

Competitive Research Grant
Sub-Project Completion Report

on

**Tobacco Replacement Through High Value and
Nutrient Rich Crops for Food Security and
Nutrition of Charland People Under Bhuapur
Upazilla of Tangail**

Project Duration

May 2016 to September 2018

**On-Farm Research Division,
Bangladesh Agricultural Research Institute**



Submitted to
Project Implementation Unit-BARC, NATP-2
Bangladesh Agricultural Research Council
Farmgate, Dhaka-1215



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Project Implementation Unit

National Agricultural Technology Program-Phase II Project (NATP-2)

Bangladesh Agricultural Research Council (BARC)

New Airport Road, Farmgate, Dhaka – 1215

Bangladesh

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Acronyms

AEZ	:	Agro-ecological zone
BARC	:	Bangladesh Agricultural Research Council
BARI	:	Bangladesh Agricultural Research Institute
BCR	:	Benefit cost ratio
BHM	:	BARI Hybrid Maize
BINA	:	Bangladesh Institute of Nuclear Agriculture
BIRRI	:	Bangladesh Rice Research Institute
CRG	:	Competitive Research Grant
DAE	:	Department of Agriculture Extension
NATP	:	National Agricultural Technology Program
OFRD	:	On-Farm Research Division
PIU	:	Project Implementation Unit
SRDI	:	Soil Resource Development Institute

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Executive Summary

Char land is the Bengali term for Mid-channel Island that periodically emerges from the riverbed as a result of accretion. The whole of the *char* land is unstable and prone to annual flooding. The *char* dwellers are some of the poorest and most vulnerable people particularly those who live on the Island/attached river *chars*, although people living on the unprotected river banks experience similar difficulties. In Tangail district total charland area is 19763 ha, among this under Bhuapur it is estimated to be 9662 ha under AEZ#7 & 8. Due to lack of money and profitable offers from different tobacco companies some farmers are inspired to cultivate tobacco and the land owner also get Tk. 6000 to 7000 as a rent for one bigha (33 decimal) of land during tobacco cultivation period from tobacco businessman, which is very harmful for soil and human health. There is a great scope to replace tobacco by cultivating different high value and nutrient rich crops such as black cumin, wheat, maize, groundnut, sweet potato, chili, vegetables (bottle gourd) etc with the BARI released newly modern cultivars. A baseline survey was conducted at the project implementing area with 60 farmers. It was observed that most of the sample farmers' cultivated local variety with insufficient, and imbalanced fertilizer. They cultivate groundnut, tobacco, wheat, maize, jute, aman rice, sesame, grass pea etc. Tobacco- Jute/Sesame- Fallow, G.nut/Lentil -Fallow- Fallow, Wheat/Maize -Jute/Sesame-Fallow etc are the major cropping patterns in the study area. Lack of knowledge about new crop variety/technology was the main problem of the farmer and it was due to insufficient training and less awareness of the farmers.

The project was undertaken in two villages (Basalia and Gobindashi) of charland area of Bhuapur upazilla with different high value crops to replace tobacco. The project activity was conducted among 74 farmers covering 15.41 ha of land. Two types of research work have been conducted in this project. One was adaptive research and another was field demonstration. In adaptive research five crops (wheat, maize, groundnut, sweet potato and black cumin) were tested with new improved varieties against their old varieties among 30 farmers covering 0.65 ha of land. In case of field demonstration six crops (wheat, maize, groundnut, black cumin, chilli and bottle gourd) were demonstrated with their high yielding new varieties among 74 farmers and covered 14.76 ha area.

From the adaptive research and field demonstration it was observed that all modern wheat varieties gave 27.08 to 63.14% higher grain yield and income was increased 32.46 to 67.74% over locally used variety (Sonali). BARI released hybrid maize varieties gave 6.19 to 45.61% higher grain yield and 41.57 to 60.75% higher income compared to locally available hybrid maize variety (Pasific 984). Modern groundnut varieties gave 14.73 to 64.48 % higher yield against locally used Dhaka-1 variety and incase of demonstration, BARI Chinabadam-8 provided 54.66% higher pod yield which gave 117.88% more income (gross margin) than Dhaka-1. Newly released sweet potato varieties gave 9.02 to 27.75% higher yield and 13.69 to 42.10% higher income than local variety. Black cumin (BARI Kalozira-1) was established among the charland farmers of Bhuapur. BARI Kalozira-1 gave 44.12% higher yield and 49.20% higher income over the local black cumin variety. Chili and bottle gourd gave more economic return among the farmers in the project area. All modern varieties gave more yield (6.19 to 64.48 %) and economic return (13.69 to 117.88%) against local varieties due to their higher yield potentiality and proper management practices. Except wheat all high value and nutrient rice crops ensured 97.13 to 446.38 % higher income (gross margin) instead of tobacco.

However, it was revealed that high value crops increased crop productivity, farm efficiency and farmers income in char land ecosystem as well as created awareness among char land people about harmful effect of tobacco cultivation.

CRG Sub-Project Completion Report (PCR)

A. Sub-project Description

1. **Title of the CRG sub-project:** Tobacco replacement through high value and nutrient rich crops for food security and nutrition of charland people under Bhuapur upazilla of Tangail
2. **Implementing organization:** Bangladesh Agricultural Research Institute
3. **Name and full address with phone, cell and E-mail of PI/Co-PI (s):**
PI: Mohammad Asiqur Rahaman, Senior Scientific Officer, On-Farm Research Division, Bangladesh Agricultural Research Institute (BARI), Tangail-1900, Cell phone:01717210374, Email: asiqurbari@ymail.com
Co-PI: Md. Mahmudur Rahman, Senior Scientific Officer, On-Farm Research Division, Bangladesh Agricultural Research Institute (BARI), Tangail-1900, Cell phone: 01711671291, Email: ofrdtangail@gmail.com
4. **Sub-project budget (Tk):**
 - 4.1 Total: 29,86,949.00(Twenty-nine Lac eighty-six thousand nine hundred forty-nine Taka only)
 - 4.2 Revised (if any): 29,86,949.00 (Twenty-nine Lac eighty-six thousand nine hundred forty-nine Taka only)
5. **Duration of the sub-project:**
 - 5.1 Start date (based on LoA signed): 14 May, 2017
 - 5.2 End date: 30 September, 2018
6. **Justification of undertaking the sub-project:**

Chars are newly developed lands in different river beds and basins that comprise the area of approximated 0.82 million ha in Bangladesh (Ahmed et. al., 1987) out of which about 64 to 97% area are cultivable. Cultivated soils of chars are mostly sandy loam to silty loam with slightly acidic to slightly alkaline in reaction and deficient in plant nutrients as well as organic matter content (SRDI, 2002). Total charland area of Tangail district is 19763 ha, among this under Bhuapur it is estimated to be 9662 ha (DAE, Tangail, 2009) under AEZ# 7 & 8. Most of the charlands remain fallow during rabi season. Main constraints of charlands are drought, uncertain flood, duration of flood, education, less knowledge about modern agriculture, communication etc. Coarse textured soils, low water holding capacity and low soil fertility are the major constraints of agriculture to achieve satisfactory yield. Generally top soils are dried quickly but sub-soils remain wet for longer time. Due to lack of money and profitable offers (i.e., providing necessary inputs, cost-free seedlings and incentives with an assurance of lucrative prices, easy to market access and sell etc.) from different tobacco companies some farmers are inspired to cultivate tobacco and the land owner also get Tk. 6000 to 7000 for rented of one bigha (33 decimal) during tobacco cultivation period from tobacco businessman, which is very harmful for soil and human health. In Tangail total 134 ha area goes under tobacco of which about 56 ha under Bhuapur. There is a great scope to replace tobacco by cultivating different high value and nutrient rich crops such as black cumin, wheat, maize, groundnut, sweet potato, vegetables etc with their newly released modern cultivars. So, there is a great scope to increase of crop productivity and income in charlands by replacement of tobacco through cultivation of modern varieties of different high value crops as well as adoption of improved management practices.

7. **Sub-project goal:** Tobacco replacement and increase food security and nutrition for charland people of Bhuapur, Tangail.

8. **Sub-project objective (s):**

8.1 To ensure food security and nutrition for charland people by replacement of tobacco with high value and nutrient rich crops.

8.2 To increase productivity, income and change livelihood by adaptation and dissemination of high value and nutrient rich crops against tobacco

8.3 To develop skill, knowledge and awareness of the farmers

9. **Implementing location (s):** Two different village (Basalia and Gobindashi) at different union (Char land area) under Bhuapurupazilla of Tangail

10. **Methodology in brief:**

The project involves a substantial amount of on-farm experiments and dissemination of new high value and nutrient rich crops (i.e., black cumin, wheat, maize, groundnut, mustard, sweet potato, vegetables, chilli, sesame etc). Adaptive research and field demonstration were carried out among the 74 farmers' field covering 15.41 ha land under charland ecosystem in two villages (Basalia and Gobindashi) of Buapurupazilla with different high value crops to replace tobacco.

The baseline survey was conducted among the 60 farmers. Data on farm households were collected from the above mentioned 2 villages survey under the project. At first, a list of all farm households from the represented villages was prepared and then 60 farm households of the villages were selected using random sampling technique method. Primary data was collected from the respondents (growers and intermediaries) using pre-design interview schedules. Before going on an actual interview, a brief introduction of the aims and objectives of the study were provided to each of the respondents. The questions were asked systematically in a very simple manner and information were recorded on the interview schedules in order to minimize errors. Data were collected in the local unit and finally converted into standards units (MT). After collection of the data, each interview schedule was verified for the sake of consistency and completeness. Editing was done before putting the data on the computer. Summarization, careful scrutiny and necessary summary tables have been made from the data. Tabular techniques have been used for analysis, interpretation, and presentation of data to fulfill the objectives of the baseline survey.

The project focused mainly BARI released crop varieties and agronomic management practices for the above-mentioned area. On-farm trials of black cumin, wheat, maize, sweet potato and groundnut was conducted. At the same time best performed varieties (earlier reported by BARI) of different crops i.e., chilli, bootle gourd, black cumin, wheat, maize and groundnut was demonstrated among the farmers. Under this project 15.41 ha land cultivated along with different crops. Two scientific assistant have been existing in the worked in project area (MLT site Bhuapur, Tangail) to conduct research work and demonstration. They got one basic pay per year. Labour haired when as needed.

The detailed methodologies:

I. **Farmer selection:** Farmers selected on the basis of farm size (Small and marginal), elevation of land, experience and existing resources.

II. **Training program:**

Farmers training- Two training program named production technology of black cumin, wheat, maize, groundnut, sweet potato, chilli and vegetables etc was conducted during the project period. In each training program 35 participants were included.

III) Field trial/production program/activities:

During the project time, 70 farmers were selected from the project area. All activities was conducted in *rab* season and some activities also conducted in kharif season. First year, adaptation and validation was accomplished through research activities, validated varieties and technologies demonstrated at the same time.

IV) Field Day: Field days was arranged on different crops at its growth stages to observe their good performance among the farmers, researchers, extension people and printing and electronic media.

V) Documentation: Two TV news on charland agriculture in Tangail was telecast on Channel I and final project completion report also completed.

VI) Reporting: Findings of research activities was documented.

11. Results and discussion:

a. Baseline survey:

Baseline survey was conducted among the 60 sample farmer in the two villages (Basalia and Gobindashi) of charland area at Bhuapurupazilla under Tangail district. The major outputs of baseline survey are given below-

Socio-economic outline

In general farmer's age, education, household size, farm size, etc., are the indicator of socio-economic outline. These are very much related with farming systems. In most of the cases, farming activities depends on farmer's age, education, size of household and size of farm .



Age Distribution, Literacy Level and Farm Category of Selected Farmers

Age, literacy and farm size have important impact on decision making processes of agricultural production. These help a person to make right decision regarding his farm business and to obtain new information of various production processes.

The younger farmers are more technically efficient than the older farmers and a younger farmer can easily adopt new technology and thereby increase his efficiency. The sample farmers were aged more than 33 years. The average age of the farmers of study areas is 53 years and it ranges from 33 to 85 (Table 1). Level of education of the sample farmers has been divided into five groups, illiterate, primary level secondary level, higher secondary level and above higher secondary level. It had observed that the highest percentage of the farmers was in illiterate level (33%) whereas lowest in above higher secondary school level (4%). Only 21% was up to class V, 29% was up to SSC level. and rest 13% was up to HSC level.

Table 1. Average age and educational level of sample farmers

Farmers age (year)	Educational level (%)					
	Illiterate	Primary level	Secondary level	Higher Secondary level	Above higher Secondary level	Total literate
53	33	21	29	13	4	67

Family Composition, Farm Size and effective family labor of the Selected Farmers

A family size has been defined as the total number of persons of either sex living together and taking meals from the same kitchen under the administration of a single head of the family. The family member considered are wife, sons, unmarried daughter, father, mother, brother and other relatives who live permanently in the family. The national average family size of Bangladesh is 4.50 members (HIES, 2010). The average family size for sample farmers was 5.30 (Table 2).

In this study, the land holding of the sample selected farmers was defined as the sum total of all types of land possessed by the farmers and having legal right on it. Land distribution of farmers is presented in Table 2. The average farm size of either category was 0.84 ha where the percent of the marginal, small and medium categories were 4, 71 and 25 decimals, respectively. The small and large categories farm was absent in the study area. In the survey area the average effective family labour was 2.46.

Table 2: Average family size and farm size of the sample farmers

Family size (no.)	Farm Categories (%)					Effective family labor (Av.)
	Landless (0-0.02 ha.)	Marginal (0.021-0.20 ha.)	Small (0.021-1.00 ha.)	Medium (1.1- 3 ha.)	Large (above 3 ha.)	
5.30	0	4	71	25	0	2.46

Soil Type of the Sample Farmers

There are three soil types available in the study area and in most of the area are sandy loam(70.83%) followed by loam soil (20.84%) and clay loam soil (8.33) (Table 3). This also indicates that there is limited scope for crop diversification.

Table 3: Soil type of the sample farmers at charland area of Bhuapur, Tangail

Soil type		
Sandy Loam	Loam	Clay Loam
70.83	20.84	8.33

Irrigation Status of the sample farmers

Irrigation water is available but the farmers are not habituated to provide it. They gave irrigation only in maize.

Major Farming Systems Followed by the Sample Farmers

The realization of existing farming systems is very much important to adopt any new technology in a certain area. Among the study area maximum farmers (42%) practiced Crop + Livestock farming system and 33 percent farmers practiced Crop + Livestock + Poultry farming system. Only Crop practiced by 13% farmers. Rest 12 % sample farmerpracticed Crop+ Poltry (4%), Crop + Poltry Fish + (4%) and , Crop + Poultry + Livestock + Fisheries farming system(Table 4).

Table 4: Major farming systems of the sample farmers

Major Farming Systems	Percent (%) ofhouseholds
Crop	13
Crop + Livestock	42
Crop + Poultry	4
Crop + Livestock + Poultry	33
Crop + Poultry + Fisheries	4
Crop + Livestock + Poultry + Fisheries	4

Cropping Patterns Practiced by the Sample Farmers

The major cropping patterns practiced by the sample farmers were

- Tobacco- Jute- Fallow,
- Tobacco- Sesame- T.aman,
- G.nut -Fallow- Fallow,
- G.nut + Lentil-B. Aus (76)/ Sesame- Fallow,
- Wheat -Jute/ Sesame-Fallow,
- Khesari- Fallow -T. Aman (Gainja/ Chamara),
- Maize -Sesame/ jute -Fallow,
- Lentil -Jute -Blackgram,
- G.nut -Sesame + B. Aman (Chamara),
- Wheat -Jute-T. Aman.

Variety wise information

In the survey area, most of the farmers used Dhaka-1 as groundnut variety, wheat var.sonali, BARI Gom-24 and BARI Gom-26 was used. B/T. Aman rice was found with gainja and chamara varieties. In the study area farmers cultivated maize with commercial hybrid maize variety (Pacific, Don, Elite, Miracal,), FalguniTosha(O-9897) jute varieties used for jute production.

Use of Input

Labor, Seed, Urea, TSP, MP, Zn, Boron, Gypsum, Cowdung, Pesticide, Irrigation, tillage are the main inputs for crop production. In the charland area, groundnut, T. Aman rice, wheat, maize and Jute are the main cultivated crops. Mostof the farmers used minimum dose of input than the recommended dose and obtained poor yield (Table 5).

Table 5: Average per hectare input use in the cultivated crops atcharland area of Bhuapu, Tangail

Name of crops	Input use											Tillage cost (Tk ha ⁻¹)
	Human labor (m ^d)	Seed (kg)	Urea (kg)	TSP (kg)	MP (kg)	Zinc sulphate (kg)	Boric acid (kg)	Gypsum (kg)	Cow dung (Tk)	Pesticide (Tk.)	Irrigation (Tk.)	
T. Aman rice	59	45	120	109	73	15	0	75	500	0	0	7875
Wheat	68	130	175	153	70	47	0	80	3000	0	5042	6937
Maize	69	14	630	435	221	37		92	4500		8438	6750
Jute	126	8	91	69	45	0	0	112	0	0	0	7500
Groundnut	73	98	75	37	157	0	0	0	0	1500	0	5250

Cost and Return of Different Crops

Total cost, gross return, gross margin and BCR have been shown in the table 6. In the study area, the highest gross margin was in chilli cultivation followed by ground, maize, potato, jute, T. Aman, wheat and boro rice, respectively.

Table 6: Cost and return (Tk. ha⁻¹) of different crops of sample farmers at atcharland area of Bhuapu, Tangail

Items	T. Aman	Maize	Wheat	Jute	G.nut
Labor	23187	26850	27086	52200	22500
Ploughing	7875	6750	6937	7500	5250
Seed	2250	5700	3842	1650	10830
Manure (cowdung)	3000	4500	0	0	0
Fertilizer	8079	30105	16373	7703	2025
Pesticides	1875	4500	1875	0	1500
Irrigation	0	8438	0	0	0
Total variable cost	46266	86843	56113	69053	42105
Yield (t ha⁻¹)	2.6	8.5	2.6	1.96	1.05
By product	4500	4000	1500	8000	0
Gross return	51300	117125	66500	90320	52500
Gross margin	5034	30282	10387	21267	10395
BCR	1.11	1.35	1.19	1.31	1.25

Major Marketing Channel

Major marketing channel followed by the sampled farmers of the charland area have been shown in Table 7. In case of rice, jute, maize, groundnut and wheat, most of the farmers used the following channel.

Table 7: Major marketing channel followed by the sampled farmers of the charland area

Marketing Channels
Farmers- Faria – Bepari –Aratdar- Retailer -Consumer
Farmers- Bepari – Wholesaler - Retailer –Consumer
Farmers- Retailer –Consumer

Constraints

Farmers were asked about the problems and they answered more than 5 problems. These problems summarized and showed in Table 8. Lack of knowledge about modern agricultural practices and new crops variety, unavailability of quality seed and fertilizer, lack of quality seeds, high price of labor, lack of credit facility were the major problem of the farmer of the three previous enclaves.

Table 8. Constraint to sample farmers of charland area of Bhuapur, Tangail

Problems/ constraint

1. Lack of knowledge about modern agricultural practices and new crops variety
2. Unavailability of quality seed and fertilizer
3. Low yield of crops
4. Lack of Training
5. Infestation of insect/pests
6. Lack of cash money
7. High price of labor
8. Lack of credit facility

VARIETAL TRIAL AND FIELD DEMONSTRATION:

ADAPTIVE RESEARCH:

Adaptive trial of wheat, maize, groundnut, sweet potato and black cumin was conducted among 30 farmers to select suitable high yielding modern varieties as well as increase yield and income of charland people against their local varieties covering 0.65 ha land.

ADAPTIVE TRIAL OF BARI DEVELOPED HIGH YIELDING WHEAT VARIETIES

The trial was conducted at MLT site, Bhuapur, Tangail during Rabi, 2017-18 at charland situation under AEZ-8. It was laid out in RCB design with six replications. Six BARI released high yielding varieties of wheat viz. BARI Gom-25, BARI Gom-26, BARI Gom-28, BARI Gom-29, BARI Gom-30 and BARI Gom-33 along with local one named Sonali as check were tested. The unit plot size was 8 m × 5

m. The land was fertilized with 119, 30, 55, 22, 1 kg ha⁻¹ N, P, K, S, B, respectively (recommended as BARI). Two third of urea and all other fertilizers were applied at the time of final land preparation. One third urea was top dressed at 18 to 21 days after sowing (DAS) after first irrigation. Seeds were sown on 11 November to 15 November, 2017 in lines 20 cm apart with 120 kg ha⁻¹ seed rate. Three irrigations were provided at 17, 50 and 75 DAS. One hand weeding was done at 20 DAS. The crop was harvested during to 10 to 14 April, 2018. Data on plant height yield and yield contributing characters were collected and analyzed statistically following CropStat analytical package.

Results and Discussions

Significant variations were observed among the varieties (Table 9). The maximum plant height (108.70 cm) was recorded from local variety followed by BARI Gom-29 (106.47 cm) and BARI Gom-33 (105.13 cm), while that of minimum from BARI Gom-25 (100.60 cm). The highest number of spikes m⁻² was obtained from BARI Gom-26 (301.67). The lowest numbers of spikes m⁻² was in BARI Gom-29 (277.00). Higher number of grains per spike (36.40) was obtained from BARI Gom-33 followed by BARI Gom-30. The lowest number of grains (29.90) was found in local variety. Thousand grain weight was highest in BARI Gom-33(51.38 g) which was significantly different from the others variety and the lowest (36.25 g) was obtained from local variety. The maximum grain yield (4.06 t ha⁻¹) was obtained from BARI Gom-33 followed by BARI Gom-30 (3.91 t ha⁻¹). The lowest grain yield (2.49 t ha⁻¹) was found in local variety Sonali. Wheat var. BARI Gom-33 gave higher grain yield due to cumulative effect of no. of spikes per m²& thousand grain weight. All modern varieties gave 27.08 to 63.14 % higher grain yield against local variety Sonali.



Table 9. Yield and yield contributing characters of wheat varieties at farmers' field of MLT site Bhuapur, Tangail during 2017-18

Variety	Plant height (cm)	Effective spike m ⁻²	Grain spike ⁻¹ (no.)	1000 grain wt. (g)	Grain Yield (t ha ⁻¹)	Yield increase (%)
BARI Gom-25	100.60	283.67	31.23	41.09	3.16	27.08
BARI Gom-26	102.37	301.67	33.67	43.63	3.63	46.11
BARI Gom-28	102.80	277.00	31.53	41.87	3.29	32.44
BARI Gom-29	106.47	282.67	32.27	41.61	3.25	30.56
BARI Gom-30	104.10	292.67	35.27	44.81	3.91	57.10
BARI Gom-33	105.13	286.00	36.40	51.38	4.06	63.14
Local (Sonali)	108.70	284.67	29.90	36.25	2.49	-
LSD _(0.05)	4.81	14.48	2.85	3.45	0.48	-
CV (%)	2.60	2.90	4.90	4.50	8.00	-

ADAPTIVE TRIAL OF BARI DEVELOPED HIGH YIELDING MAIZE VARIETIES

The trial was conducted charland situation at the MLT site Bhuapur under AEZ-8 during the Rabi 2017-18 to find out the performance of BARI Hybrid maize varieties and to popularize them among the farmers. The trial was laid out in RCB design in six farmers' fields considering as six dispersed replications. The unit plot size was 8 m x 5 m. Four released varieties viz., T₁= BARI Hybrid maize-7, T₂ = BARI Hybrid maize-9, T₃= BARI Hybrid maize-12, T₄= BARI Hybrid maize-13 and one locally available hybrid T₅= Pacific-984 were tested. The plots were fertilized with 250, 52.8, 99.6, 40, 5 and 1 kg ha⁻¹ N P K S Zn and B, respectively. One third of N and full amount of other fertilizers were applied at the time of final land preparation in the form of urea, triple super phosphate, muriate of potash, gypsum, zinc sulphate and boric acid respectively. Rest amount of N were applied in two equal splits as top dress at 30 days after sowing (DAS) and 60 DAS (before flowering). The seeds were sown during 13 to 17 November, 2017 at Bhuapur in line with seed rate of 25 kg ha⁻¹. The plant spacing was 60 cm x 25 cm. Two weeding were done at 36 and 60 DAS. Three irrigations were provided at 18, 30 and 60 DAS. Other necessary managements were done as and when necessary. The crop was harvested during 10 to 16 April, 2018 at Bhuapur. The data on different yield and yield components were recorded having 10 plants randomly selected in each plot. Collected data were analyzed statistically and means were adjusted using LSD Test at 5% level of significance using CropStat package and presented in Table 1.

Results & Discussions

Yield and yield attributes were influenced significantly by the varieties (Table 10). Days to maturity was maximum in Pacific-984 (155 days) followed by BARI Hybrid Maize -12 (154 days). Early days to maturity were observed in BARI Hybrid Maize-7 (148 days) followed by BARI Hybrid Maize-9 (149 days). The maximum plant height (195.80 cm) was recorded in BARI Hybrid Maize-7 followed by BARI Hybrid Maize-12 (193.27 cm) and the lowest plant height (188.00 cm) from BARI Hybrid Maize-13. The maximum number of grains cob⁻¹ (492.10) and 1000-grain weight (358.67 g) was obtained from BHM-9 followed by Pacific (grains cob⁻¹ 489.68 and 1000-grain weight 356.45 g) and BARI Hybrid Maize -7 (grains cob⁻¹ 485.70, 1000-grain weight 353.53 g). The lowest number of grains cob⁻¹ 457.03, 1000-grain weight 339.49 was obtained from BARI Hybrid Maize-13. The higher grain yield (9.47 t ha⁻¹) was obtained from BARI Hybrid Maize -9 followed by BARI Hybrid Maize-7 (9.44 t ha⁻¹).

The lowest grain yield (7.91 t ha⁻¹) was recorded from Pacific-984. The result showed that 6.19 to 19.72 % higher yield was obtained from BARI released Hybrid Maize varieties compared to locally available hybrid maize variety (Pacific 984). Both the variety showed higher yield due to more no. of grains per cob & thousand grain weight.



Table 10. Yield and yield attributes of BARI hybrid maize varieties and Pacific-984 at the MLT site, Bhuapur, Tangail during Rabi 2017-2018

Variety	Days to maturity	Plant height (cm)	Grains cob ⁻¹ (no.)	1000 grain wt. (g)	Grain yield (t ha ⁻¹)	Yield increase (%)
BARI Hybrid Maize-7	148	195.80	485.70	353.53	9.44	19.34
BARI Hybrid Maize-9	149	189.07	492.10	358.67	9.47	19.72
BARI Hybrid Maize-12	154	193.27	481.00	350.92	8.52	7.71
BARI Hybrid Maize-13	152	188.00	457.03	339.49	8.40	6.19
Pacific-984	155	191.23	489.68	356.45	7.91	-
LSD (0.05)	1.45	4.13	27.46	19.39	0.61	-
CV (%)	0.90	3.20	7.30	4.60	5.70	-

ADAPTIVE TRIAL OF BARI DEVELOPED HIGH YIELDING GROUNDNUT VARIETIES

The experiment was conducted at MLT site, Bhuapur, Tangail AEZ-8 during Rabi season of 2017-2018 following RCB design with six dispersed replications. The unit plot size was 8 m x 5 m. Five improved varieties of groundnut viz. BARI Chinabadam-8, BARI Chinabadam-9, BARI Chinabadam-10, Binachinabadam-6, Binachinabadam-7 and a local variety (Dhaka-1) were used. Crop management practices used shown in table 3. Before sowing, seeds were treated with Provax @ 0.2% to prevent seed and soil borne diseases. The half urea and entire amount of TSP, MP, gypsum and boric acid were applied during final land preparation. The rest half urea was top dressed at the initial stage of peg developments. All intercultural operations were done properly. The cost and return was calculated on the basis of prevailing market price of the commodities. At harvesting stage different data were collected properly and analyzed statistically using Cropstat analytical package.

Table 11. Crop management practices used at MLT Site, Bhuapur, Tangail during Rabi 2017-18

Sowing time	Harvesting time	Fertilizer dose (kg ha ⁻¹) : N-P-K-S-Zn-B
26 Oct. to 02 Nov. 2017	10 -23 April, 2018	12-32-43-54-0-1(based on BARI)

Results and Discussions

Pod yield and yield attributes were influenced significantly by the varieties (Table 12). The maximum plant height was recorded from local variety followed by BARI Chinabadam-8 (40.62cm), while that of the lowest was from Dhaka-1 (32.43cm). The maximum plant population was found in BARI Chinabadam-8 (19.40) which was statistically identical with BARI Chinabadam-10 and BARI Chinabadam-9 (19.01 & 18.61). The minimum plant population was found in locally popular variety Dhaka-1 (14.88). The highest number of effective pods plant⁻¹ (20.20) was recorded in BARI Chinabadam-8 which was significantly different among the tested varieties. The lowest number of effective pod plant⁻¹ (15.27) was recorded from Binachinabadam-8. The highest 100-seed weight (59.42 g) was recorded in BARI Chinabadam-8 and the lowest was in Binachinabadam-7 (44.11g). The maximum shelling percentage (63.01%) was recorded from BARI Chinabadam-8 followed by Dhaka-1 (62.83%). The lowest shelling percentage 50.05% was found in Binachinabadam-8. BARI and BINA released groundnut varieties gave 6.47 to 64.48 % higher pod yield compared to local variety. The highest pod yield was recorded from BARI Chinabadam-8 due to its higher yield attribute as well as shelling (%).



Table 12. Yield and yield contributing characters of groundnut varieties at the MLT Site, Bhuapur, Tangail during Rabi 2017-18

Variety	Plant height (cm)	Plants m ⁻²	100 pod wt. (g)	Effective pod plant ⁻¹ (no.)	Seed pod ⁻¹ (no.)	100 seed wt. (g)	Shelling (%)	Pod Yield (t ha ⁻¹)	Yield increase (%)
BARI Chinabadam-8	40.62	19.40	109.57	20.40	1.95	59.42	63.01	2.76	64.48
BARI Chinabadam-9	38.03	18.61	92.70	18.60	1.80	49.35	60.39	2.28	36.22
BARI Chinabadam-10	38.50	19.01	91.67	16.80	1.82	50.11	58.75	2.46	46.97
Binachinabadam-7	32.43	17.11	79.75	15.37	1.70	44.11	59.11	2.09	24.48
Binachinabadam-8	33.05	17.40	82.28	15.27	1.83	46.07	50.05	1.78	6.47
Tridana (Dinajpur)	39.82	17.50	86.93	18.92	3.08	48.18	59.78	1.92	14.73
Local (Dhaka-1)	32.43	14.88	71.47	16.15	1.72	45.78	62.83	1.68	-
LSD (0.05)	3.43	1.89	7.95	1.43	0.21	4.79	7.50	0.30	
CV (%)	8.00	8.80	7.70	7.00	8.70	8.40	10.70	11.80	

ADAPTIVE TRIAL OF BARI DEVELOPED HIGH YIELDING SWEET POTATO VARIETIES

An experiment was carried out in farmer's field of MLT site, Bhuapur, Tangail under AEZ- 8 during the Rabi season of 2017-18 to evaluate the suitable sweet potato varieties in charland ecosystem. Four sweet potato varieties viz., BARI Misti Alu-4, BARI Misti Alu-8, BARI Misti Alu-10, BARI Misti Alu-12, BARI Misti Alu-13 and local variety were tested. The unit plot size was 8m × 5 m. The plant spacing viz. 60cm × 30cm were used. The experiment was laid out in a randomized complete block design with five dispersed replications. The land was fertilized with 83-34-100-15-4 kg per ha of N-P-K-S-Zn and 10 ton cow dung per hectare (based on BARI). Half amount of N, K and full dose of other fertilizers were applied during final land preparation. The rest amount of N and K fertilizer were applied at 35 DAP. Vine were transplanted on 11-23 November, 2017. Intercultural operations and plant protection measures were taken as and when necessary during the crop growing period. No disease and insect pest infestation was observed during the crop growing period. The crop was harvested on 09- 11 April, 2018. Necessary data in relation to yield and yield attributes were taken at harvest and analyzed statistically by using CropStat analytical package. Cost return analysis of different varieties was computed on the basis of prevailing market price.

Result and Discussion

The yield, yield attributes and cost return have been presented in Table 13&14. High number of tubers plant⁻¹ (3.74) was recorded from BARI Misti Alu-4 followed by BARI Misti Alu-12 but the lowest in BARI Misti Alu-8 (3.24). Tuber weight plant⁻¹ showed maximum in BARI Misti Alu-10 (643.76 g) followed by BARI Misti Alu-12 & BARI Misti Alu-8 while lowest in local variety. The maximum individual tuber weight was obtained from BARI Misti Alu-12 (201.44 g) followed by BARI Misti Alu-10 and the lowest value was found in BARI Misti Alu-4 (160.38 g). BARI Misti Alu-12 produced the maximum tuber yield (23.25 t ha⁻¹) due to its highest individual tuber weight (201.44 g) and maximum number of tuber per plant (3.55). The lowest yield was recorded from BARI Misti Alu-4 (18.13 t ha⁻¹) due to its lowest individual tuber weight. All BARI released varieties except BARI Misti Alu-4 gave 9.02 to 27.75 % higher tuber yield against local variety. Cost and return analysis showed that the highest gross return (Tk. 290625 ha⁻¹), gross margin (Tk. 213055 ha⁻¹) and benefit cost ratio (3.75) was found from BARI Misti Alu-12 (table 14).



Table 13. Tuber yield and yield parameters of sweet potato varieties at MLT site, Bhuapur, Tangail during Rabi 2017-18

Variety	Tuber Plant ¹ (no.)	Tuber wt. Plant ⁻¹ (g)	Individual Tuber wt. (g)	Tuber Yield (t ha ⁻¹)	Yield Increase Over Local Variety (%)
BARI Misti Alu-4	3.74	504.72	160.38	18.13	-0.40
BARI Misti Alu-8	3.24	612.28	189.60	20.58	13.06
BARI Misti Alu-10	3.31	643.76	192.18	21.63	18.83
BARI Misti Alu-12	3.55	615.03	201.44	23.25	27.75
BARI Misti Alu-13	3.30	551.87	175.30	19.84	9.02
Local	3.38	323.53	172.06	18.20	-
LSD (0.05)	0.39	78.19	19.82	2.73	
CV (%)	9.60	10.50	7.60	9.70	

Table 14. Cost, return and profitability of sweet potato varieties at MLT site, Bhuapur, Tangail during Rabi 2017-18

Variety	Gross return (Tk. ha ⁻¹)	Total cost (Tk. ha ⁻¹)	Gross margin (Tk. ha ⁻¹)	BCR
BARI Misti Alu-4	226594	77570	149024	2.92
BARI Misti Alu-8	257219	77570	179649	3.32
BARI Misti Alu-10	270344	77570	192774	3.49
BARI Misti Alu-12	290625	77570	213055	3.75
BARI Misti Alu-13	248031	77570	170461	3.20
Local	227500	77570	149930	2.93

Price of Sweet Potato (Tk. kg⁻¹) = 12.50

ADAPTIVE TRIAL OF BARI DEVELOPED HIGH YIELDING BLACK CUMIN VARIETY

The experiment was conducted at MLT site, Bhuapur, Tangail during the rabi 2017-18. BARI Kaloziira-1 was tested against a local one under farmer's field condition. The experiment was laid out in RCB design with six dispersed replications (six farmers' field). The unit plot size was 8 m × 5 m. The crop was fertilized with 5 t ha⁻¹ cow dung, 60, 20 and 38 kg ha⁻¹ N, P and K, respectively. The entire quantity of cow dung, P and K were applied during final land preparation. Nitrogen was applied in two equal splits at 15 days after germination and other half of N was applied in flowering stage followed by irrigation. The seeds were sown during 23 Oct. to 30 November, 2017. Plant protection measures were taken as and when required. Other intercultural operations were done when necessary. The crop was harvested on 9 to 12 April, 2018. At maturity different data were collected and statistical analysis was done followed by paired t-test method.

Results and discussions

Black cumin var. BARI Kaloziira-1 produced significantly higher number of capsules plant⁻¹ (13.75) compared to local one. Significantly the higher yield (975 kg ha⁻¹) was obtained from BARI Kaloziira-1 over local one (718 kg ha⁻¹) (table 15) due to higher yield attributes.



Table 15. Yield and yield attributes of black cumin varieties at the MLT site Bhuapur, Tangail during 2017-18

Variety	Plant population m ⁻² (no.)	Plant height (cm)	Capsules plant ⁻¹ (no.)	Seeds capsule ⁻¹ (no.)	1000 seed Weight (g)	Yield (t ha ⁻¹)	Yield Increase (%)
BARI Kalozira-1	65	59.40	13.75	71.67	2.43	1.17	43.38
Local	58	52.43	9.85	62.27	2.14	0.816	
Level of significance	NS	NS	*	NS	**	**	

FIELD DEMONSTRATION:

Field demonstration of wheat, maize, groundnut, black cumin, chilli and bottle gourd was conducted among 74 farmers with their high yielding new varieties covering 14.76 ha area.

FIELD DEMONSTRATION OF BARI DEVELOPED HIGH YIELDING WHEAT VARIETIES

The production programme of wheat was conducted at MLT site, Bhuapur, Tangail during *Rabi* 2017-18 in the farmers' field with irrigation facilities under AEZ-8. Five varieties viz., BARI Gom-26, BARI Gom-28, BARI Gom-29, BARI Gom-30 and BARI Gom-33 were demonstrated among the twenty-two farmers' field by covering 5 heaters of land. The land was fertilized with 110, 36, 63, 22, 4 and 2 kg ha⁻¹ of N, P, K, S, Zn and B, respectively. Two-third of urea and all other fertilizers were applied during final land preparation. Remaining urea was applied as top dress at 20 days after sowing (DAS) after irrigation. Seeds were sown during 22 November to 07 December, 2017. In the both locations seeds were sown in lines apart 20 cm with seed rate 120 kg ha⁻¹. Three irrigations were provided at 20, 50 and 75 DAS. One hand weeding was done at 25 to 30 DAS. The crop was harvested during 27 March to 4 April, 2018. Yield was recorded by crop cut of 20 m² (from 5 points) from each plot.

Results and Discussions

Average seed yield (t ha⁻¹) of five wheat varieties are presented in table 16. The highest seed yield was observed from BARI Gom-33 (3.98 t ha⁻¹) followed by BARI Gom-30. Lowest yield (2.72 t ha⁻¹) was found from local variety (Sonali). It was observed that 31.99 to 46.32% yield increased as compared to local variety (Sonali). All the modern varieties showed gross margin as well as BCR but BARI Gom-33 and BARI Gom-30 showed higher yield and benefit among the farmers.



Table 16. Grain yield, cost and return analysis of different wheat varieties grown during 2017-18

Variety	Grain Yield (t ha ⁻¹)	Yield increase (%)	Gross return (t ha ⁻¹)	Cultivation cost (t ha ⁻¹)	Gross margin (t ha ⁻¹)	Increase income (%)	BCR
BARI Gom-26	3.74	37.50	93500	53145	40355	46.03	1.76
BARI Gom-28	3.80	39.71	95000	53145	41855	51.46	1.79
BARI Gom-29	3.59	31.99	89750	53145	36605	32.46	1.69
BARI Gom-30	3.91	43.75	97750	53145	44605	61.41	1.84
BARI Gom-33	3.98	46.32	99500	53145	46355	67.74	1.87
Local (Sonali)*	2.72	-	68000	40365	27635	5.34	1.68

* Farmers management practices

Grain price (Tk kg⁻¹): 23.75

FIELD DEMONSTRATION OF BARI DEVELOPED HIGH YIELDING MAIZE VARIETIES

The trial was conducted at the MLT site, Bhuapur, Tangail under AEZ-8 during the Rabi 2017-18 to test the performance of BARI Hybrid maize and to popularize BARI released hybrid varieties among the farmers. BARI Hybrid Maize-7, BARI Hybrid Maize-9 and Khoibhutta were among the fourteen farmers covering 3.2 ha of land. The crop was fertilized with 250-55-110-45-5-1.5 kg ha⁻¹ N-P-K-S-Zn-B, respectively (based on BARI). One third of urea and all amounts of other fertilizers were applied during final land preparation. The remaining urea was applied in two splits at 35-40 days after sowing (DAS) and 60-65 DAS. The seeds were sown during 19 November to 9 December, 2017 in line with seed rate of 25 kg ha⁻¹. The plant spacing was 60 cm x 25 cm. Two weeding were done at 36 and 60 DAS. Three irrigations were provided at 18, 30 and 60 DAS. Other necessary managements were done as and when necessary. The crop was harvested during 19 April to 7 May, 2018. The data on different plant characters, yield components and seed yield were recorded having 30 plants randomly selected from the plot.

Results and Discussions

Table 17 shows that BARI Hybrid Maize-7, BARI Hybrid Maize-9 and Khoibhutta gave 9.32, 9.96 and 3.89 t ha⁻¹ respectively which was 36.26 to 45.61% higher as well as yield income were increased 41.57 to 60.75 % in BARI released hybrid varieties compare to locally available hybrid (Pacific 984).

Though BARI Khoibhutta gave much lower grain yield than Pacific-984 but it insure to increase 58.59% higher income against Pacific-984 due to higher price of grain.



Table 17. Grain yield, Cost and return analysis of BARI Hybrid Maize-7, BARI Hybrid Maize-9, Khoibhutta and local hybrid (Pasific 984) production

Variety	Grain Yield (t ha ⁻¹)	Yield increase (%)	Gross return (t ha ⁻¹)	Cultivation cost (t ha ⁻¹)	Gross margin (t ha ⁻¹)	Increase income (%)	BCR
BARI Hybrid Maize-7	9.32	36.26	174750	86200	88550	41.57	2.03
BARI Hybrid Maize-9	9.96	45.61	186750	86200	100550	60.75	2.17
Khoibhutta	3.09	-54.82	185400	86200	99200	58.59	2.15
Pscific-984	6.84	0.00	128250	65700	62550	-	1.95

* Famers management practices

Grain price (Tk kg⁻¹): Khoibhutta= 60 and others variety= 18.75

FIELD DEMONSTRATION OF BARI DEVELOPED HIGH YIELDING GROUNDNUT VARIETY

The program was conducted with BARI Chinabadam-8 at the charland area of the MLT site, Bhuapur, Tangail (AEZ: 8) during the Rabi 2017-18 in the farmers field under irrigated condition to popularize and disseminate the BARI developed groundnut varieties among the farmers and also increase yields and economic return. BARI Chinabadam-8 was cultivated among the 21 farmers covering 5 ha of land. The crop was fertilized with 12-32-43-54-1kg ha⁻¹ N-P-K-S-B, respectively (based on BARI). Half of nitrogen and full amount of cowdung, P, K, S and B were applied at the time of final land preparation in the form of urea, triple super phosphate, muriate of potash, gypsum and boric acid, respectively. 37 kg ha⁻¹ extra gypsum was top dressed at pegging stage. Remaining N were top dressed at 45 days after sowing (DAS) before flowering stage and covered with soil followed by irrigation. The seeds were sown during 27 October to 15 November 2017 with seed rate of 100 kg ha⁻¹. The plant spacing was 30 cm x 15 cm. Intercultural operation, pests and other crop management practices were done as and when necessary. The crop was harvested during 5-10 April, 2018. Yield was recorded by crop cut of 20 m² randomly from each plot.



Results and Discussions

From table 18 it was observed that 2.49 t ha⁻¹ pod yield was obtained from BARI Chinabadam-8. Which gave 54.66 % higher yield as well as 117.88% increased income compared to Dhaka-1. Though cost was much lower in local variety but yield did not complement.

Table 18. Pod yield, Cost and return analysis of BARI Chinabadam-8 and local (Dhaka-1) production

Variety	Pod Yield (t ha ⁻¹)	Yield increase (%)	Gross return (t ha ⁻¹)	Cultivation cost (t ha ⁻¹)	Gross margin (t ha ⁻¹)	Increase income (%)	BCR
BARI Chinabadam-8	2.49	54.66	149400	51245	98155	117.88	2.92
*Local (Dhaka-1)	1.61		80500	35450	45050		2.27

*Farmers practice

Pod Price (Tk kg⁻¹): BARI Chinabadam-8 = 60 (Due to attractive color and bolder size market price is higher), Local chinabadam= 50



FIELD DEMONSTRATION OF BARI DEVELOPED HIGH YIELDING BLACK CUMIN VARIETY

The block demonstration of black cumin was conducted at the MLT Site, Bhuapur, Tangail during the *Rabi* 2017-18 in the farmers' field with irrigation facilities under AEZ# 8 to popularize BARI released black cumin variety among the farmers and also increase yield and economic return of farmers. BARI Kaloziira-1 was used as planting material. BARI Kaloziira-1 was cultivated among the eight farmers at Bhuapur covering 1.2 hectares of land. The crop was fertilized with 5 t ha⁻¹ cow dung, 60, 20 and 38 kg ha⁻¹ N, P and K, respectively (based on BARI). The entire quantity of cow dung, P and K were applied during final land preparation. Nitrogen was applied in two equal splits at 15 days after germination and other half of N was applied in flowering stage. Seeds were sown as broadcast during 8 to 15 December, 2017 using 10 kg ha⁻¹ seed rate. Two irrigations were provided at 15 and 40 DAS. Two hand weeding was done at 20 to 45 DAS. The crop was harvested during 10 to 13 April, 2018. Yield was recorded by crop cut of 8 m² from each plot.

Results and Discussions

Black cumin var. BARI Kaloziira-1 produced 0.98 t ha⁻¹ seed yield which was 44.12 % higher with improved management than local variety followed poor management practice (Table 19). Modern management practices showed 49.20% income of BARI Kaloziira-1 producer against local variety with traditional management practice.

Table 19. Seed yield, cost and return analysis of BARI Kaloziira-1 and local variety production

Variety	Seed Yield (t ha ⁻¹)	Yield Increase (%)	Cultivation cost (t ha ⁻¹)	Gross return (t ha ⁻¹)	Gross margin (t ha ⁻¹)	Increase income (%)	BCR
BARI Kaloziira-1	0.98	44.12	176400	41895	134505	49.20	4.21
Local*	0.68		122400	32250	90150		3.80

*Farmers practice; Price (Tk kg⁻¹): BARI Kaloziira-1 = 180



FIELD DEMONSTRATION OF HIGH YIELDING WINTER CHILLI

The demonstration trial was conducted under the farmers' fields at the MLT site, Bhuapur, Tangail during Rabi, 2017-18 in the farmers' field with irrigation facilities under AEZ# 8 to popularize chilli cultivation among the farmers and also increase yield and economic return of farmers. Locally popular chilli variety Bindu (Bogra) was cultivated among the three farmers covering 0.54 hectares of land. The land was fertilized with 97-60-100-20-0.360-0.260 kg⁻¹ of N, P, K, S, Zn, B and 5 t ha⁻¹ of cow dung per hectare, respectively (based on BARI). Cow dung, full amount of PKS and half of N were applied during final land preparation. The remaining nitrogen was applied in three equal splits at 25, 50 and 70 days after planting under moist soil condition and mixed thoroughly with the soil. Other intercultural operations and plant protection measures were taken as and when at necessary. Sprouted chilli seeds were sown as broadcast during 05 to 15 October, 2017 using 3 kg ha⁻¹ seed rate. Three irrigations were provided as and when necessary. Two hand weeding was done at 20 to 45 DAS. Green chilli was harvested from 10 March to 20 May 2018. Yield was recorded from 5 random points controlling 1 m² area from each plot.

Results and Discussions

From the demonstration it was observed that average 10.50 t ha⁻¹ green chilli was produced which was gave Tk315000 and 210688ha⁻¹ gross return and gross margin respectively with 3.02 BCR (table 20).

Table 20. Yield, cost and return analysis of chilli production

Variety	Green chilli Yield (t ha ⁻¹)	Gross return (t ha ⁻¹)	Cultivation cost (t ha ⁻¹)	Gross margin (t ha ⁻¹)	BCR
Bindu (Bogra)	10.50	315000	104312	210688	3.02

Price (Tk kg⁻¹): Green chilli = 30



FIELD DEMONSTRATION OF HIGH YIELDING BOTTLE GOURD

The demonstration trial was conducted under the farmers' fields at the MLT site, Bhuapur, Tangail during Rabi, 2017-18 in the farmers' field with irrigation facilities under AEZ# 8 to popularize bottle gourd cultivation among the farmers and also increase yield and economic return of farmers. Locally popular bottle gourd variety was cultivated among the four farmers covering 0.32 hectares of land. The land was fertilized with 69-35-75-18-4.3-1.7 kg ha⁻¹ of N, P, K, S, Zn, B and 10 t ha⁻¹ of cow dung, respectively (based on BARI). Cow dung, full amount of P, S, Zn and B were applied during final land preparation. Nitrogen (N) and Potassium (K) were applied in four equal splits at 15, 35, 55 and 75 days after sowing under moist soil condition and mixed thoroughly with the soil. Other intercultural operations and plant protection measures were taken as and when at necessary. Seeds were sown in pit during 13 to 16 October, 2017 using 1 kg ha⁻¹ seed rate. Three irrigations were provided as and when necessary. Two hand weeding was done at 20 to 45 DAS. Fruits were harvested during 10 April to 20 May, 2018. Yield was recorded considering whole plot and convert it to ton per hectare.



Results and Discussions

From table 21 it was observed that average 27.58 t ha⁻¹ bottle gourd was produced which was gave Tk386120 and 266360 ha⁻¹ gross return and gross margin respectively with 3.22 BCR.

Table 21. Fruit yield, cost and return analysis of bottle gourd production

Variety	Fruit Yield (t ha ⁻¹)	Gross return (t ha ⁻¹)	Cultivation cost (t ha ⁻¹)	Gross margin (t ha ⁻¹)	BCR
Local	27.58	386120	119760	266360	3.22

Price (Tk kg⁻¹): Bottle gourd = 14

12. Research highlight/findings:

A. Adaptive research

- ❖ Wheat var. BARI Gom-33 gave higher grain yield (63%) than the local variety (Sonali).
- ❖ Maize var. BARI Hybrid Maize-7/9 outyielded (7-19%) increase yield than the locally used var. Pacific-984.
- ❖ Groundnut var. BARI Chinabadam-8 gave higher yield (6-64%) than the local & other variety.
- ❖ Sweet potato var. BARI Misti Alu-12 increase yield (9-27%) against other variety.
- ❖ Blackcumin var. BARI Kalozira-1 outyielded local variety with 43% increase yield.
- ❖ BARI released all crop varieties gave 6.19 to 64.48% higher yield, 13.69 to 117.88% more economic return, less pest susceptible than local variety.

B. Demonstration

- ❖ Wheat variety BARI Gom-33 followed by BARI gom-30, maize var. BARI Hybrid Maize-9 and Khoibhutta, groundnut var. BARI Chinabadam-8, chilli var. local, bottle gourd (local) showed higher yield and economic return.
- Additional application of gypsum fertilizer (37 kg ha⁻¹) with modern cultivation practices (including irrigation) after flowering stage of groundnut gave 54.66% higher yield than traditional cultivation practices.
- Wheat var. BARI Gom-26, BARI Gom-28, BARI Gom-30, BARI Gom-33, maize var. BARI Hybrid Maize-7, BARI Hybrid Maize-9, groundnut var. BARI Chinabadam-8, BARI Chinabadam-9, BARI Chinabadam-10, blackcumin var. BARI Kalozira-1 may be cultivated for charland farmers due to its higher yield and more economic return.
- Black cumin, chilli and bottle gourd easily fitted in T. aman- Tobacco- Jute/Sesame cropping pattern which can be replace tobacco.
- Due to higher yield and market price charland farmers benefited economically and ensured food security which improved their livelihood and discourage them tobacco cultivation.
- BARI released new crops and varieties gave higher yield and much more (97.13 to 446.38 %) economic return than tobacco, which ultimately uplifted farmers livelihood.
- As a result food security ensured, nutritional status increased and income of project benefited farmers uplifted.

B. Implementation Position

1. Procurement:

Description of equipment and capital items	PP Target		Achievement		Remarks
	Phy (#)	Fin (Tk)	Phy (#)	Fin (Tk)	
(a) Office equipment	a) Desktop computer b) Laptop c) UPS d) Laser printer e) Scanner f) Digital camera	190000/-	a) Desktop computer b) Laptop c) UPS d) Laser printer e) Scanner f) Digital camera	190000/-	100%
(b) Lab & field equipment	a) Soil moisture meter b) Electric balance c) Rain gas meter d) Thermo meter	45000/-	a) Soil moisture meter b) Electric balance c) Rain gas meter d) Thermo meter	44900/-	100%
(c) Other capital items (Furniture)	a) File cabinet b) Steel almira c) Computer table d) Computer chair	52500/-	a) File cabinet b) Steel almira c) Computer table d) Computer chair	52200/-	100%

2. Establishment/renovation facilities: Not applicable

Description of facilities	Newly established		Upgraded/refurbished		Remarks
	PP Target	Achievement	PP Target	Achievement	

3. Training/study tour/ seminar/workshop/conference organized:

Description	Number of participant			Duration (Days/weeks/ months)	Remarks
	Male	Female	Total		
(a) Training (2 in 2 locations)	51	9	60	1 day	-
(b) Workshop	-	-	-	-	-
(c) Field day (1)	71	9	80	1 day	-

C. Financial and physical progress

Fig in Tk

Items of expenditure/activities	Total approved budget	Fund received	Actual expenditure	Balance/ unspent	Physical progress (%)	Reasons for deviation
A. Contractual staff salary	317785	317785	310688	7097	97.77	
B. Field research/lab expenses and supplies	1474434	1474434	1474434	0	100	
C. Operating expenses	414030	412105	412105	0	100	
D. Vehicle hire and fuel, oil & maintenance	210000	195655	195655	0	100	
E. Training/workshop/ seminar etc.	145600	137740	137740	0	100	
F. Publications and printing	100000	4970	0	4970	0	
G. Miscellaneous	38000	36600	36600	0	100	
H. Capital expenses	287100	287100	287100	0	100	

NB. Unspent money (Tk. 7097.00 + Tk. 4970.00 = Tk. 12067.00) return to Director, PIU-BARC, NATP Phase-2, Farmgate, Dhaka through Check.

D. Achievement of Sub-project by objectives: (Tangible form)

Specific objectives of the sub-project	Major technical activities performed in respect of the set objectives	Output(i.e. product obtained, visible, measurable)	Outcome(short term effect of the research)
To ensure food security and nutrition for charland people by replacement of tobacco with high value and nutrient rich crops.	-Site and farmer selection. -Baseline survey conduction. -Field visit. -Adaptive research and field demonstration of suitable high value and nutrient rich crops.	- Profitable alternative crops with suitable varieties against tobacco have been identified.	-Farmers awareness have been increased to use suitable crops/varieties against tobacco cultivation. -Higher productivity insures food security.
To increase productivity, income and change livelihood by adaptation and dissemination of high value and	-Implementation of On-farm adaptive research and field demonstration of suitable high value and nutrient rich crops with improve management practices against locally used	-BARI Gom-30, BARI Gom-33, BARI Hybrid Maize-9, BARI Chinabadam-8, BARI Kalozira-1 have been selected for their higher yield and economic returns. -Black cumin, Chilli, Bottle gourd, Sweet potato,	- Moreproductivity increase income and changed livelihood. -Knowledge on modern agricultural technologies along with suitable

nutrient rich crops against tobacco	varieties. -Arranged field day. -Monitoring, data collection and analysis.	Groundnut, Wheat and Maize provide more profits (97.13 to 446.38 %). -Black cumin, chilli and bottle gourd easily fitted in T. aman-Tobacco- Jute/Sesame cropping pattern which can be replace tobacco. -Additional application of gypsum fertilizer (37 kg ha-1) with modern cultivation practices (including irrigation) after flowering stage of groundnut gave 54.66% higher yield than traditional cultivation practices.	crops/ varieties and management practices have been improved. -Proper land utilization and cropping intensity enhancement are possible by using modern high yielding crops variety and improved production technology. -Farmers have been stored different new crops/varieties seeds of for next year cultivation.
To develop skill, knowledge and awareness of the farmers	Training programs and field day were arranged regarding to the farmers to gather knowledge and increase awareness about tobacco cultivation.	-Farmers' income (gross margin) increased about 97.13 to 446.38 % against tobacco. - Yield have been increased 6.19 to 64.48% against local variety. -Farmers' knowledge, income and awareness have been increased.	-Awareness build up among the charland people. -Poverty reduced with higher yield and economic return. -Farmers' capacity have been improved on production of new crops/varieties through modern technologybased agricultural practices.

E.Materials Development/Publication made under the Sub-project:

Publication	Number of publication		Remarks (e.g. paper title, name of journal, conference name, etc.)
	Under preparation	Completed and published	
Technology bulletin/ booklet/leaflet/flyer etc.			
Journal publication			
Information development			
Other publications, if any (Farmers Training Manual)		1	কৃষকপ্রশিক্ষণম্যানুয়াল

F. Technology/Knowledge generation/Policy Support (as applied):

i. Generation of technology (Commodity & Non-commodity)

- Wheat var. BARI Gom-30, BARI Gom-33, maize var. BARI Hybrid Maize-9, groundnut var. BARI Chinabadam-8, black cumin var. BARI Kalozira-1 may be cultivate for charland farmers due to its higher yield and more economic return.
- Black cumin, chilli and bottle gourd may be fitted in T. aman- Tobacco- Jute/Sesame cropping pattern which can be replace tobacco.

ii. Generation of new knowledge that help in developing more technology in future

Additional application of gypsum fertilizer (37 kg ha⁻¹) with modern cultivation practices (including irrigation) after flowering stage of groundnut gave 54.66% higher yield than traditional cultivation practices.

iii. Technology transferred that help increased agricultural productivity and farmers' income

-Modern high yielding varieties of Black cumin, Chilli, Bottle gourd, Sweet potato, Groundnut, Wheat and Maize provide more profits (97.13 to 446.38 %) which might change farmers' livelihood and insure food security against tobacco.

- High value crop with nutrient rich may help to increase agricultural productivity and farmers' income which was broadcasted on TV media "Channel i". The developed variety with modern management prctices may help increased crop production as well as farm income of the charlandpeople.

iv. Policy Support

The findings of the present project may assist the policy makers of the agricultural sectors for planning and setting their future research directions in order to technology generation as well as increasing production and productivity for sustainable food and nutrition security incharland ecosystem of Bangladesh.

G. Information regarding Desk and Field Monitoring

i) Desk Monitoring [description & output of consultation meeting, monitoring workshops/seminars etc.):

Monitoring workshop	Date(s) of workshop	Remarks
Technical Division/Unit, BARC	14/03/2018	Identifying the problem and gave the proper suggestion for attaining better achievement of the Sub-project activities.
NRM Unit, BARC & PIU-BARC, NATP-2	15/05/2018	

ii) Field Monitoring (time& No. of visit, Team visit and output):

None field monitoring was done.

H. Lesson Learned/Challenges (if any)

- i) Unavailability of quality seed and agricultural inputs hampered crop productivity and income of charland people.
- ii) Lack of knowledge and proficiency causes of lowering the agricultural productivity.
- iii) Lack of Institutional facility and support hampered the rapid development of agricultural sector.

I. Challenges (if any)

- Natural calamities/hazards especially hail storm, heavy rainfall, drought, heavy cold wave is a major constraint to perform the project activities smoothly.
- Procurement of goods delayed and research activities hampered due to untimely fund release.

Signature of the Principal Investigator
Date
Seal

Counter signature of the Head of the
organization/authorized representative
Date
Seal