are some variations in socioeconomic characteristics between the Bheramara Upazila, DaulatpurUpazila, Mirpur Upazila cotton growers. But the magnitude of the variations was not large. There are substantial indications suggesting that both Bheramara Upazila, DaulatpurUpazila, Mirpur Upazila cotton growers were progressive.

CHAPTER –6

PROFITABILITY OF COTTON PRODUCTION

6.1 Introduction

The main purpose of this chapter is to assess the costs, returns and profitability of growing Cotton. Profitability is a major criterion to make decision for producing any crop at farm level. It can be measured based on net return, gross margin and ratio of return to total cost. The costs of all items were calculated to identify the total cost of production. The returns from the crops have been estimated based on the value of main products (Cotton Fiber).

6.2 Profitability of Cotton Production

6.2.1 Variable Costs

6.2.1.1 Cost of Land Preparation

Land preparation is the most important components in the production process. Land preparation included ploughing, laddering and other activities needed to make the soil suitable for Cotton cultivation. The land preparation cost for hybrid variety and local variety about same. For land preparation in Cotton production, no. of tiller was required 2 times with Tk. 4750 per tiller. Thus, the average land preparation cost of Cotton production was found to be Tk. 9500 per hectare, which was 4.56 and 4.62 percent respectively hybrid variety and local variety of total cost (Table 6.2).

6.2.1.2 Cost of Hired Human Labour

Hired Human labour was the most important and largely used input in producing both hybrid variety and local variety cotton production. It shared a large portion of total cost of hybrid variety and local variety cotton production. It can be seen from Table 6.1 that the amount of human labour used for hybrid variety was 95 man-days per hectare. While this was 70 man-days per hectare for local variety production (Table 6.2). Total cost of human labour was estimated Tk. 38000 and Tk. 28000.00 covering 18.23 and 13.60 percent of total cost of hybrid variety and local variety cotton production, respectively (Table 6.2).

6.2.1.3 Cost of Seed

The Cotton Development Board produces high quality seed cotton every year on farms and through contract farmers which is distributed among the general farmers in the next season. Farmers can collect quality cotton seeds by contacting the field workers of the unit offices of the Cotton Development Board near famer at a subsidized p. of Tk. 30-40 for 1 bigha of land. Cost of seed varied widely depending on its quality and availability. Per hectare total cost of seed for Cotton production were estimated to be Tk. 240.00, which constituted 0.12 percent of the total cost (Table 62).

6.2.1.5 Cost of Urea

In the study area, farmers used different types of fertilizers. On an average, farmers used urea 219.46 kg and 190 kg respectively hybrid variety and local variety per hectare. Per hectare cost of urea was Tk. 3950.28 and Tk. 3420 which represents 1.90 and 1.66 percent respectively hybrid variety and local variety of the total cost (Table 6.2).

6.2.1.6 Cost of TSP

Among the different kinds of fertilizers used, the rate of application of TSP 211.5 kg for hybrid variety and 190 kg for local variety. The average cost of TSP was Tk. 5287.50 and Tk. 4750 which representing 2.55 and 4.62 percent respectively hybrid variety and local variety of the total cost (Table 6.2)

6.2.1.7 Cost of MoP

From the different kinds of fertilizers used, the rate of application of MoP 246 kg for hybrid variety and 215 kg for local variety. The average cost of MoP was Tk. 4182 and Tk. 3655 which representing 2.01 and 1.78 percent respectively hybrid variety and local variety of the total cost (Table 6.2).

6.2.1.8 Cost of Zinc

The average application of Zinc 22.1 kg for hybrid variety and 30 kg for local variety. The average cost of Zinc was Tk. 3536 and Tk. 4800 which representing 1.70 and 2.33 percent respectively hybrid variety and local variety of the total cost (Table 6.2).

6.2.1.9 Cost of Gypsum

The average application of gypsum per hectare was 110.1 kg for hybrid variety and 90.5 kg for local variety. The average cost of gypsum was Tk. 1321.20 and Tk. 1086 which representing 0.63 and 2.33 percent respectively hybrid variety and local variety of the total cost (Table 6.2).

6.2.1.9 Cost of Liam

Liam is very important for cotton cultivation. Liam should be apply 20-25 before seedling. The average application of Liam per hectare was 150 kg to 160 kg. Per hectare cost of Liam was found Tk. 37500, which represents 18.07 percent of the total cost (Table 6.2).

6.2.1.10 Cost of Insecticides

Farmers used different kinds of insecticides to keep their crop free from pests and diseases. The average cost of insecticides for hybrid variety and local variety was Cotton production was same and it needed about Tk. 8000 per hectare of cotton production (Table 6.2).

6.2.1.9 Cost of Irrigation

Cotton cultivation requires about 800-1300 mm of rainfall annually. But the annual rainfall in the south-western part of Bangladesh is about 1300-2000 mm, which is more than required. As the distribution of this rainfall does not take place in the right amount at the right time, sometimes 1/2 light irrigation may be required at that time if there is no rain in the month of Kartik, especially in the newly sown (Bhadramas) crop.The average cost of irrigation was found to be Tk. 2000 per hectare of cotton production (Table 6.2).

6.2.1.10 Cost of manure

It was observed in the present study area that farmers used cow dung for producing their enterprises. They bought a large portion of cow dung from the milk producers. It was found that cow dung or compost application 5000 kg per hectare for Cotton production. And the cost of cow dung was Tk. 25000 per hectare of cotton production (Table 6.2).

Table 6.1: Per Hectare Return of Hybrid and Local variety Cotton Production

	Cost Items	Quantity	Price Per Unit (Tk.)	Costs/Returns (Tk ha-1)	% of total
For Hybrid variety	A. Gross Return				
	Main product (cotton fiber)	1800	250	450000.00	98.90
	By-product (fuel)			5000.00	1.10
	Total return			**455000.00**	**100.00**
For Local variety	A. Gross Return				
	Main product (cotton fiber)	1350	250	337500.00	99.12
	By-product (fuel, oil)			3000.00	0.88
	Total return			**340500.00**	**100.00**

Source: Field survey, 2020

6.2.1.11 Total Variable Cost

Therefore, from the above different cost items it was clear that the total variable cost of Cotton production was estimated Tk. 139404.98 and Tk. 140051.00 per hectare, which was 66.89 and 68.04 percent respectively hybrid variety and local variety of the total cost (Table 6.2).

6.2.2 Fixed Cost

6.2.2.1 Rental Value of Land

Rental value of land was calculated on the basis of opportunity cost of the use of land per hectare for the cropping period of three months. Cash rental value of land has been used as cost of land use. On the basis of the data collected from the Cotton farmers the land use cost was found to be Tk. 37500 per hectare (Table 6.2).

Table 6.2: Per Hectare cost of Hybrid and Local variety Cotton Production

Variety name	For Hybrid variety				For Local variety			
Cost Item	**Quantity**	**Price Per Unit (Tk.)**	**Costs/Returns (Tk ha-1)**	**% of total**	**Quantity**	**Price Per Unit (Tk.)**	**Costs/Returns (Tk ha-1)**	**% of total**
B. Gross Cost								
C. Variable Cost					1350	250	337500.00	99.12
Seed cost	5.64	200	1128.00	0.54			3000.00	0.88
Irrigation	2	1000	2000.00	0.96			340500.00	100.00
Power tiller/land Preparation	2	4750	9500.00	4.56				
Hired labour	95	400	38000.00	18.23				
Urea	219.46	18	3950.28	1.90	6	40	240.00	0.12
TSP	211.5	25	5287.50	2.54	2	800	1600.00	0.78
MOP	246	17	4182.00	2.01	2	4750	9500.00	4.62
Gypsum	110.1	12	1321.20	0.63	70	400	28000.00	13.60
Zinc	22.1	160	3536.00	1.70	190	18	3420.00	1.66
Laim	150	250	37500.00	17.99	190	25	4750.00	2.31
Total Fertilizers cost			55776.98	26.76	215	17	3655.00	1.78
Manure	5000	5	25000.00	12.00	90.5	12	1086.00	0.53
Insecticides			8000.00	3.84	30	160	4800.00	2.33
Total Variable cost (TVC)			139404.98	66.89	160	250	40000.00	19.43
D. Fixed Cost							57711.00	28.04
Land use cost			37500.00	17.99	7000	5	35000.00	17.00
Family labour	65	400	26000.00	12.48			8000.00	3.89
Interest on operating capital			5494.62	2.64			5494.62	2.67
Total Fixed cost (TFC)			68994.62	31.37			65794.62	25.38
E. Total costs (TC)			208399.60	100.00			205845.62	100.00

6.2.2.2 Cost of Family Labour

Family labor was the most important and largely used input in producing both hybrid variety and local variety cotton production. It shared a large portion of total cost of hybrid variety and local variety cotton production. It can be seen from Table 6.1 that the amount of human labour used for hybrid variety was 65 man-days per hectare. While this was 57 man-days per hectare for local variety production (Table 6.2). Total cost of human labour was estimated Tk. 26000.00 and Tk. 22800.00 covering 12.48 and 11.08 percent of total cost of hybrid variety and local variety cotton production, respectively (Table 6.2).

6.2.2.3 Interest on Operating Capital

It may be noted that the interest on operating capital was calculated by taking in to account all the operating costs incurred during the production period of Cotton@ 9% of bank rate. Interest on operating capital for Cotton production was estimated at Tk. 5494.62 and Tk. 5494.62 per hectare, of hybrid variety and local variety cotton production, respectively (Table 6.2).

6.2.3 Total Cost (TC) of Cotton Production

In order to estimate total cost per hectare all the resources used in hybrid variety and local variety cotton production has been recaptured together. It can be seen from Table 6.1 and Table 6.2 that per hectare total cost of production of hybrid variety and local variety cotton were Tk. 208399.60 and Tk. 205845.62 respectively.

6.2.4 Return of Cotton Production

6.2.4.1 Gross Return

Per hectare average yield of hybrid variety and local variety cotton fiber were estimated 1800 kg and 1350 kg, respectively. Gross return per hectare was calculated by multiplying the total amount of products by average farmgate price. By product was included. Per hectare gross return of hybrid variety and local variety cotton was Tk. 250

(Table 6.1). Figure 6.3 shows that per hectare gross return of hybrid variety and local variety cotton were found Tk. 455000 and Tk. 340500.

Table 6.3: Difference between Per Hectare Cost and of Hybrid and Local Cotton Production

Cost Item	Cost/Returns (Tk/ha) Hybrid variety	Cost/Returns (Tk/ha)Local variety
A. Gross Return	455000	340500
B. Gross Cost		
C. Total Variable Cost (TVC)	139404.98	140051
D. Total Fixed Cost (TFC)	68994.62	65794.62
E. Total costs (TC)	208399.60	205845.62
F. Gross Margin (A-C)	315595.02	200449.00
G. Net Return (A-E)	246600.40	134654.38
H. Undiscounted BCR (A/E)	2.18	1.65

Source: Field survey, 2020

6.2.4.2 Gross Margin

Gross margin is the gross return over variable cost. Gross margin is obtained by deducting total variable cost from gross return. Per hectare gross margin was estimated Tk. 315595.02 and Tk. 200449.00 of hybrid variety and local variety cotton production, respectively (Table 6.3).

6.2.4.3 Net Return

Net return is a very useful tool to analyze or compare performance of enterprises. It is calculated by subtracting total cost from total return. Per hectare net return hybrid variety and local variety cotton were Tk. 246600.40 and Tk. 134654.38, respectively (Table 6.3).

6.2.5 Benefit Cost Ratio (Undiscounted)

Benefit cost ratio (BCR) is a relative measure, which is used to compare benefit per unit of cost. In the study, BCR of hybrid variety and local variety cotton was calculated as a ratio of gross return and gross cost. Undiscounted Benefit cost ratio of hybrid variety and local variety cotton production per hectare came out to be 2.18 and 1.65 respectively, which implies that Tk. 2.18 and Tk. 1.65, respectively for corresponding fiber crop will be achieved by expending every Tk. 1.00 (Table 6.1 and Table 6.2 and Table 6.3).

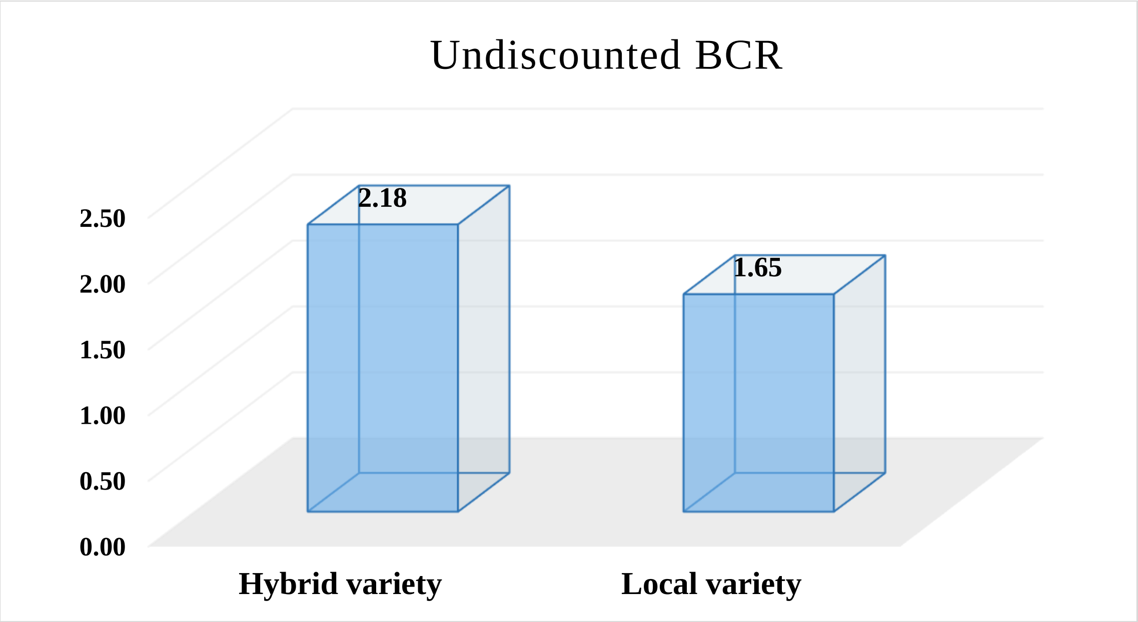


Figure 6.1: Comparative BCR of hybrid variety and local variety cotton production

6.2.6 Comparative Profitability hybrid variety and local variety cotton

In this section, a comparison has been made to assess per hectare relative profitability of growing hybrid variety and local variety cotton. The summary results having per hectare yield, gross return, gross margin, net return and BCR of hybrid variety and local variety cotton were presented in Table 6.3. It is evident that both hybrid variety and local variety cotton enterprises were profitable. Moreover, Hybrid cotton cultivation was more profitable than local variety cotton cultivation (Table 6.3 and Figure 6.1).

6.3 Concluding Remarks

From the above discussion it is easy to understand about the different cost items and their application doses of farmers, yields and returns per hectare of Cotton cultivation. Cotton production is a labour intensive enterprise. It is most essential to use modern inputs such as seeds, fertilizers, human labour, power tiller, pesticides and irrigation efficiently. Timely and efficient use of these inputs are the most important to increase production and profitability. On the basis of above discussions it could cautiously be concluded here that cultivation of Cotton is a profitable. And Hybrid cotton cultivation was more profitable than local variety cotton. Cultivation of Cotton would help farmers to increase their income earnings.

CHAPTER 7

MAJOR FACTORS AFFECTING AND TECHNICAL EFFICIENCY OF COTTON PRODUCTION

7.1 Introduction

The estimation of efficiency with the help of production function has been a popular area of applied econometrics. Technical efficiency reflects the ability of a farmer to obtain the maximum possible output from a given level of inputs and production technology. It is a relative concept, since each farmers production performance is compared to a best-practice input-output relationship or production frontier. A farmer is technically inefficient in the sense that if it fails to produce maximum output from a given level of inputs. Technical inefficiency is then measured as the deviation of a farmer from the best-practice frontier. The main objective of this chapter is to estimate the technical inefficiency as well as frequency distribution of Cotton farmers through technical efficiency analysis. The technical efficiency in production was estimated by using the stochastic frontier production. The primary advantage of a stochastic frontier production function is that it enables one to estimate U, (non-negative random variable which is under the control of the farmers).

Since the pioneering work on technical efficiency by Farrell in 1957, which drew upon the works of Debreu (1951) and Koopmans (1951), considerable effort has been directed at refining the measurement of technical efficiency. Empirical studies suggest that farmers in developing countries fail to exploit the potential of technology perhaps due to inefficient decision making due to various reasons of which management capacity is important one.

7.2 Interpretation of ML Estimates of the Stochastic Frontier Production Function:

Maximum likelihood estimation begins with writing a mathematical expression known as the Likelihood Function of the sample data. The likelihood of a set of data is the probability of obtaining that particular set of data, given the chosen probability distribution model. This expression contains the unknown model parameters. The values of these parameters that maximize the sample likelihood are known as the Maximum Likelihood Estimates or MLE's. 7.1

The maximum likelihood estimates for parameters of the Cobb-Douglas stochastic frontier production function and technical inefficiency effect model for Cotton production for all farmers are presented in Table 7.1.

Table 7.1: ML Estimates for Parameters of Cobb-Douglas Stochastic Frontier Production Function for hybrid and local Cotton Farmers.

Variety name	**For hybrid Cotton Farmers**			**For local Cotton Farmers**		
Variables	**Parameter**	**Coefficients**	**T-ratio**	**Parameter**	**Coefficients**	**T-ratio**
Constant (X_0)	β_0	6.38**	2.05	β0	2.93*	1.78
Human Labour (X_1)	β_1	0.6774**	2.21	β1	0.0868**	2.22
Urea (X_2)	β_2	-0.3483***	-3.40	β2	-0.1764**	-2.20
TSP (X_3)	β_3	0.7819***	4.10	β3	0.2544**	2.30
MoP (X_4)	β_4	-0.1930	-0.37	β4	-0.1061***	-3.18
Gypsum (X_5)	β_5	0.2310***	3.78	β5	-0.2202	-0.70
Irrigation (X_6)	B_6	0.0970***	3.71	B6	0.2175*	1.71
Insecticide (X_7)	B_7	-0.05232	-0.11	B7	-0.2533	-0.58

Note: *, ** and * indicates significant at 1, 5 and 10 percent level respectively**.

Source: Field survey, 2020

7.3 Interpretation the Results of Hybrid variety Cotton

Human Labor (X_1)

The regression coefficient of labour cost (X_1) of hybrid Cotton production was positive and significant at 5 percent level of significance, which implied that if the expenditure on labour was increased by 1 percent then the yield of hybrid Cotton would be increased by 0.674 percent, other factors remaining constant (Table 7.1).

Urea (X_2)

The regression coefficient of urea cost (X_2) o hybrid f Cotton production was negative and significant at 1 percent level of significance, which implied that if the expenditure on urea was increased by 1 percent then the yield of hybrid Cotton would be decreased by 0.3483 percent, other factors remaining constant (Table 7.1).

TSP (X_3)

The regression coefficient of TSP cost (X_3) of hybrid Cotton production was positive and significant at 1 percent level of significance, which implied that if the expenditure on TSP was increased by 1 percent then the yield of hybrid Cotton would be increased by 0.7819 percent, other factors remaining constant (Table 7.1).

MoP (X_4)

The regression coefficients of MoP cost (X_4) was not significant.

Gypsum (X_5)

The regression coefficient of Gypsum cost (X_5) of hybrid Cotton production was positive and significant at 1 percent level of significance, which implied that if the expenditure on gypsum was increased by 1 percent then the yield of hybrid Cotton would be increased by 0. 2310 percent, other factors remaining constant (Table 7.1).

Irrigation (X_6)

The regression coefficient of irrigation cost (X_6) of hybrid Cotton production was positive and significant at 1 percent level of significance, which implied that if the expenditure on irrigation was increased by 1 percent then the yield of hybrid Cotton would be increased by 0.0970 percent, other factors remaining constant (Table 7.1).

Insecticide (X_7)

The regression coefficients of Insecticide cost (X_7) was not significant.

7.4 Interpretation the Results of Local variety Cotton

Human Labor (X_1)

The regression coefficient of labour cost (X_1) of local Cotton production was positive and significant at 5 percent level of significance, which implied that if the expenditure on labour was increased by 1 percent then the yield of local Cotton would be increased by 0.0868 percent, other factors remaining constant (Table 7.1).

Urea (X_2)

The regression coefficient of urea cost (X_2) of local Cotton production was negative and significant at 5 percent level of significance, which implied that if the expenditure on urea was increased by 1 percent then the yield of local Cotton would be decreased by 0.1764 percent, other factors remaining constant (Table 7.1).

TSP (X_3)

The regression coefficient of TSP cost (X_3) of local Cotton production was positive and significant at 5 percent level of significance, which implied that if the expenditure on TSP was increased by 1 percent then the yield of local Cotton would be increased by 0.2544 percent, other factors remaining constant (Table 7.1).

MoP (X_4)

The regression coefficient of MoP cost (X_4) of local Cotton production was negative and significant at 1 percent level of significance, which implied that if the expenditure on MoP was increased by 1 percent then the yield of local Cotton would be decreased by 0. 1061 percent, other factors remaining constant (Table 7.1).

Gypsum (X_5)

The regression coefficients of Gypsumcost (X_5) was not significant.

Irrigation (X_6)

The regression coefficient of irrigation cost (X_6) of local Cotton production was positive and significant at 10 percent level of significance, which implied that if the expenditure on irrigation was increased by 1 percent then the yield of local Cotton would be increased by 0.2175 percent, other factors remaining constant (Table 7.1).

Insecticide (X_7)

The regression coefficients of Insecticide cost (X_7) was not significant.

Table 7.2: ML Estimates for Technical Inefficiency Model for hybrid and local Cotton Farmers.

Variety name	**For hybrid Cotton Farmers**			**For local Cotton Farmers**		
Variables	**Parameter**	**Coefficients**	**T-ratio**	**Parameter**	**Coefficients**	**T-ratio**
Constant	δ_0	-5.46*	-2.44	δ_0	-12.39*	-1.69
Farm Size (Z_1)	δ_1	-0.0673**	-2.25	δ_1	-0.0154***	-3.47
Age (Z_2)	δ_2	0.1170**	1.89	δ_2	0.5766	0.59
Education (Z_3)	δ_3	-.0944	-0.42	δ_3	0.3070***	2.81
Training (Z_4)	δ_4	-0.1523**	-2.50	δ_4	0.0601**	2.21
Experience (Z_5)	δ_5	-0.3242*	-1.70	δ_5	0.1035	0.66
Distance of Market (Z_6)	δ_6	0.8291	1.05	δ_6	0.6807*	1.63
Log-likelihood Function		42.27			20.57	

Note: *, ** and * indicates significant at 1, 5 and 10 percent level respectively**.

Source: Field survey, 2020

7.5 Interpretation of Technical Inefficiency Model for hybrid cotton

In the technical inefficiency effect model Farm size, education, experience, and training have expected (negative) coefficients. The negative and significant (5 percent, 5 percent and 5 percent and 10 percent respectively) coefficient of experience implies that experienced farmers are technically more efficient than non-experienced farmers. The negative coefficient of training postulates that trained farmer are more efficient than others. (Table 7.2)

The negative coefficient of Farm Size postulates that if farm size being large then farmer are technically more efficient than others. (Table 7.2)

The coefficients of farmer's education is positive meaning that these factors have no impact on the technical inefficiency. That is, these factors do not reduce or increase technical inefficiency of producing Cotton. (Table 7.2)

The positive coefficient of Market distance meaning that distance of cotton market have no impact on the technical inefficiency. (Table 7.2)

7.6 Interpretation of Technical Inefficiency Model for local variety cotton

In the technical inefficiency effect model only Farm size has expected (negative) coefficients. The negative and significant at 1 percent. The negative coefficient of Farm Size postulates that if farm size being large then farmer are technically more efficient than others. (Table 7.2)

The coefficients of farmer's age and education, experience, training positive meaning that these factors have no impact on the technical inefficiency for local variety cotton cultivation. That is, these factors do not reduce or increase technical inefficiency of producing local variety Cotton. (Table 7.2) The positive coefficient of Market distance meaning that distance of cotton market have also no impact on the technical inefficiency. (Table 7.2)

7.7 Technical Efficiency and Its Distribution

Table 7.3 shows difference frequency distribution of farm-specific technical efficiency for two varieties Cotton farmers. It reveals that average estimated technical efficiencies for hybrid variety Cotton are 92 percent and local variety cotton are 81 percent which indicate that hybrid variety Cotton production could be increased by 08 and local variety cotton production could be increased by 19 percent with the same level of inputs without incurring any further cost. Increase of only managerial skills result a substantial increase of output for Cotton. It was observed that about 66.67 per cent of sample farmers obtained up to 90 percent technical efficiency level for hybrid cotton and 43.33 percent for local cotton. The minimum and maximum technical efficiencies for hybrid variety were observed to be 53 and 99 per cent respectively. On the other hand, the minimum and maximum technical efficiencies for local variety were observed to be 36 and 98 per cent respectively.

Table 7.3: Difference between Frequency Distribution of Technical Efficiency of Hybrid and local Cotton Farms

Variety name	**Hybrid Variety**		**Local Variety**	
Efficiency (%)	No. of farms	Percentage of farms	No. of farms	Percentage of farms
0-60	2	6.67	6	20
61-80	2	6.67	6	20
81-90	6	20.00	5	16.67
91-99	20	66.67	13	43.33
Total	**30**	**100.00**	**30.00**	**100.00**
Minimum	0.53		0.36	
Maximum	0.99		0.98	
Mean	0.92		0.81	
SD	0.12		0.18	

Source: Field survey, 2020

7.8 Concluding Remarks

From the above discussion it is easy to understand about the different cost items and their application doses of farmers, yields and returns per hectare of hybrid and local Cotton cultivation. Cotton production is a seed and labor intensive enterprise. It is most essential to use modern inputs such as seeds, fertilizers, human labour, power tiller, pesticides and irrigation efficiently. Timely and efficient use of these inputs are the most important to increase production and profitability. On the basis of above discussions it could cautiously be concluded here that cultivation of Cotton is a profitable. Cultivation of Cotton would help farmers to increase their income earnings

CHAPTER 8
PROBLEMS AND CONSTRAINTS TO COTTON PRODUCTION

8.1 Introduction

The focus of this chapter is to identify the extent of problems encountered by the Cotton farmers. Farmers faced a lot of problems in producing Cotton. The problems were social and cultural, financial and technical. This chapter aims at represent some socioeconomic problems and constraints to producing Cotton. The problems and constraints faced by the farmers were identified according to opinions given by them. The major problems and constraints related to Cotton cultivation are discussed below:

8.2 Long duration of cotton cultivation

Most of the farmers had told Long duration of cotton cultivation is very bigger problem than other crops. But harvest time price of Cotton remained low because of ample supply. So they could not get reasonable return for their products. It can be seen from Table 8.1 that 91.67 percent Cotton growers reported this as high problem.

8.3 Low price of Cotton

Most of the farmers had to sell a large portion of their product at the harvesting period to meet various obligations like, household's expenditure and repayment of loan. But harvest time price of cotton remained low because of ample supply. So they could not get reasonable return for their products. It can be seen from Table 8.1 that 90.00 percent Cotton growers reported this as high problem.

8.4 Insect attack in Cotton Field

The growers of Cotton were also affected by the problem of attack of pests and diseases. Pests and diseases attack reduce crop yield and increase cost of production. About 83.33 percent Cotton growers reported this as high problem (Table 8.1).

8.5 Adverse Climate

It was found that Cotton growers faced some acute problems relating to the nature in their production process. Natural calamities like drought, hailstorm, excessive rainfall, caused substantial damage to the crop in the field. Farmers said that excessive rainfall during the harvesting period reduces both the quantity and storability of Cotton. Table 8.1 shows that almost 75 percent Cotton growers in reported this as high problem.

8.6 Bool rot attack in cotton field

The growers of Cotton were also affected by the problem of attack of pests and diseases at end of the stage. Pests attack bool rot as a result reduce crop yield. About 75 percent Cotton growers reported this as high problem (Table 8.1).

8.7 High Price of Hybrid cotton Seed

Most of the registered farmer get subsidy in cotton seed from cotton Development Board. But rest of the farmer depends on company seed. High price of hybrid seed was also one of the most important limitations of producing Cotton in the study area. From Table 8.1 it is evident that about 66.67 percent Cotton growers reported this as high problem.

8.8 Lack of Operating Capital

The farmers of the study area had capital constraints. For cultivation of Cotton, a huge amount of cash money was needed to purchase various inputs like, human labour, seed, fertilizers, pesticides, etc about 66.67 percent Cotton farmers reported that they did not have sufficient amount of money for purchasing the required quantity of inputs for the relevant enterprises and marked this as high problem. (Table 8.1).

8.9 Shortage of Human labour

Most of the human labour is being used during seed/seedling plantation and harvesting period of Cotton. Cotton are labour intensive spices. Non-availability of human labour was found in different stages of production such as planting, intercultural operations and harvesting. Table 8.1 shows that near 50 percent of Cotton growers reported this as high problem.

8.10 Lack of Scientific Knowledge of Farming

Although modern agricultural technologies have been using in the study area, a large number of farmers have no adequate knowledge of right doses and methods of using modern inputs and technologies of producing their enterprises. Near 46.67 percent Cotton growers were encountered this problem. (Table 8.1).

Table 8.1 Problems and Constraints of Cotton Production by no. of Farmers

Type of Problems	No. of farmers	Percentage of farmers	Rank
Long duration of cotton cultivation	55	91.67	1
Low price of cotton	54	90.00	2
Insect attack in cotton field	50	83.33	3
Adverse climate	45	75.00	4
Boll rot attack in cotton field	45	75.00	5
High price of hybrid cotton seed	40	66.67	6
Lack of operating capital	40	66.67	7
Natural calamities	30	50.00	8
Shortage of human labour	30	50.00	9
Lack of scientific knowledge of farming	28	46.67	10
Adulteration of fertilizer, insecticide, and pesticide	25	41.67	11
High price of fertilizers	22	36.67	12
Need high crop management	18	30.00	13
Lack of necessary advice and instruction from concerned authority	12	20.00	14

Source: Field survey, 2020

8.11 Adulteration of Fertilizer, Insecticide, and Pesticide

Chemical fertilizers, insecticides and pesticides are the most important inputs of Cotton production. They were being intensively used in Cotton production in the study area. Many farmers reported to have been cheated by applying adulterate fertilizers and pesticides in their crop field. It can be seen from Table 8.1 that near 41.67 percent Cotton growers faced this problem highly.

8.12 High Price of Fertilizers

Farmers claimed that non-availability of fertilizers at fair p. was a problem in the way of producing enterprise. It appears from the table 8.1 that about 36.67 percent Cotton growers reported this as high problem.

8.13 Need High Crop Management

Lack of crop management and marketing is one of the most important limitations of producing Cotton in the study area. From Table 8.1 it is evident that about 30.00 percent Cotton growers reported this as high problem.

8.14 Lack of necessary advice

During the investigation some farmers complained that they did not get extension services regarding improved method of Cotton cultivation from the relevant officials of the Department of Agricultural Extension (DAE). As an agricultural extension personnel block supervisor, the main advisor of technical knowledge to the farmers about their farming problems. About 20.00 percent Cotton growers reported this as high problem (Table 8.1). Farmers of both areas marked that they hardly ever got help from the block supervisor and Agricultural Extension Officer.

8.15 Concluding Remarks

The above mentioned discussions as well as the results presented in Table 8.1 indicates that Cotton growers in the study area have currently been facing some major problems in conducting their Cotton farming. These are the major constraints for the producers of Cotton in the study area. Public and private initiatives should be taken to reduce or eliminate these problems for the sake of better production of Cotton.

CHAPTER 9
SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

9.1 Summary

Along with food and shelter, clothing is one of the primary requirements of human beings. Cotton, unique among agricultural crops provides food and fiber. Cotton is a major natural fiber crop. Its seeds provide edible oil and oil cakes used for livestock feed. Because of being a rural based agricultural country Bangladesh has remarkable contribution in agricultural sectors especially in rice, vegetables, fruits and fish production during last three decades. Bangladesh is highly populated country, so our attention was to produce food to feed the people. Presently Bangladesh has reached to a sustainable level of food production. Now the Government is going to crop

Fig 9.1: Cotton Field

Presently, cotton has been producing in the 39 districts and there is a scope to expand cotton cultivation in other areas like-saline and drought prone areas, Hilly areas, char land areas in the country. This production potential can be raised up to 5.0 lakh bale by expanding cotton cultivation in the saline and drought prone areas, hilly areas, char land areas through implementing research, extension services, and training. After the introduction, cotton cultivation was not increased to its expected peak due to the lack of facilities and modern technologies.

Cotton Development Board was established in 1972 to boost up cotton production in the country. Commercial cultivation was started from 1976-77 with medium staple length upland cotton varieties. The cotton research division of Bangladesh Agricultural Research Institute (BARI) has been transferred to Cotton Development Board in 1991. The present activities of Cotton Development Board is to conduct cotton research, extension, training, seed production & distribution, marketing & ginning and provide small scale credit facilities to cotton farmers.

There are two alternatives for increasing cotton production in the country. These are-
a) Increasing area under cotton cultivation (horizontal expansion) and
b) Increasing yield per unit area (vertical expansion) of cotton.
It is possible to increase the area under cotton cultivation by adopting profitable cotton based cropping pattern, replacing tobacco cultivation, bringing areas of river bank and char land, drought and saline prone areas, hill slopes and valley areas, agro-forestry system and other cropping systems. Another practical option is to increase cotton production by increasing per hectare yield through high yielding modern varieties, hybrids, transgenic cotton and improved management practices. Besides, quality seeds are the prerequisites for better yield. Intervention of modern production technologies the present yield potential of cotton has to be increased up to the world average. Hybrid cotton production in Bangladesh.
The present study will give the answers of some of the important questions regarding the aspects like growth of this crop, cost of cultivation, returns from this crop and constraints to its production and marketing. Therefore, a systematic research work was required to carry out for this crop in order to make available complete information to the farmers who want to grow this crop.

The sampling frame for the present study were selected purposively as to select the area where the Cotton cultivation was intensive. On the basis of higher concentration of Cotton crop production, three upzillas namely Bheramara, Daulatpur and Mirpur in Khustia was selected. A sample size of 60 is generally regarded as the minimum requirement for larger population that will yield a sufficient level of certainty for decision-making (Poate and Daplyn, 1993). In this case, who were cultivating different varieties of Cotton in the selected areas were selected as samples. Farmers generally plant Cotton from mid- June to July and harvest after four months. Data for the present study have collected during the period of July 2020 to August 2020. Primary data were collected from primary producers. Selected respondents were interviewed personally with the help of pre-tested questionnaires. The collected data were checked and verified for the sake of consistency and completeness. Editing and coding were done before putting the data in computer. All the collected data were summarized and scrutinized carefully to eliminate all possible errors. Data entry was made in computer and analysis was done using the concerned software Microsoft Excel and STATA.

Economic profitability is a major criterion to make decision for producing any crop at farm level. It can be measured based on net return, gross margin and ratio of return to total cost. The average land preparation cost of Hybrid Cotton production and Local Cotton Production was found to be Tk. 9500 per hectare in both cases. The quantity of human labor used in Hybrid Cotton production and Local Cotton Production were found to be about 95 man-days and 70 man-days per hectare respectively and average price of human labor was Tk.400 per man-day. Therefore, the total cost of human labor in Hybrid Cotton production and Local Cotton Production were found to be Tk. 38000 and Tk. 28000 representing 18.23 percent and 13.60 percent of total cost respectively. Per hectare total cost of seed for Hybrid Cotton production and Local Cotton Production were estimated to be Tk. 1128 and Tk. 240 respectively. On average, farmers used Urea, TSP, MoP, Gypsum, Zinc, and Liam was 219.46 Kg, 211.5 kg, 246 kg, 110.1 kg, 22.1 kg and 150 kg respectively, per hectare in Hybrid Cotton Production. And farmers used Urea, TSP, MoP, Gypsum, Zinc, and Liam was 190 Kg, 190 kg, 215 kg, 90.5 kg, 30 kg and 160 kg respectively in Local Cotton Production. The average cost of insecticides Hybrid Cotton production and Local Cotton Production were found to be Tk. 8000 in both cases. Whereas the average cost of irrigation in Hybrid Cotton production and Local Cotton Production were found to be Tk. 2000 and Tk 1600 per hectare respectively. The total variable cost of Hybrid Cotton production and Local Cotton Production were Tk. 139404.98 and Tk. 140051.00 per hectare, which was 66.89 percent and 68.04 percent of the total cost respectively.

The average yield of Hybrid Cotton and Local Cotton were 1800 kg and 1350 kg per hectare. Total price of Hybrid Cotton and Local Cotton were Tk. 450000 and Th 337500 respectively.
The gross margin of Hybrid Cotton production and Local Cotton Production were found to be Tk. 315595.02 and Tk. 200449 per hectare respectively. The net return in Hybrid Cotton production and Local Cotton Production were found to be Tk. 2446600.40 and Tk. 134654.28 per hectare respectively. Benefit Cost Ratio (BCR) was found to be 2.18 in Hybrid Cotton Production which implies that one-taka investment in Hybrid Cotton production generated Tk. 2.18. Benefit Cost Ratio (BCR) was found to be 1.65 in Local Cotton Production which implies that one-taka investment in Local Cotton production generated Tk. 1.65.

Technical efficiency reflects the ability of a farmer to obtain the maximum possible output from a given level of inputs and production technology. Technical efficiency is then measured as the deviation of a farmer from the best-practice frontier. The regression coefficients of Human labor (X1), TSP (X3), Gypsum (X5) and Irrigation (X6) were positive but the coefficient of Urea (X2), MoP (X4) and Insecticide (X7) was found negative in Hybrid Cotton Production. It indicates that if Human labor (X1), TSP(X3), Gypsum (X5) and Irrigation (X6) were increased by one percent, the production of Cotton would be increased by 0.6774, 0.7819, 0.2310, and 0.0970 percent of sample farmers respectively. The regression coefficients of Human labor (X1), TSP (X3) and Irrigation (X6) were positive but the coefficient of Urea (X2), MoP (X4), Gypsum (X5) and Insecticide (X7) was found negative in Local Cotton Production. It indicates that if Human labor (X1), TSP(X3) and Irrigation (X6) were increased by one percent, the production of Cotton would be increased by 0.0868, 0.2544 and 0.2175 percent of sample farmers respectively.

In the technical inefficiency effect model for Hybrid Cotton Production, farm size, training, experience were negative coefficients. The negative coefficient of farm size implies that large farm households are technically more efficient than small farm households. The negative coefficient of training postulates that farmers having more training are technically more efficient than others. The negative coefficient of experience implies that experienced farmers are technically more efficient than non-experienced farmers.

In the technical inefficiency effect model for Local Cotton Production, farm size was negative coefficients. The negative coefficient of farm size implies that large farm households are technically more efficient than small farm households.

Average estimated technical efficiencies for Hybrid Cotton Variety was 92 percent which indicate that Hybrid Cotton production could be increased by 08 per cent with the same level of inputs without incurring any further cost. Increase of only managerial skills result in a substantial increase of output for Cotton.

Average estimated technical efficiencies for Local Cotton Variety was 81 percent which indicate that Local Cotton production could be increased by 19 per cent with the same level of inputs without incurring any further cost. Increase of only managerial skills result in a substantial increase of output for Cotton.

Farmers faced a lot of problems in producing Cotton. The problems were social and cultural, financial and technical. Long duration of cotton cultivation was one of the most important limitations of producing Cotton in the study area. Low price of cotton, Insect attack in cotton field, Adverse climate, Boll rot attack in cotton field, High price of hybrid cotton seed and Lack of operating capital were the major problems faced by farmers. These are the major constraints for the producers of Cotton in the study area. Public and private initiatives should be taken to reduce or eliminate these problems for the sake of better production of Cotton.

9.2 Conclusion

There is a striking gap between the supply and demand of cotton in Bangladesh. Cotton is a necessary raw material for maintaining Bangladesh's current flow of garments export. However, although the demand of cotton is steadily increasing, there is hardly any supply from within the country

Bangladesh aims to produce 1 million bales of cotton by the end of 2025, as the largest cotton importing country meets its total requirement from imports at present. Present study indicate that farmers are technically efficient that means there is an opportunity to increase production to a large extent using the existing level of agricultural inputs, the agricultural extension services and the available technology.

For profitable and commercial cotton production and processing, hybrid as well as high yielding and short duration varieties and good quality seeds are urgent need. Need to introduce Bt cotton to increase per unit yield, and develop own hybrid to sustain cotton in our country as profitable crop. As CDB became the member of NARS, so by the strengthening cotton research CDB ensures high yielding variety and quality seed to the farmers. To develop own hybrid the research facilities within CDB has to strengthen and build a close relation with other NARS institutions and other research organizations inside and outside the country. Also need to be more international collaboration with leading cotton growing countries and cotton research institutions for developing hybrid and Bt varieties.

9.3 Suggestion

On the basis of the finding of the study it was evident that Cotton was profitable enterprises and it can generate income earnings and employment opportunity to the rural people of Bangladesh. But some problems and constraints bared to attain the above mentioned objectives. The policy makers should, therefore, take necessary measures. According to the findings of the study; some policy recommendations may be advanced which are likely to be useful for policy formulation. The following specific recommendation may be made for the development of Cotton sector.

As most of the Cotton farmers are technically efficient at present production technology, improved method of production technology with sufficient storage ability should be introduced.

- As Cotton is a profitable enterprise, government and concern institutions should provide adequate extension programme to expand its area and production.
- Cotton based cropping pattern should be developed and disseminated to those areas of Bangladesh where their production is suitable.
- Government should take necessary measures to lower the price of inputs which have positive significant impact on yield. It will increase the net benefit of Cotton producers.
- Adequate training on recommended fertilizer doses, insecticides, use of good seed, intercultural operations, etc., should be provided to the Cotton farmers which will enhance production as well as technical efficiency by improving the technical knowledge of the farmers.

- Cotton farmers had to sell their product at low price during harvesting or just after harvest. An appropriate storage scheme should be developed so that the farmers are not forced to sell their product at low price during the harvest period.

9.4 Limitations of the Study

There are some limitations of the study thus are indicated below.

a. Most of the data were collected through interview of the farmers and sometimes they did not well-cooperate with the interviewer.
b. The information were gathered mostly through the memories of the farmers which were not always correct.
c. Due to resource and time constraints, broad based and in-depth study was hampered to some extent.

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