

Country Report on Research, Development of Cotton Production in Bangladesh

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Introduction

The textile sector is the important source of growth in Bangladesh's rapidly developing economy. Exports of textiles and garments are the principal source of foreign exchange earnings. Currently, the textile industry in Bangladesh accounts for 45 % of all industrial employment and contributes 5% to the total national income. The industry employs nearly 4 million people; of which women represent higher proportion. Export of textiles and apparel generates 84% of the country's export earnings. Bangladesh exports its apparel products worth nearly \$5 billion per year to the United States, European Union (EU), Canada and other countries. It is the 6th largest apparel supplier to the United States and EU countries. The basic raw material of textile sector is cotton. Bangladesh is the 2nd raw cotton consumer and the highest raw cotton importer of the world. Cotton is an important cash crop of Bangladesh. Two types of cotton are grown in Bangladesh e.g. American Upland Cotton (*Gossypium hirsutum*) and Hill Cotton (*Gossypium arboreum*). American Upland Cotton is grown in 42 districts of plain areas and Hill Cotton is grown in 3 districts of Chittagong Hill Tract areas. Cultivation of American Upland Cotton was started in 1974-75 with the introduction of Deltapine-16, an imported variety from the USA. Since then its area and production has been gradually increased. Hill cotton has been growing in the Chittagong Hill Tract areas in Jhum as a mixed crop for centuries in the hill slopes. But now it is replaced by American upland cotton through rice –cotton intercropping in three hill districts.

Due to the integrated efforts taken by CDB, over the last few years the cotton production had shown a significant increase. In 2020-21, the planting area of American upland cotton in Bangladesh was 27005 hectares and the average lint yield was 1090 kg ha⁻¹. Our yield was higher than our neighboring cotton growing countries such as India (483 kg ha⁻¹) and Pakistan (671 kg ha⁻¹) while it was lower than world top cotton producing countries like Australia (1887 kg ha⁻¹), China (1787 kg ha⁻¹), Brazil (1712 kg ha⁻¹). CDB has targeted to increase lint yield 1400 kg ha⁻¹ within 2025 and 1800 kg ha⁻¹ within 2030. To achieve these targets, the strategies taken by the CDB include: 1. ensuring the quality seed, 2. optimization of production technologies and 3. dissemination of generated technologies.

1. BANGLADESH AT A GLANCE

Bangladesh is a unitary, independent and sovereign republic known as the People's Republic of Bangladesh. Bangladesh emerged as an independent country on March 26, 1971. The national flag of the Republic consist of a circle colored by red throughout its area, resting on a green rectangular background. Currency of the country is known as Taka (Tk). The citizens of Bangladesh are known as Bangladeshi. The Republic comprises three basic organs: (1) The legislature (2) The judiciary (3) The executive. The President of Bangladesh is elected by members of Parliaments in accordance with law. He is head of the state. The president acts in accordance with the advice of the Prime Minister. The president appoints the Prime Minister from the Member of Parliament who appears to him/her to command the support of the majority of the members of parliament (MP). The executive power of the Republic is exercised by or on the authority of the Prime Minister. The supreme commander of the defense services vest in the President. No war can be declared and the Republic cannot participate in any war except with the assent of Parliament.

Geographical Location: South Asia, between 20o34' and 26o38' North latitude and between 88o01' and 92o41' East Longitude, consist of food fertile alluvial land.

Boundary: North- India, West- India, South- Bay of Bengal and East- India and Burma.

Capital city: Dhaka

Area: 1, 47,570 sq.km. Or 56, 977 sq. miles.

Total population: Near about 160 million (Muslims - 90%, Hindus- 9% and others-1%).

Annual growth rate: 1.36%

Per capita income: 2554 US dollar.

Climatic variations: The climate of Bangladesh is tropical monsoon marked by sweltering temperature and high humidity. Bangladesh has mainly four seasons. Summer (March-May), Monsoon (June-September), Autumn (October-November) and Winter (December-February).

Rainfall:

1194 mm to 3445 mm (Average during monsoon, June-August).

Humidity:

Highest 99% (July), lowest 36% (December & January).

The Economy:

GDP growth rate: 6.40%.

Growth rate in Agriculture: 3.10%

Contribution of Agriculture in GDP: 12.65%.

Contribution of Garments industries in GDP: 18%

RMG contributes 84% of total export

2. Quality seed production

Since its establishment in 1972, one of the core activities of CDB is the production of quality cotton seed. CDB maintains 601 cotton genotypes in its germplasm center located at Mahigonj, Rangpur. Continuous efforts are taken by the Cotton Breeders of CDB for the development of high yielding varieties with desirable traits. CDB used to produce breeder seed, foundation seed. For providing the farmers quality cotton seed the main activities of Cotton Development Board are:

- I. variety maintenance & improvement,
- II. seed production and
- III. seed processing.

I. Variety maintenance and improvement

Till to date, CDB has released seventeen high yielding American upland cotton (*Gossypium hirsutum*), three hill cotton (*Gossypium arboreum*) and one hybrid cotton varieties. The key characteristics of the released varieties are given in Table 1. The methods adopted for variety maintenance and improvement are Single Plant Selection, non-replicated progeny row trial, replicated progeny row trial, preliminary yield trial, advanced yield trial and on-farm trial. Hybridization among different parents is done to develop hybrid cotton variety. With the technical support from the International Atomic Energy Agency (IAEA), CDB has adopted mutation breeding for the development of climate resilient cotton varieties (Fig. 1). For the release of Bt cotton regulatory trials are being conducted by the CDB (Fig. 2).

Table 1. Characteristics of cotton varieties

Variety	Boll/ plant	Boll weight (g)	Plant height (cm)	Seed cotton yield (t/ha)	Duration of life cycle	GOT (%)
CB-1	20	4.40	115	2.10	170-180	38.00
CB-2	33	5.40	121	2.00	170-180	36.47
CB-3	25	5.00	90	2.30	150-165	37.00
CB-4	42	6.00	134	2.25	180-200	37.86
CB-5	47	5.10	133	2.00	180-195	40.00
CB-6	35	5.60	129	2.50	186-200	36.85
CB-7	34	5.60	121	2.50	180-195	38.53

CB-8	35	4.0	105	2.50	180-195	35.00
CB-9	44	5.80	106	2.50	190-200	35.75
CB-10	42	5.50	126	2.00	160-180	34.00
CB-11	43	5.70	106	3.50	160-175	35.00
CB-12	40	5.50	130	4.00	170-180	40.00
CB-13	40	6.00	130	4.20	170-180	42.00
CB-14	45	6.00	135	4.50	175-185	39.50
CB-15	40	6.50	140	4.50	180-190	40.00
CB-16	40	5.5	137	4.5	175-185	42
CB-17	40	6.0	135	4.5	180-190	42
HC-1	13	2.94	205	1.80	190-195	40.50
HC-2	27	3.02	206	1.60	190-195	41.00
HC-3	20	4.5-5	170	2.5	170-180	46.00
Hybrid-1	65	6-6.5	160	5- 6	165-175	42.00

II. Cotton seed production

Seed production and distribution is one of the major activities of Cotton Development Board. CDB is the only producer of Breeder and Foundation seeds of cotton in Bangladesh in its research centers. Available areas for of these research centers are given in Table 2. However, truthfully labeled cotton seed are produced under the supervision of CDB field officers through contact farmers. CDB produces breeder seed and foundation seed in two research centers and three seed multiplication farms. Truthfully labeled seed or certified standard seed are produced through contract farmers in selected and isolated seed production blocks. The seed cotton produced by the contact farmers is procured at a relatively higher price.

Table 2. Research Infrastructure of CDB

SL. no.	Location	Total Area (acre)	Cultivable area (acre)	Others(acre)
1	Cotton Research Center Sreepur, Gazipur	59.1	44.1	15.0
2	Cotton Research Center Sadarpur, Dinajpur	50.4	33.1	17.3
3	Cotton Research Center Jagadishpur Jessore	61.8	43.7	18.1
4	Cotton Research Center	9.3	7.1	2.2

Mahigonj Rangpur

5	Hill cotton Research Center Balaghata, Bandarban	5.9	3.6	2.3
Total=		186.4	131.6	54.8

The quantity of cotton seed produced by CDB over the last ten years is given in Figure 3. In 2009-2010, 32 tons of cotton seed was produced that increased to 78 tons in 2018-2019. CDB has targeted to produce 100 tons of cotton seed in 2025 and 150 tons of cotton seed in 2030.

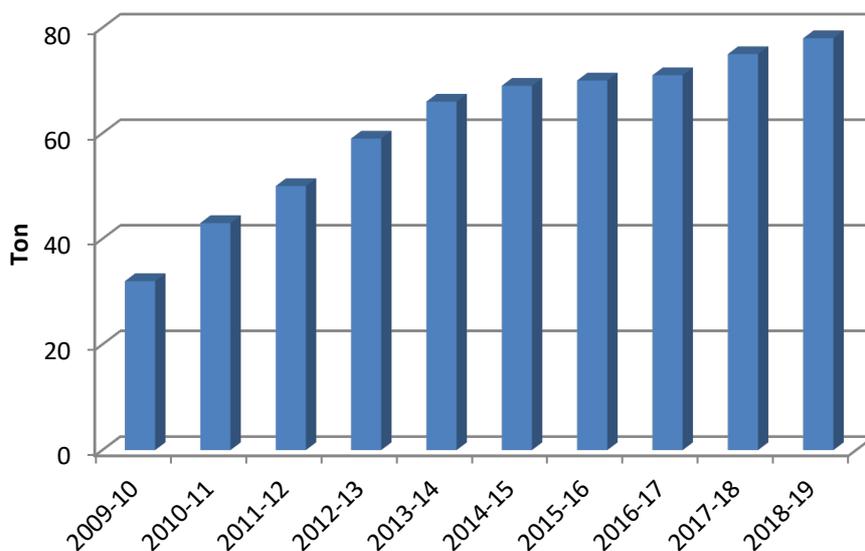


Figure 3. Cotton seed production by year

In order to utilize the produced cotton seed, CDB has taken necessary steps to expand cotton growing areas. In 2018-2019, cotton was grown over 44185 hectares of land. CDB has targeted to increase cotton growing areas to 75000 hectares within 2025 and 100000 hectares within 2030. Study on suitability of cotton conducted by the Bangladesh Agricultural Research Council showed that in Kharif 2 season 25.59 Lac hectares of land is highly suitable for cotton cultivation (Fig. 4). However without replacing the food crop from the fertile land, CDB has targeted to expand cotton cultivation in the low productive areas such as drought prone, saline areas in coastal region, and hill tracts.

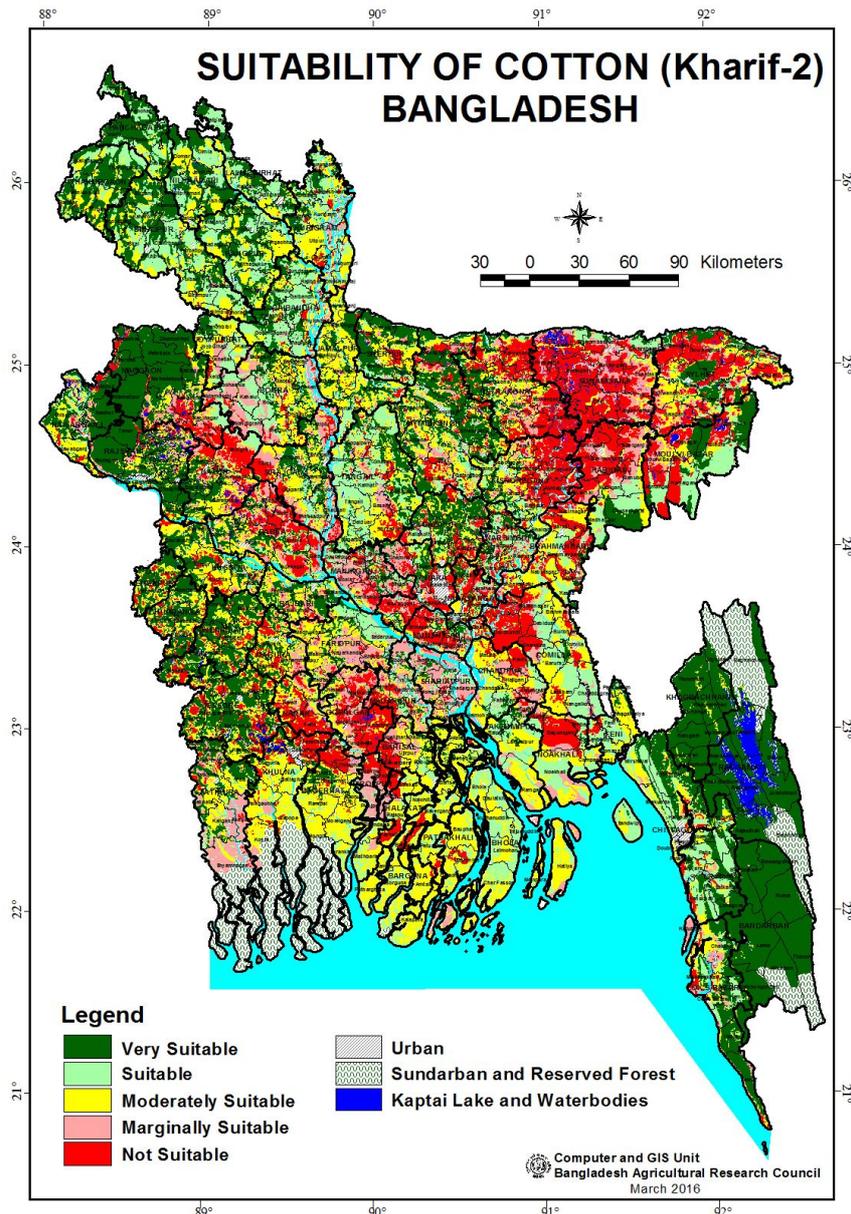


Figure 4. Suitability of cotton in Kharif 2 season

Drought prone areas are mainly located in the north-western and northern regions of Bangladesh and spread over an area of 5.46 million ha. Among the regions, north-western Barind tract is specially drought prone. In these areas the severity of drought is increasing day by day due to the impact of climate change. Improvement of cotton genotype tolerance to drought has received increasing attention in crop improvement programs of CDB. The marked genetic variability in desirable traits among cotton germplasm has great potential for exploitation through conventional and/or molecular breeding approaches.

The coastal region covers almost 29,000 sq. km i.e. about 20% of the country with more than 30% of the cultivable lands of the country. About 53% of the coastal areas are affected by salinity.

Agricultural land use in these areas is very poor, which is much lower than country's average cropping intensity. Although, cotton is considered a pioneer crop in reclamation of saline soils, its growth and development as well as yield and fiber quality are adversely affected by excessive soil salinity. Development of salt tolerant cotton varieties was initially attempted by CDB through direct selection from the existing cotton varieties and germplasm.

Chittagong Hill Tracts (CHT) is the extensive hill area located in the southern eastern part of Bangladesh. The area of the Chittagong Hill Tracts is about 13,184 sq km. Shifting agriculture (jhum) is still the dominant cultivation systems in this region. Cotton is grown as a component crop of Jhum. Several adaptive trials were conducted by CDB in the hill slope and generated rice - cotton intercropping technology, as an alternative option, which provide more yield and income to the hill farmers.

For successful expansion of cotton cultivation in low productive areas, CDB has taken intensive program to produce quality seed combining the advance biotechnology tools with traditional knowledge as well as initiated collaborative work with international development partners.

III. Cotton Seed processing

Harvested seed cotton contains seed and lint. Cotton seed and lint are separated by ginning machines at five cotton research centers of CDB. In addition to that CDB has eleven ginning center across the country. After ginning, cotton seed is processed and stored in the ginning centers for distribution among the farmers in the next crop season. Seeds are distributed to the farmers through the unit and sub-unit offices.

3. Optimization of production technologies:

To generate cotton production technologies, CDB has been conducting research since 1991. CDB conducts research to develop hybrid and short duration high yielding cotton varieties with desirable fiber characteristics, to generate agronomic management technologies to increase productivity, integrated management of soil fertility combining organic and inorganic sources of fertilizer, development of bio-pesticide in controlling cotton insect pest, cotton disease management, identification of cotton seed health and identification of the factors affecting the cotton fiber quality. Besides, research on stress management has been prioritized to expand cotton cultivation in the hill, char, saline and drought areas combining the traditional knowledge and skill with advanced biotechnology tools. Recently, Bt cotton research was initiated by CDB to introduce Bt cotton in Bangladesh. Moreover, in order to develop drought tolerance cotton varieties, CDB has commenced

mutation breeding program. Cotton research has been conducting in 5 disciplines (Breeding, Agronomy, Entomology, Pathology and Soil Science) at the research farms/centers. Research on upland cotton is conducted at Mahiganj (Rangpur), Sripur (Gazipur), Sadarpur (Dinajpur) & Jagadishpur (Jessore) research farm/centre. While research on Hill Cotton is conducted at Hill Cotton Research Center located at Balaghata, Bandarban and 3 Sub-Centers (Raicha, Bandarban; Kawkhali, Rangamati & Matiranga, Khagrachari). Till to date CDB has generated 56 technologies (Table 3).

Table 3. Technologies generated by the Cotton Research in Bangladesh

Sl. No.	Discipline	No. of Achievement
1.	Breeding	21 varieties
2.	Agronomy	18 technologies
3.	Entomology	7 technologies
4.	Soil Science	10 technologies
5.	Pathology	2 technologies

4. Dissemination of generated technologies

For the dissemination of the generated technologies, CDB provides extension services to the cotton farmers in 32 districts and 112 upazilas of the country. Extension activities are implemented through four Regional Offices (located at Jessore, Rangpur, Dhaka and Chittagong) and 13 Zonal Offices those are located at Jashore, Kushtia, Jinaidah, Chuadanga, Rajshahi, Bogra, Rangpur, Thakurgaon, Mymensingh, Dhaka, Rangamati, Khagrachari and Bandarban). Each zone is divided into units/sub-units depending on the intensity of cotton cultivation. Total number of unit/sub-unit offices is 181. Each unit is headed by a Cotton Unit Officer and a Sub-unit is headed by a Store-cum-Field man or Assistant Cotton Unit Officer. Unit / Sub-unit offices are the basic grass root level extension offices of CDB. Main extension activities at the field level are to motivate farmers to grow cotton, transfer of improved production technology and advisory services to the cotton farmers through regular field visit by the grass-root level extension workers i.e. Cotton Unit officers, Store-cum-Field man and Assistant Cotton Unit Officers. Extension workers interact with the cotton farmers individually and as well as in groups. Demonstration plots are established in the units/sub-units.

Cotton is a cash crop and involved in international trade, therefore, its marketing system is relatively complex. The marketing and processing of cotton starts from the farm gate after harvest of cotton and goes through various steps of processing. Private ginners provide ginning facilities of the seed cotton harvested by the cotton growers. Ginning is a process to separate seed and fiber. There are around 20 number of private ginners in the main cotton growing areas who procure seed

cotton from cotton growers. These are the middle stage processing centre for the seed cotton produced by the farmers and they play important role for cotton production and marketing. After ginning, fiber is sent to the spinning mills and seed is used for oil extraction by expeller. The crude oil is then brought to the oil refinery factory to produce edible oil. The oil cake is used for animal or fish feed.

5. Intercropping:

Cotton is a long duration crop. It will take at least 5-6 month from sowing to harvest. Generally, cotton is sowing a wide range of distance (90cm x 60 cm). To make the crop more profitable and to provide additional income to the farmers, the introduction of inter and relay cropping with well experienced management practices have open up a new hope of better competitiveness of cotton crop in cotton cultivation. So, much emphasis and stress have been given to inter and relay cropping of cotton for getting more total income from the same piece of land. This system of cotton cultivation has already gained popularity due to the rational and tireless efforts of CDB extension staff. Among the inter crops Amaranths sp. (Red amaranth, amaranth), radish (as leafy vegetables), onion, mungbean, chili, turmeric, ginger etc. have been successfully cultivated as inter and relay crops with cotton. Farmers are getting about 25% more net profit by growing different leafy vegetables and about 50% by growing turmeric/ginger with cotton. Sowing of wheat between cotton rows in November also revealed encouraging results. Inter cropping of ground nut with cotton was also reported to give more total income over the sole cotton.

Table 4: Fertilizer Management of upland cotton:

Sl.no.	Name of Nutrients	Dose kg/ha	Forms of fertilizer
1.	N	105	Urea
2.	P ₂ O ₅	35	Triple Super Phosphate
3.	K ₂ O	100	Muriate of Potash
4.	S	18	Gypsum
5.	Zn	7.2	Zinc sulphate
6.	Mg	3.7	Magnesium sulphate
7.	B	3.4	Borax
8.	Organic matter	6000	Cow dung

N, P₂O₅, K₂O, Zn, Mg, Boron in the form of Urea, Triple Super phosphate, Muriate of Potash, Gypsum, Zinc Sulphate, Magnesium Sulphate, and Borax respectively and Cow dung are being used by the farmers. One fourth of Urea(N) & MOP(K₂O) from total requirement, and total amount of required TSP(P₂O₅), Gypsum(S), ZnSo₄(Zn), Mgso₄(Mg) and Borax(B) and full of Cow dung are applied at the time of sowing. The rest quantity of Urea (N) & MOP (K₂O) applies as side dress in three equal splits after 20, 45 and 65 days after sowing.

6. Hill Cotton: (Gossypium arboreum)

Cotton is important crop in hill farming. Hill cotton is grown in three hill districts of Bangladesh (Khagrachari, Bandarban and Rangamati) since the prehistoric time. Hill cotton is a long duration crop and generally hilly farmers grow cotton in (shifting cultivation) which is locally called jhum i.e they cultivate cotton with other crops like rice, maize, chilies, sesame, ladies finger, marpha, arhor etc. in the same pit at a time in the hill slopes and harvested sequentially. The short staple, coarse type Hill cotton has demand in external market besides its local use for handloom clothes in hill districts. Some quantities of Hill cotton is exported to other countries. The yield of Hill cotton is generally very low and varied widely over the years. The season for the Hill cotton is from May-October.

7. Cotton Oil & Oil Cake

Private ginneries produce cotton crude oil. Some of them are used in soap industries and rest of the crude oil is refined by refine industry for edible purpose. The speller machine used by the ginneries for oil extraction, which can extract 15 to 18% crude oil from cotton seeds. Cotton oil refinery industry can produce 78 to 80 kg refined oil from 100kg crude oil. The oil cake is generally used for livestock feeding. Cotton oil cake has high demand in the market for multiple uses. Rural based ginning facilities and cotton oil processing plants is promoting rural industries and creates employment opportunity. This will have very significant social and economic impact both at the farmer level, regional level as well as macro level.

8. Hybrid Cotton Production

CDB has so far evaluated hybrids cotton varieties provided by different seed companies since 2006. Their yield performance was much higher than the local inbred varieties. These were supposed to give 40-45% higher yield than the CDB existing varieties. But the seed costs of hybrids are much higher than open pollinated varieties. However, CDB is still searching superior cotton hybrids for improvement of yield per unit area and uniformity in growth, flowering and first boll-split.

9. FUTURE DIRECTION

Cotton to Fit into Farmers' cropping patterns

The land resource is very much limited in the country. Cropping intensity of Bangladesh is very high (about 180%). Farmers expect to have maximum total return from their land in a given time period. Many farmers show reluctance in cotton cultivation for its long maturation period of about 6 months. As such, a short duration variety of around 4.5 months combined with moderate yield is very much needed to satisfy the long felt demand of farmers. This type of variety may be accommodated very effectively in the cropping patterns of northern districts particularly where winter comes earlier than the other parts of country. More emphasis will be given on the aspect of research.

Insect/Pest Issue

Sucking pest infestation at an early stage of crop growth is quite hazardous and very often escapes the notice of farmers causing heavy damages to the non-hairy cotton varieties under cultivation in the country. Cultivation hairy variety is most effective measure in controlling the infestation. Work on this dimension of research is going on since 1985. A highly tolerant variety to sucking to sucking pest attack associated with higher yield is yet to be found out. The newly evolved variety CB-18 is moderately tolerant Jassid. Research in this line would be strengthening to find out a Jassid tolerant cotton variety with high yield potential.

Bollworm especially American bollworm is another virulent insect causes most of the damages to cotton crop. Hand picking of larvae followed by use of insecticides at economic injury level under the IPM concept is found to be very effective and economical in controlling the attack of this insect. However, farmers are not to be attentive in adopting this method. The farmers spraying insecticides, which is not very effective neither the practice is economic. The farmers needed training in this area as well as well as they are to be motivated for effective control of bollworm.

Conclusion

Cotton contributes in our society in various ways. Cotton increases food security of the rural farmer's in many ways. Cotton seed is sown manually in furrow by maintaining 90 × 45 cm spacing. At the early growing stage of cotton, intercropping with vegetables, chili, mungbean is adopted by the farmers of Bangladesh. Moreover, relay cropping of turmeric, ginger, banana, chili, wheat and sugarcane also gains popularity among the farmers. These practices by increasing farmer's income, improve the farmer's food purchasing capacity.

The main source of rural employment is the agricultural farming activities. From seed sowing to drying of harvested boll 400-450 person/ha is required in Bangladesh. It creates employment opportunity particularly for the rural woman because of dry land farming of cotton is more preferable to them than wet land rice farming. Biomass fuel is the main source of rural household energy in Bangladesh. Cotton is a woody plant and the stalks are used as fuel wood by the farmers. On an average 4.8 tons of stalks are produced per hectare of land.

In addition to the fiber, the main raw material for textile sector in Bangladesh, cotton by-products such as seed oil, oil cake and fuel wood are also contributing to national economy by value addition. The harvested boll known as seed cotton generally contains 40% lint and 60% seed. Cottonseed contains hull and kernel. The hull produces fiber and linters. The kernel contains oil, protein, carbohydrate and other constituents such as vitamins, minerals, lecithin, sterols etc.

Cottonseed oil is extracted from cottonseed kernel. Presently, cotton seeds are used by the 18 crude oil crushing industries to produce crude oil (25%) and oil cake (75%). One oil refinery industry in Bangladesh refines the crude oil to produce edible oil. The oil cake is generally used as organic fertilizer, fish feed or livestock feed. Cotton seed oil is edible oil which is important food item. Cotton oil cake contributes in livestock and fish production which indirectly contribute in farmer's food security.

Bangladesh is a climate change hotspot with a high frequency of natural disasters such as flood, drought etc. Climate change is putting extra strain on the rural peoples of the low productive areas of Bangladesh, where traditionally grown crops are found no longer profitable to them. Promoting cotton cultivation is found to be a viable option to mitigate the negative impact of climate change. Moreover, increasing of the domestic cotton production will simultaneously contribute to the economy by reducing the import dependency of raw cotton. Considering the national importance as well as the value addition by cotton, the vision 2020-2021 of CDB is to expand cotton cultivation over 100000 hectare of land and to achieve this target CDB has been implementing several development project/program funded by the Bangladesh Government.

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