

Project ID:688

Competitive Research Grant

Sub-Project Completion Report

on

Crops Productivity in Beel areas of Bangladesh

Project Duration

May 2017 to September 2018

Agronomy Division

Bangladesh Agricultural Research Institute
Gazipur 1701

Submitted to

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



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Acronyms

<i>Aus</i>	Rice grown summer season (generally grown in April to August/September)
B	Boron
<i>B. aman</i>	Broadcast <i>aman</i> (Deep water rice)
<i>Boro</i>	HYV rice transplanted in winter (November-January) and harvested in summer (April-May)
BARC	Bangladesh Agricultural Research Council
BARI	Bangladesh Agricultural Research Institute
BCR	Benefit cost ratio
Beel	Low land goes under water and remains under water about 4-5 months generally from July to November
Co-PI	Co- Principal Investigator
CRG	Competitive Research Grant
CV	Co-efficient of variation
DAH	Days after harvesting
DAE	Days after emergence
DAS	Days after sowing
GAY	Garlic equivalent yield
FP	Farmers' Practice
HYV	High yielding variety
HW	Hand weeding
K	Potassium
LoA	Letter of Agreement
LSD	Least significant difference
N	Nitrogen
NATP	National Agricultural Technology Program
P	Phosphorus
PCR	Project Completion Report
PI	Principal Investigator
PIU	Project Implementation Unit
Ratoon	Cultivation regrowth of main crop
RCB	Randomized complete Block
RN	Recommended Nutrient
RW	Recession of water
S	Sulphur
SA	Scientific Assistant
Zn	Zinc

Table of Contents

Sl No.	Subject	Page No.
	Cover Page	i
	Citation	ii
	Acronyms	iii
	Table of Contents	iv
	Executive Summary	v
A.	Sub-project Description	1
	1. Title of the CRG sub-project	1
	2. Implementing organization	1
	3. Name and full address of PI/Co-PI (s)	1
	4. Sub-project budget	1
	5. Duration of the sub-project	1
	6. Justification of undertaking the sub-project	1
	7. Sub-project goal	2
	8. Sub-project objective	2
	9. Implementing location	2
	10. Methodology	2
	11. Results and discussion	6
	12. Research highlight/findings	24
	13. References	24
B.	Implementation Position	26
	1. Procurement	26
	2. Establishment/renovation facilities	26
	3. Training/study tour/ seminar/workshop/conference organized	26
C.	Financial and physical progress	26
D.	Achievement of Sub-project by objectives	27
E.	Materials Development/Publication made under the Sub-project	27
F.	Technology/Knowledge generation/Policy Support	27
	i. Generation of technology	27
	ii. Generation of new knowledge that help in developing more technology in future	27
	iii. Technology transferred that help increased agricultural productivity and farmers' income	27
	iv. Policy Support	28
G.	Information regarding Desk Monitoring	28
H.	Information regarding Field Monitoring	28
I.	Lesson Learned/Challenges	29
J.	Challenges	29
	Enclosure	30

Executive Summary

A sub-project entitled “**Crops Productivity in Beel areas of Bangladesh**” under NATP-2, BARC has been executed for 17 months from May 2017 to September 2018. According to LoA (signed on 15 May 2017), PI and Co-PI were the authorized persons for implementing the sub-project in favour of BARI. Objectives of the sub-project were to identify technology for improving crop productivity and to adapt HYV with best crop management practices in beel areas. Total approved Budget is Tk.3000000 (Thirty lakh taka only). Experimental locations were selected as (1) Dobila and (2) Khalkhula, Tarash-Sirajgonj (3) Charkadaho, Gurudashpur-Natore, and (4) Monglarbeel (Surjack-Katagor), Boalmari-Faridpur. Key findings of thirteen adaptive/validation trials have been summarized here. Hybrid maize varieties of NK-40, 900 M Gold and Miracle (Grain yield: 10.02-10.64 t/ha and BCR: 1.88-2.00), HYV mustard varieties of BARI Sarisha-14 (Seed yield: 1.67 t/ha and BCR: 1.65) and BARI Sarisha-15 (Seed yield: 1.60 t/ha and BCR: 1.59), wheat variety of BARI Gom-30 (Grain yield: 5.02 t/ha and BCR: 1.78), garlic variety of BARI Rashun-3 (Bulb yield: 12.54 t/ha and BCR: 1.64), and onion variety of BARI Pij-4 (Bulb yield: 19.61 t/ha and BCR: 2.00) showed better yield performance and economic return in beel area. Seed dibbling at 7 days after recession water was found suitable for higher grain yield (12.10 t/ha) and higher BCR (2.19). Fertilizer dose like 325-90-185-60-5-2.5 kg/ha of N-P-K-S-Zn-B + Weeding at 20 days after emergence (DAE) (Grain yield: 12.98 t/ha and BCR: 2.24) for maize, Fertilizer dose of 140-44-70-30-1.8-1 kg/ha of N-P-K-S-Zn-B + Weeding at 15 DAE for mustard (Seed yield: 1.75 t/ha and BCR: 1.69), Fertilizer dose like 125-190-206-25-5 -2.5 kg/ha of N-P-K-S-Zn-B + Weeding at 30 days after dibbling (Garlic equivalent yield: 25.22 t/ha and BCR: 2.84) for Garlic+ Watermelon intercropping, Fertilizer dose of 125-45-31-25-2-1 kg/ha of N-P-K-S-Zn-B + Weeding at 20 DAE for wheat (Grain yield: 5.52 t/ha and BCR: 1.81), Nutrient dose like 150-75-200-50-5.6-2.5 kg/ha of N-P-K-S-Zn-B + Weeding at 30 DAE for onion (Bulb yield (19.96 t/ha and BCR: 2.01) were found suitable for higher yield and BCR. Fertilizer dose of 40-20-10-5-0.8-0.5 kg/ha of N-P-K-S-Zn-B + Weeding at 5-7 days after harvest of main rice for ratooning (Grain yield: 2.10 t/ha and BCR: 3.82), and Fertilizer dose of 26-11-11-5-0.8-0.8 kg/ha of N-P-K-S-Zn-B + Hand weeding at 20 DAE and 50-60 DAE (Grain yield: 1.59-1.61 t/ha and BCR: 1.91-2.11) for B. *aman* rice were found profitable in beel area. Farmers’ were interested to cultivate hybrid maize varieties, short duration mustard variety before *boro* rice (in upper land of Chalanbeel), BARI Gom-30 (Moderate interest), Garlic+ Watermelon intercropping, B. *aman* and *ratoon* rice along with their management practices. Furthermore, some farmers are growing short duration mustard like BARI Sarisha-14 before *boro* rice in Chalanbeel area with their own interest (recent field visit by PI and Co-PI at the project area). Base line information has been collected by a quick survey (Enclosure-2). Capacity building training for farmer and field day has been completed. Procurement has been completed. Financial progress is about 99.47%. Research findings will help the policy makers of the agriculture subsector for setting their future research direction.

CRG Sub-Project Completion Report (PCR)

A. Sub-project Description

1. **Title of the CRG sub-project: Crops Productivity in Beel areas of Bangladesh**
2. Implementing organization: Agronomy Division, Bangladesh Agricultural Research Institute
3. Name and full address with phone, cell and E-mail of PI/Co-PI (s):

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4. Sub-project budget (Tk):
 - 4.1 Total: Tk. 3000000 (Thirty lakh)
 - 4.2 Revised (if any): Not Applicable
5. Duration of the sub-project:
 - 5.1 Start date (based on LoA signed): 15 May 2017
 - 5.2 End date: 30 September 2018
6. Justification of undertaking the sub-project:

Beel (Low land goes under water and remains under water about 4-5 months generally from July to November) area are under unfavourable ecosystem covering an area of 2.43 million hectares in Bangladesh (Aziz *et al.*, 2016). Generally unfavourable ecosystem is less productive and remains fallow in most of the part of the year (BARC, 2013). Although the farmers of this area grow some crops but they do not use improved crop varieties and production technologies (Islam *et al.*, 2012). Previous research indicates that there is a possibility of improving productivity of different crops and cropping pattern through adaptation of HYV of crops along with their production technologies. *Boro* rice is the main crop in beel area. But *boro* rice require huge amount of water. One kg *boro* rice production requires 2500 litre water (Bouman, 2009). On the other hand, wheat and maize require 1300 litre and 900 litre water respectively (Bouman, 2009). Consequently, *boro* rice cultivation depleted huge amount of underground water resulting bellowing the underground water level. Chalan Beel is the largest

wetland in northern part of Bangladesh is uniqueness for largely drastic fall in water level (Anonymous, 2017). Lifting of underground water is becoming a problem for farmers. Moreover, the most important useful underground water resource is going to be critical and not eco-friendly. Hence, alternate cropping rather than *boro* rice can save underground water resource as well as environment. In this context, *boro* rice can be replaced by wheat, maize, mustard, garlic, lentil and onion. Previous survey and experience indicate that farmers also grow maize, wheat, mustard, garlic, lentil, onion, pea, lathyrus, potato in beel area especially upper side land (Kandha) of beel (BARI, 2016). These crops require low water as compared to *boro* rice. Govt. policy is also pertaining to save underground water resource and safe environment. Use of HYV and improved management practice can improve the productivity of the crops in beel area. Sometime farmers grow short duration mustard variety in Mustard-*Boro* rice cropping pattern. This pattern can be improved by short duration HYV mustard and improved management practices (BARI, 2016). Maize crops sometimes damages due to summer storm. Direct seeding technique can escape the crop from storm by earlier planting in muddy soil. Garlic+watermelon can be improved by HYV garlic and management practices. Lands remain fallow after *boro* rice cultivation in beel area. There is possibility of growing broadcast *aman* (*B.aman*) rice after *Boro* rice especially in upper side land of beel but not in the bottom (Mian, 2012-<http://makhayermian.blogspot.com>). Although, some farmers do this practise (*B.aman*) in Faridpur, Pabna, Tangail, Cumilla but they do not use proper management. There is severe weed infestation in *B. aman* rice in early growth stage (Mian, 2012-<http://makhayermian.blogspot.com>). Generally, farmers do not use any recommended fertilizer in *B. aman*. Hence, there is a scope of improving productivity of *B. aman* through weed and fertilizer management. It is a need to develop a production package for *B.aman* cultivation in beel area. Ratooning of *aus* rice is a farmers' innovative practice in low lands of Chalonbeel area. Rice ratooning is one of the potential technologies to increase rice production. Better yield of ratoon crop is possible by adopting appropriate management practices for main crop as well as for ratoon crop. The management practices include land preparation, adequate plant density and spacing, use of appropriate cultivars, water management, application of adequate rate of fertilizers, appropriate height of cutting, and control of diseases, insects and weeds (Santos *et al.*, 2011). Proper management package is a need for ratooning of *boro* rice in specific area. Cultivation of mustard, wheat, maize, garlic, onion, lentil and watermelon in beel area may save underground water use as compared to *boro* rice cultivation. Therefore, the project was undertaken for improving crops productivity through HYV along with improved production package.

7. Sub-project goal: Sustainable and higher productivity of food crops contributing to food and nutritional security and underground water resource saving and eco-friendly food crop production in beel areas of Bangladesh.
8. Sub-project objective (s):
 - i. To identify technology (8-10) for improving crop productivity
 - ii. To adapt HYV and best crop management practices (10-12)
 - iii. To improve knowledge (120 farmers) and income (20-30%) of farmers
9. Implementing location (s): (a) Dobila and (b) Khalkhula, Tarash-Sirajgonj (c) Charkadaho, Gurudashpur-Natore, and (d) Monglarbeel (Surjack-Katagor), Boalmari-Faridpur.
10. Methodology in brief:

Experimental locations were selected as (1) Dobila and (2) Khalkhula, Tarash upazila of Sirajgonj district (3) Charkadaho, Gurudashpur upazila of Natore district and (4) Monglarbeel (Surjack-Katagor), Boalmari upazila of Faridpur. Thirteen experiments have been completed. The methodology is given briefly in the following tabular form.

Title of the Experiment	Treatment/verity	Date of sowing	Date of harvesting	Cultural practices
Selection of suitable hybrid maize varieties in Chalan Beel area	BARI Hybrid-9, Miracle, 900 M Gold and NK-40	5 December 2017	19 April 2018	Weeding at 20-25 DAE& 3 irrigation
Performance of short duration mustard varieties in the Chalan Beel area	BARI Sarisha-14, BARI Sarisha-15, BARI Sarisha-17 and local Tori	6-15 November 2017	6-12 February 2018	Weeding 15-18 DAE and 1 irrigation at 25 DAE
On farm adaptation trial of wheat varieties in Chalan Beel area	BARI Gom-25, BARI Gom-26, BARI Gom-28 and BARI Gom-30	3 December 2017	27 March 2018	Weeding at 20 DAE and 2 irrigation
Performance of garlic varieties for intercropping with watermelon in Chalan beel area	BARI Rashun-1, BARI Rashun-2, BARI Rashun-3, BARI Rashun-4 and Itali	3 December 2017	28 March 2018	Weeding at 30 DAE for garlic and irrigation

Title of the Experiment	Treatment/verity	Date of sowing	Date of harvesting	Cultural practices
Performance of onion varieties at Monglarbeel area	BARI Pij-1, BARI Pij-4 and local var. Lalteer	28 January 2018	5-8 May 2018	Transplanted & weeding 30 DAT
Minimizing technique of waterlogged effect for maize cultivation in Chalan Beel area”	Dibbling in mud, Dibbling 7 days after RW, Transplant in mud (20 days old seedling), Recommended practice in zoe condition (FP)	20-29 November 2017	20-28 April 2018	Weeding at 25 DAS/DAT
Effect of fertilizer and weed management of hybrid maize in the Chalan Beel area”	T ₁ = 260-72-148-48-4-2 kg/ha of N-P-K-S-Zn-B (RN) + W (20 DAE), T ₂ =325-90-185-60-5-2.5 kg/ha of N-P-K-S-Zn-B (125% RN) + W (20 DAE), T ₃ =207-54-131-8-0-0 kg/ha of N-P-K-S-Zn-B (FP) and T ₄ =Control.	1 December 2017	16-28 April 2018	Var. Miracle Weeding as per specification
Effect of fertilizer and weed management of mustard in the Chalan Beel area”	T ₁ = 120-35-60-25-1.5-1 kg/ha of N-P-K-S-Zn-B (RN) + W (15 DAE), T ₂ =140-44-70-30-1.8-1 kg/ha of N-P-K-S-Zn-B (125% RN) + W (15 DAE), T ₃ =86-75-40-0-0-0 kg/ha of N-P-K-S-Zn-B (FP) and T ₄ =Control	30 November 2017 (re-sowing)	25 February 2018	Var. BARI sarisha-15 Weeding as per specification
Effect of fertilizer and weed management of Garlic+ Watermelon intercropping in Garlic+ Watermelon-B. <i>aman</i> cropping pattern in Chalan Beel area”	T ₁ = 100-152-165-20-4-2 kg/ha of N-P-K-S-Zn-B (RN) + Weeding (30 DAD), T ₂ =125-190-206-25-5-2.5 kg/ha of N-P-K-S-Zn-B (125% of RN) + W (30 DAD), T ₃ =34-112-84-10-3-1 kg/ha of	6 November 2017 (garlic) 1 December	24 March 2018 (garlic) & 28 April 2018 (watermel)	Transplanting watermelon 25-30 days after garlic sowing

	N-P-K-S-Zn-B (FP)	2017 (watermelon)	on)	
Fertilizer and weed management of wheat in Chalan Beel area”	T ₁ = 100-36-25-20-1.8-1 kg/ha of N-P-K-S-Zn-B (RN) + W (20 DAE), T ₂ =125-45-31-25-2-1 kg/ha of N-P-K-S-Zn-B (125% RN) + W (20 DAE), T ₃ =80-40-60-0-0-0 kg/ha of N-P-K-S-Zn-B (FP)	30 November 2017	21 March 2018	Var. BARI Gom-30
Fertilizer and weed management of onion in Monglarbeel area”	T ₁ = 100-36-25-20-1.8-1 kg/ha of N-P-K-S-Zn-B (RN) + W (20 DAE), T ₂ =125-45-31-25-2-1 kg/ha of N-P-K-S-Zn-B (125% RN) + W (20 DAE), T ₃ =80-40-60-0-0-0 kg/ha of N-P-K-S-Zn-B (FP)	29 January 2018.	8-12 May 2018	Transplanting of seedling

Title of the Experiment	Treatment/verity	Date of sowing	Date of harvesting	Cultural practices
Fertilizer and weed management of <i>ratoon</i> rice in chalan beel area	T ₁ = 50-30-20-8-1.5-1 kg/ha of N-P-K-S-Zn-B + Weeding (at 5-7 DAH=days after harvest), T ₂ =40-20-10-5-0.8-0.5 kg/ha of N-P-K-S-Zn-B +Weeding (5-7 DAH), T ₃ =20-13-11-0-0-0 kg/ha of N-P-K-S-Zn-B (FP=Farmers practice) and T ₄ =Control	17 June 2017 for <i>ratoon</i>	20-26 September 2017 (1 st) & 30 November 2017	local rice cultivar. Pajam Weeding as per treatment
Fertilizer and weed management of <i>B. aman</i> in Beel area	T ₁ = 21-9-9-4-0.6-0.6 kg/ha of N-P-K-S-Zn-B + HW (Hand Weeding at 20 DAE and 50-60DAE), T ₂ =26-11-11-5-0.8-0.8 kg/ha of N-P-K-S-Zn-B + HW (20 DAE and 50-60DAE), T ₃ =14-5-8-3-0-0 kg/ha of N-P-K-S-Zn-B (FP=Farmers’ Practice) + HW (20 DAE and 50-60 DAE) and T ₄ =Control	17-24 May 2017	7-13 December 2017	Broadcasting of local aman rice cv. <i>Modhudigha</i>

Experiment “Selection of suitable hybrid maize varieties (BARI Hybrid-9, Miracle, 900 M Gold and NK-40) in the Chalan Beel area” was sown on 5 December 2017 and harvested on 19 April 2018. Experiment “Performance of short duration mustard varieties (BARI Sarisha-14, BARI Sarisha-15, BARI Sarisha-17 and local Tori) in the Chalan Beel area” was sown on 6-15 November 2017 and crop was harvested on 6-12 February 2018. Trial “On farm adaptation trial of wheat varieties (BARI Gom-25, BARI Gom-26, BARI Gom-28 and BARI Gom-30) in Chalan Beel area” was sown on 3 December 2017 and crop harvested on

27 March 2018. Experiment “Performance of garlic varieties (BARI Rashun-1, BARI Rashun-2, BARI Rashun-3, BARI Rashun-4 and Itali) for intercropping with watermelon in Chalan beel area” was sown on 3 December 2017 and harvested 28 March 2018. Experiment “Performance of onion varieties (BARI Piaj-1, BARI Piaj-4 and local variety) at Monglarbeel area” was transplanted on 28 January 2018 and harvested on 5-8 May 2018. Seed/seedling of experiment “Minimizing technique (T_1 = Dibbling in mud, T_2 = Dibbling 7 days after RW, T_3 =Transplant in mud (20 days old seedling), T_4 =Farmer’s practice: recommended practice in *zoe* condition) of waterlogged effect for maize cultivation in Chalan Beel area” was sown/planted on 20-29 November 2017 and harvested on 20-28 April 2018. Experiment “Effect of fertilizer and weed management of hybrid maize (Miracle) in the Chalan Beel area” was sown on 1 December 2017 and harvested on 16-28 April 2018. Treatments for this fertilizer trial were viz. T_1 = 260-72-148-48-4-2 kg/ha of N-P-K-S-Zn-B (RN) + W (20 DAE), T_2 =325-90-185-60-5-2.5 kg/ha of N-P-K-S-Zn-B (125% RN) + W (20 DAE), T_3 =207-54-131-8-0-0 kg/ha of N-P-K-S-Zn-B (FP) and T_4 =Control. Experiment “Effect of fertilizer and weed management of mustard (BARI sarisha-15) in the Chalan Beel area” was sown on 30 November 2017 (re-sowing for excess raining) and crop was harvested on 25 February 2018. Treatments were viz. T_1 = 120-35-60-25-1.5-1 kg/ha of N-P-K-S-Zn-B (RN) + W (15 DAE), T_2 =140-44-70-30-1.8-1 kg/ha of N-P-K-S-Zn-B (125% RN) + W (15 DAE), T_3 =86-75-40-0-0-0 kg/ha of N-P-K-S-Zn-B (FP) and T_4 =Control for this experiment. Experiment “Effect of fertilizer and weed management of Garlic+ Watermelon intercropping in Garlic+ Watermelon-B. *aman* cropping pattern in Chalan Beel area” was sown on 6 November 2017 (garlic) and on 1 December 2017 (watermelon) and harvested on 24 March 2018 (garlic) and watermelon harvesting was started from 28 April 2018. Treatments were like T_1 = 100-152-165-20-4-2 kg/ha of N-P-K-S-Zn-B (RN) + Weeding (30 DAD), T_2 =125-190-206-25-5-2.5 kg/ha of N-P-K-S-Zn-B (125% of RN) + W (30 DAD), T_3 =34-112-84-10-3-1 kg/ha of N-P-K-S-Zn-B (FP). Experiment “Fertilizer and weed management of wheat (BARI Gom-30) in Chalan Beel area” was sown on 30 November 2017 and harvested on 21 March 2018. Treatments were as T_1 = 100-36-25-20-1.8-1 kg/ha of N-P-K-S-Zn-B (RN) + W (20 DAE), T_2 =125-45-31-25-2-1 kg/ha of N-P-K-S-Zn-B (125% RN) + W (20 DAE), T_3 =80-40-60-0-0-0 kg/ha of N-P-K-S-Zn-B (FP) for this experiment. Trail on “Fertilizer and weed management of onion in Beel area” was transplanted on 29 January 2018 and harvested on 8-12 May 2018. Treatments were as T_1 = 120-60-160-40-4.5-2 kg/ha of N-P-K-S-Zn-B (RN) + Weeding (30 DAE), T_2 =150-75-200-50-5.60-2.5 kg/ha of N-P-K-S-Zn-B (125% RN) + Weeding (30 DAE), T_3 =100-60-140-30-0-0 kg/ha of N-P-K-S-Zn-B (FP) for this trial. Seedling of experiment on “Fertilizer and weed management of *ratoon* rice (local rice cultivar) in chalan beel area” was transplanted on 17 June 2017 for *ratoon* rice. First crop was harvested on 20-26 September 2017. Then weeding was done and fertilizer was applied at of main rice. *Ratoon* rice was harvested on 30 November 2017. Treatments were viz. T_1 = 50-30-20-8-1.5-1 kg/ha of N-P-K-S-Zn-B + Weeding (at 5-7 DAH=days after harvest), T_2 =40-20-10-5-0.8-0.5 kg/ha of N-P-K-S-Zn-B + Weeding (5-7 DAH), T_3 =20-13-11-0-0-0 kg/ha of N-P-K-S-Zn-B (FP=Farmers practice) and T_4 =Control for this experiment. Seed of experiment on “Fertilizer and weed management of *B. aman* (cv. *Modhudigha*) in Beel area” was broadcast on 17-24 May 2017 and crop was harvested on 7-13 December 2017. Treatments were viz. T_1 = 21-9-9-4-0.6-0.6 kg/ha of N-P-K-S-Zn-B + HW (Hand Weeding at 20 DAE and 50-60DAE), T_2 =26-11-11-5-0.8-0.8 kg/ha of N-P-K-S-Zn-B + HW (20 DAE and 50-60DAE), T_3 =14-5-8-3-0-0 kg/ha of N-P-K-S-Zn-B (FP=Farmers’ Practice) + HW (20 DAE and 50-60DAE) and T_4 =Control for this trial. Experiment on broadcast *aman* has been conducted in 4 farmers’ field after harvesting of *boro* rice. Initial soil samples of experimental sites have been collected and analyzed (Enclosure-2). All experiments were laid out in RCB design with 4 replications. Crop management was done as per recommendation of the respective crops. Key data was recorded and analyzed with R statistics. Means were compared using $LSD_{(0.05)}$. Cost and return analysis was done for all experiments. Farmer’s opinion about technologies was also recorded. Capacity building training and Field day were organized properly. Half Yearly Progress and Annual Progress Report were submitted. Monitoring team visited the experiment and reported. Three workshops on progress of the project was

organized by BARI and NATP-2 (BARC). SA and contractual accountant have been appointed and worked properly. Base line survey and selection of farmers have completed (Enclosure-1). Procurement of capital items has been completed successfully. Details report has been included in Results and Discussion section (Sl. No. 11) of PCR. Aphid in mustard field was controlled by spraying malathion. There was no other insect and disease attack in the crops.

11. Results and discussion:

Experiment-1

Selection of suitable hybrid maize varieties in Chalan Beel area

Plant height, ear height, number of grains/cob, 1000-grain weight, grain yield, stover yield, harvest index and field duration of hybrid maize at Chalan Beel have been varied significantly among the varieties (Table 1 and Table 2). Higher grain yield 10.02, 10.06 and 10.64 t/ha were observed in NK-40, 900 M Gold and Miracle respectively. Higher grain yield was contributed by the cumulative effect of higher number of grains/cob and higher 1000-grain weight (Table 1). BARI Hybrid Maize-9 gave the lowest grain yield (9.46 t/ha). Cost and return analysis of hybrid maize varieties has been presented in Table 3. The highest gross margin (Tk .90400 /ha) and BCR (2.00) were computed in Miracle due to higher gross return (Tk.180880/ha) and higher grain yield (Table 3). Farmers are interested to cultivate these hybrid maize varieties (NK-40, 900 M Gold and Miracle) instead of *boro* rice for higher economic return and as water saving technology.

Table 1. Plant height, ear height, grains/cob and 1000-grain weight of maize varieties at Chalan beel

Variety	Plant height(cm)	Ear height (cm)	Grains/cob (no.)	1000-grain weight (g)
BARI Hybrid Maize-9	241	98	532	340
Miracle	232	66	496	384
900M Gold	222	77	457	363
NK-40	197	77	363	434
LSD _(0.05)	33	11	38	31
CV (%)	7.47	7.14	4.09	4.07

Table 2. Grain yield, straw yield, harvest index, field duration of maize varieties at Chalan beel

Variety	Grain yield (t/ha)	Stover yield (t/ha)	Harvest index (%)	Field duration (day)
BARI hybrid Maize-9	9.46	11.88	43.12	138
Miracle	10.64	11.13	48.87	135
900M Gold	10.06	11.82	44.97	135
NK-40	10.02	10.51	48.81	135
LSD _(0.05)	1.04	1.26	1.15	2.23
CV (%)	6.52	7.09	2.70	1.03

Table 3. Cost and returns analysis of four maize varieties at Chalan beel

Variety	Cost of cultivation (Tk./ha)	Gross return (Tk./ha)	Gross margin (Tk./ha)	BCR
BARI hybrid Maize-9	90480	160820	70340	1.78
Miracle	90480	180880	90400	2.00
900M Gold	90480	171020	80540	1.89
NK-40	90480	170340	79860	1.88

Maize: Tk.17/kg grain

Experiment-2

Performance of short duration mustard varieties in Chalan Beel area

Plant height, siliqua / plant, seeds / siliqua, 1000-seed weight, seed yield, straw yield and field duration of mustard at Chalan Beel have been differed significantly among the varieties except plant population/m² (Table 4 and Table 5.) Significantly the highest seed yield (1600 and 1667 kg/ha) was observed in BARI Sarisha-15 and BARI Sarisha-14 (Table 5). Cost and return analysis of mustard varieties has been presented in Table 6. Higher BCR (1.59-1.65) and gross margin (Tk.29535-32885/ha) were found in BARI Sarisha-14 and BARI Sarisha-15 due to higher gross return (Tk.80000-83350/ha) and higher seed yield. The lowest BCR (1.05) was observed in local variety (Table 6). BARI Sarisha-15 and BARI Sarisha-14 were found suitable for cultivation before *boro* rice in the upper land of Chalan Beel area producing higher seed yield (1600-1667 kg/ha) and economic returns. Farmers are interested to cultivate BARI Sarisha-14 and BARI Sarisha-14 before *boro* rice for their better performance in Chalan Beel area.

Table 4. Plant population/m², plant height, siliqua/plant and seeds/siliqua of mustard varieties at Chalan beel

Variety	Population/m ² (no.)	Plant height (cm)	Siliqua/plant (no.)	Seeds/siliqua(no)
BARI Sarisha-14	89	94	56	31
BARI Sarisha-15	85	88	60	22
BARI Sarisha-17	87	93	53	20
Local	91	65	71	17
LSD _(0.05)	NS	19	6	1.30
CV (%)	9.87	12.51	4.09	3.61

Table 5. The 1000-seed weight, seed yield, straw yield and field duration of mustard varieties at Chalan beel

Variety	1000-seed wt. (g)	Seed yield (kg/ha)	Straw yield (t/ha)	Field duration (day)
BARI Sarisha-14	3.38	1667	3.07	92
BARI Sarisha-15	3.02	1600	2.88	91
BARI Sarisha-17	3.21	1175	2.76	90
Local	2.27	815	1.67	76
LSD _(0.05)	0.17	151	0.42	0.06
CV (%)	2.98	7.19	10.21	1.23

Table 6. Cost and returns analysis of four mustard varieties at Chalan beel

Variety	Cost of cultivation (Tk./ha)	Gross return (Tk./ha)	Gross margin (Tk./ha)	BCR
BARI Sarisha-14	50465	83350	32885	1.65
BARI Sarisha-15	50465	80000	29535	1.59
BARI Sarisha-17	50465	58750	8285	1.16
Local	38650	40750	2100	1.05

Mustard: Tk. 50/kg seed

Experiment-3

On farm adaptation of wheat varieties in Chalan Beel area

Number of grains/spike, 1000-grain weight, grain yield, straw yield, harvest index and field duration of wheat at chalan beel have been varied significantly among the varieties except plant height, number of spikes/m² (Table 7 and Table 8). The highest grain yield (4.59, 4.63 and 5.02 t/ha) were observed in BARI Gom-25, BARI Gom-28 and BARI Gom-30. Yield of wheat was good due to favourable weather condition (Enclosure-4) and high management. Cost and return analysis of wheat varieties at chalan beel has been presented in Table 9. The highest BCR (1.78) and gross margin (Tk. 43970/ha) was observed in BARI

Gom-30 due to the highest gross return (Tk.100400/ha) and grain yield. BARI Gom-30 was found suitable in Chalan Beel area in respect of higher yield (5.02t/ha) and BCR (1.78). There was no blast infestation in the experimental field. Farmers showed less interest to grow wheat in Chalan Beel area.

Table 7. Plant height, spikes/m², grains/spike and 1000-gran weight of wheat varieties at Chalan beel

Variety	Plant height (cm)	Spikes/m ² (no.)	Grains/spike (no.)	1000-grain weight (g)
BARI Gom-25	90	362	34.60	40.60
BARI Gom-26	93	348	33.10	49.30
BARI Gom-28	89	369	36.80	46.10
BARI Gom-30	91	372	45.30	41.50
LSD (0.05)	NS	NS	2.07	4.41
CV (%)	6.88	5.69	3.45	6.22

Table 8. Seed yield, straw yield, harvest index, field duration of wheat varieties at Chalan beel

Variety	Grain yield (t/ha)	Straw yield (t/ha)	Harvest index (%)	Field duration (day)
BARI Gom-25	4.59	4.75	49.14	110
BARI Gom-26	4.52	4.46	50.33	109
BARI Gom-28	4.63	4.49	50.77	108
BARI Gom-30	5.02	4.85	50.86	113
LSD (0.05)	0.45	0.29	1.29	3.71
CV (%)	6.42	4.03	2.68	2.11

Table 9. Cost and returns analysis of four wheat varieties at Chalan beel

Variety	Cost of cultivation (Tk./ha)	Gross return (Tk./ha)	Gross margin (Tk./ha)	BCR
BARI Gom-25	56430	91800	35370	1.63
BARI Gom-26	56430	90400	33970	1.60
BARI Gom-28	56430	92600	36170	1.64
BARI Gom-30	56430	100400	43970	1.78

Wheat: Tk.20/kg grain

Experiment-4

Performance of garlic varieties for intercropping with watermelon in Chalan Beel area

Plant population/m², plant height, number of clove/bulb, individual bulb weight, bulb yield and field duration of garlic varieties at Chalan Beel have been presented in Table 10 and Table 11. Individual bulb weight, bulb yield and field duration were significantly influenced by variety of garlic. The highest bulb yield (12.54 and 11.47t/ha) were observed in BARI Rasun-3 and Itali (local variety). Cost and return analysis of garlic varieties at Chalan Beel has been presented in Table 12. The highest BCR (1.64) and gross margin (Tk. 196600 /ha) were found in BARI Rasun -3 due to highest gross return (Tk. 501600/ha) followed by Itali (local variety). The lowest BCR (1.27) was observed in BARI Rasun-1 variety. So, BARI Rasun-3 and local variety (Itali) were found profitable for Chalan beel area.

Table 10. Plant population/m², plant height, and clove/bulb of garlic varieties at Chalan Beel

Variety	Population/m ² (no.)	Plant height (cm)	Clove/bulb (no.)
BARI Rasun -1	84.7	50.87	20.8
BARI Rasun -2	88.3	56.10	20.4
BARI Rasun -3	97.3	62.67	24.6
BARI Rasun -4	91.3	56.47	21.1
Itali (Local)	96.7	60.47	23.4
LSD _(0.05)	6.12	7.05	NS
CV (%)	3.54	6.53	10.61

Table 11. Individual bulb weight, bulb yield and field duration of garlic varieties at Chalan Beel

Variety	Individual bulb weight (g)	Bulb yield (t/ha)	Field duration (day)
BARI Rasun -1	17.98	9.72	140
BARI Rasun -2	22.56	11.12	130
BARI Rasun -3	26.58	12.54	135
BARI Rasun -4	20.86	10.40	130
Itali (Local)	26.08	11.47	135
LSD _(0.05)	4.05	1.38	5.89
CV (%)	9.43	6.64	2.34

Table 12. Cost and returns of analysis of garlic varieties at Chalan Beel

Variety	Cost of cultivation (Tk./ha)	Gross return (Tk./ha)	Gross margin (Tk./ha)	BCR
BARI Rasun -1	305000	388800	83800	1.27
BARI Rasun -2	305000	444800	139800	1.46
BARI Rasun -3	305000	501600	196600	1.64
BARI Rasun -4	305000	416000	111000	1.36
Itali (Local)	305000	458800	153800	1.50

Garlic: Tk.40/kg

Experiment-5

Performance of onion varieties at Monglarbeel area

Plant population/m², plant height, pseudo stem yield, individual bulb weight, bulb yield and field duration of onion varieties at Monglarbeel have been presented in Table 13 and Table 14. Individual bulb weight, bulb yield and field duration were influenced significantly by different varieties of onion. The highest bulb yield (19.61 and 20.02 t/ha) were observed in BARI Piaj-4 and local variety. Cost and return analysis of onion varieties at Monglarbeel has been presented in Table 15. The higher BCR (2.00 and 2.08) and gross margin (Tk.415400 and 447000/ha) were noticed in BARI Piaj-4 and local variety due to higher gross return (Tk. 830400 and 862000/ha) and bulb yield. The lowest BCR (1.82) was observed in BARI Piaj-1 variety. BARI Piaj-4 and local variety (Lalter) of onion gave better bulb yield (19.61 and 20.02 t/ha) and higher economic returns in Monlarbeel area. Farmers are interested to cultivate BARI Piaj-4 and (Lalter).

Table 13. Plant population/m², plant height, and pseudo stem (leaf) yield of onion varieties at Monlarbeel

Variety	Population/m ² (no.)	Plant height (cm)	Pseudo stem yield (t/ha)
BARI Piaj-1	93	41	1.57
BARI Piaj-4	94	42	1.65
Local (Lalter)	93	42	1.61
LSD _(0.05)	NS	NS	NS
CV (%)	6.62	8.67	3.61

Table 14. Individual bulb weight, bulb yield and field duration of onion varieties at Monlarbeel

Variety	Individual bulb weight (g)	Bulb yield (t/ha)	Field duration (day)
BARI Pijaj-1	18.89	17.49	96
BARI Pijaj-4	20.76	19.61	98
Local(Lalter)	21.55	20.02	100
LSD _(0.05)	1.16	1.34	1.81
CV (%)	3.29	4.09	1.12

Table 15. Cost and returns of analysis of onion varieties at Monglarbeel

Variety	Cost of cultivation (Tk./ha)	Gross return (Tk./ha)	Gross margin (Tk./ha)	BCR
BARI Pijaj-1	415000	755600	340600	1.82
BARI Pijaj-4	415000	830400	415400	2.00
Local(Lalteer)	415000	862000	447000	2.08

Onion bulb: Tk.40/kg

Experiment-6

Minimizing technique of waterlogged effect for maize cultivation in Chalan Beel area

Plant height, ear height, number of grains/cob, 1000-grain weight, grain yield, stover yield and field duration of hybrid maize (Var. NK-40) at Chalan Beel were influenced significantly by seeding method of maize (Table 16 and Table 17). The highest grain yield (11.51 t/ha) was observed when maize seed was sown by dibbling 7 days after recession water (RW). The lowest grain yield (9.87 t/ha) was observed when maize seedling (20 days old seedling) was transplant in mud but it took the shortest field period (123 days) to attain maturity. Cost and return analysis of hybrid maize at Chalan Beel as influenced by seeding method of maize has been presented in Table 18. The highest cost of cultivation (Tk. 92520/ha) was observed when maize seedling (20 days old seedling) was transplant in mud. The highest BCR (2.19) and gross margin (Tk.109950 /ha) were found in seed dibbling 7 days after recession water (T₂) due to the highest gross return and highest grain yield. Seed dibbling 7 days after recession water was found suitable for higher grain yield (11.51 t/ha) and higher BCR (2.19). Framers showed interest to cultivate maize in seed dibbling method (7 days after recession water) for higher grain yield and better economic returns.

Table 16. Plant height, ear height, grains/cob and 1000-grain weight of maize as influenced by seeding method of maize at Chalan Beel

Variety	Plant height (cm)	Ear height (cm)	Grains/cob (no.)	1000-grain weight (g)
T ₁	202	77	411	433
T ₂	205	78	414	437
T ₃	175	66	388	398
T ₄	207	78	390	400
LSD _(0.05)	27	7.57	19.5	26.5
CV (%)	4.52	3.34	2.43	3.18

T₁= Dibbling in mud, T₂= Dibbling 7 days after RW, T₃=Transplant in mud (20 days old seedling),
T₄=Farmer's practice

Table 17. Grain yield, stover yield, harvest index, field duration of maize as influenced by seeding method of maize at Chalan Beel

Variety	Grain yield (t/ha)	Stover yield (t/ha)	Harvest index (%)	Field duration (day)
T ₁	10.91	11.81	48.02	134
T ₂	11.51	12.10	48.75	136
T ₃	9.08	9.90	47.84	123
T ₄	9.87	11.10	47.29	135
LSD _(0.05)	1.41	1.46	NS	6.73
CV (%)	6.86	6.53	6.48	2.55

T₁= Dibbling in mud, T₂= Dibbling 7 days after RW, T₃=Transplant in mud (20 days old seedling),
T₄=Farmer's practice (sowing in normal recommended practice in zoe condition)

Table 18. Cost and returns analysis of maize as influenced seeding method of maize at Chalan Beel

Variety	Cost of cultivation (Tk./ha)	Gross return (Tk./ha)	Gross margin (Tk./ha)	BCR
T ₁	90480	185470	94990	2.05
T ₂	92520	202470	109950	2.19
T ₃	92650	154360	61710	1.67
T ₄	90480	167790	77310	1.85

T₁= Dibbling in mud, T₂= Dibbling 7 days after RW, T₃=Transplant in mud (20 days old seedling),
T₄=Farmer's practice (sowing in normal recommended practice in zoe condition)

Experiment-7

Effect of fertilizer and weed management of hybrid maize in Chalan Beel area

Plant height, ear height, number of grains/cob, 1000-grain weight, grain yield, straw yield, harvest index and field duration of hybrid maize (Var. NK-40) at Chalan Beel have been influenced significantly by fertilizer and weed management (Table 19 and Table 20). The highest grain yield (12.98 t/ha) was observed when the crop was fertilized with $N_{325}P_{90}K_{185}S_{60}Zn_5B_{2.5}$ kg/ha + weeding at 20 days after emergence. The lowest grain yield (3.21 t/ha) was observed in control treatment. Cost and return analysis of hybrid maize at Chalan Beel as influenced by fertilizer and weed management has been presented in Table 21. The highest cost of cultivation (Tk. 98520/ha) was observed in T₂ (125% Recommended nutrient + W 20 DAE). The highest BCR (2.24) and gross margin (Tk.122140 /ha) were found in the same treatment due to higher gross return (Tk. 220660 /ha) and grain yield. Nutrient dose, 325-90-185-60-5-2.5 kg/ha of N-P-K-S-Zn-B (125% RN) + Weeding 20 DAE was found suitable for higher grain yield (12.98 t/ha) and higher BCR of 2.24. Framer's showed interest to use higher nutrient dose for higher grain yield and higher economic returns from maize cultivation in Chalan beel area.

Table 19. Plant height, ear height, grains/cob and 1000-grain weight of maize as influenced nutrient level and weeding Chalan Beel

Variety	Plant height (cm)	Ear height (cm)	Grains/cob (no.)	1000-grain weight (g)
T ₁	229	99	411	403
T ₂	249	115	444	477
T ₃	230	87	398	369
T ₄	179	52	241	298
LSD _(0.05)	19	5.99	23	30
CV (%)	5.55	4.25	3.85	4.92

T₁= 260-72-148-48-4-2 kg/ha of N-P-K-S-Zn-B (RN) + W (20 DAE), T₂=325-90-185-60-5-2.5 kg/ha of N-P-K-S-Zn-B (125% RN) + W (20 DAE), T₃=207-54-131-8-0-0 kg/ha of N-P-K-S-Zn-B (FP), T₄=Control,

Table 20. Grain yield, straw yield, harvest index, field duration of maize as influenced by nutrient level and weeding at Chalan Beel

Variety	Grain yield (t/ha)	Straw yield (t/ha)	Harvest index (%)	Field duration (day)
T ₁	11.62	12.65	47.88	144
T ₂	12.98	13.61	48.82	148
T ₃	10.27	11.27	47.68	139
T ₄	3.21	4.36	42.40	135
LSD _(0.05)	0.89	1.17	1.66	2.54
CV (%)	5.88	6.98	2.23	1.13

Table 21. Cost and returns analysis of maize as influenced by nutrient level and weeding at Chalan Beel

Variety	Cost of cultivation (Tk./ha)	Gross return (Tk./ha)	Gross margin (Tk./ha)	BCR
T ₁	90480	197540	107060	2.18
T ₂	98520	220660	122140	2.24
T ₃	87650	174590	86940	1.99
T ₄	76500	54570	-21930	0.71

Tk.17/kg grain

Experiment-8

Effect of fertilizer and weed management of mustard in Chalan Beel area

Plant height, siliqua/plant, seeds/siliqua, 1000-seed weight, seed yield, straw yield and field duration of mustard (Var. BARI Sarisha-15) at Chalan Beel have been differed significantly as influenced by fertilizer level and weed management except plant population/m² (Table 22 and Table 23). Significantly the highest seed yield (1754 kg/ha) was observed when the crop was fertilized with N₁₄₀P₄₄K₇₀S₃₀Zn_{1.8}B₁ kg/ha + weeding at 15 days after emergence (Table 21). The control treatment gave the lowest seed yield (582 kg/ha) of mustard. Cost and return analysis of mustard as influenced by fertilizer and weed management has been presented in Table 24. The highest cost of cultivation (52015 Tk./ha) was observed when the crop was fertilized with 125% of Recommended nutrient + Weeding at 15 DAE (T₂) and the lowest (26980 Tk./ha) was observed in control treatment. The highest BCR (1.69) and gross margin (Tk.35685 /ha) was found in 125% of RN + Weeding at 15 DAE (T₂) due to the highest gross return (Tk.87700/ha). The lowest BCR (1.08) was observed in control treatment. Fertilizer dose,40-44-70-30-1.8-1 kg/ha of N-P-K-S-Zn-B (125% RN) + Weeding at 15 DAE were found suitable for higher seed yield and BCR (1.69) of mustard grown in Chalan beel area. Farmers' showed interest to use this fertilizer dose for mustard cultivation at Chalan Beel area.

Table 22. Plant population/m², plant height, siliqua/plant and seeds/siliqua of mustard as influenced by nutrient level and weeding at Chalan Beel

Treatment	Population/m ² (no.)	Plant height (cm)	Siliqua/plant (no.)	Seeds/Siliqua (no.)
T ₁	91	86	62	27
T ₂	88	92	79	33
T ₃	87	76	58	22
T ₄	89	51	38	16
LSD _(0.05)	NS	13	8	1.04
CV (%)	11.73	8.55	3.61	2.67

T₁= 120-35-60-25-1.5-1 kg/ha of N-P-K-S-Zn-B (RN) + W (15 DAE), T₂=140-44-70-30-1.8-1 kg/ha of N-P-K-S-Zn-B (125% RN) + W (15 DAE), T₃=86-75-40-0-0-0 kg/ha of N-P-K-S-Zn-B (FP), T₄=Control

Table 23. The 1000-seed weight, seed yield, straw yield and field duration of mustard as influenced nutrient level and weeding at Chalan Beel

Treatment	1000-seed wt. (g)	Seed yield (kg/ha)	Straw yield (t/ha)	Field duration (day)
T ₁	3.02	1512	3.01	90
T ₂	3.42	1754	3.88	92
T ₃	3.08	1470	2.58	90
T ₄	2.19	582	1.60	75
LSD _(0.05)	0.16	119	0.38	0.06
CV(%)	2.81	5.59	8.37	1.19

Table 24. Cost and returns analysis of mustard as influenced by nutrient level and weeding at Chalan Beel

Treatment	Cost of cultivation (Tk./ha)	Gross return (Tk./ha)	Gross margin (Tk./ha)	BCR
T ₁	49165	75600	26435	1.54
T ₂	52015	87700	35685	1.69
T ₃	48480	73500	25020	1.52
T ₄	26980	29100	2120	1.08

Mustard: Tk.50.00/kg seed

Experiment-9

Fertilizer and weed management of Garlic+ Watermelon intercropping in Garlic+ Watermelon-B. aman cropping pattern in Chalan Beel area

Plant population/m², plant height, individual bulb weight, bulb yield of garlic (cv. Itali), fruit yield of watermelon (Var. Asain-2) and garlic equivalent yield (GEY) at Chalan Beel as influenced by fertilizer and weed management have been presented in Table 25 and Table 26. Plant height, individual bulb weight, bulb yield of garlic and fruit yield of water melon have been influenced significantly by fertilizer and weed management. The highest bulb yield (12.30 t/ha), fruit yield of water melon (51.67 t/ha) and GEY (25.22 t/ha) were observed in T₂ treatment. Cost and return analysis of Garlic+ Water melon intercropping at Chalan Beel as influenced by fertilizer and weed management has been presented in Table 27. The highest BCR (2.84) and gross margin (Tk. 653800 /ha) were found in T₂ treatment due to highest gross return (Tk. 1008800/ha) and GEY. The lowest BCR (2.57) was observed in T₃ (Farmer's Practice). Treatment T₂ (125-190-206-25-5 -2.5 kg/ha of N-P-K-S-Zn-B + W (30 DAD) gave the highest GEY and higher economic returns in Chalan Beel.

Table 25. Plant population/m², plant height and individual bulb weight of garlic in Garlic + Watermelon intercropping at Chalan Beel

Treatment	Population/m ² (no.)	Plant height (cm)	Individual bulb weight (g)
T ₁	88	62.5	24.6
T ₂	95	67.8	28.5
T ₃	90	63.7	25.0
LSD _(0.05)	NS	3.46	3.00
CV (%)	3.53	5.36	5.08

Table 26. Bulb yield, fruit yield of water melon and Garlic equivalent yield in Garlic + Watermelon intercropping at Chalan Beel

Variety	Bulb yield (t/ha)	Fruit yield of water melon (t/ha)	Garlic equivalent yield (t/ha)
T ₁	11.15	46.32	22.73
T ₂	12.30	51.67	25.22
T ₃	11.70	42.94	22.44
LSD _(0.05)	1.45	2.57	-
CV (%)	4.55	7.61	-

Table 27. Cost and returns of analysis of garlic + water melon intercropping at Chalan beel

Variety	Cost of cultivation (Tk./ha)	Gross return (Tk./ha)	Gross margin (Tk./ha)	BCR
T ₁	350000	909200	559200	2.60
T ₂	355000	1008800	653800	2.84
T ₃	349000	897600	548600	2.57

T₁= 100-152-165-20-4-2 kg/ha of N-P-K-S-Zn-B (RN) + Weeding (30 DAD), T₂=125-190-206-25-5 -2.5 kg/ha of N-P-K-S-Zn-B (125% of RN) + W (30 DAD), T₃=34-112-84-10-3-1 kg/ha of N-P-K-S-Zn-B (FP),
Garlic: Tk.40/kg and Water melon: Tk.2000-5000/100 piece

Experiment-10

Fertilizer and weed management of wheat in Chalan Beel area

Number of spikes/m², number of grains/spike, 1000-grain weight, grain yield, straw yield, harvest index and field duration of wheat (Var. BARI Gom-30) at Chalan Beel have been influenced significantly by fertilizer and weed management except plant height (Table 28 and Table 29). The highest grain yield (5.52 t/ha) was observed when crop was fertilized with N₁₂₅P₄₅K₃₁S₂₅Zn₂B₁ kg/ha + weeding at 20 days

after emergence (125% RN + W 20 DAE). The lowest grain yield (3.98 t/ha) was observed in farmer's practice (N₈₀P₄₀K₆₀kg/ha). Cost and return analysis of wheat at Chalan Beel influenced by fertilizer and weed management has been presented in Table 30. The highest cost of cultivation (Tk.60850 /ha) was observed in T₂ (125% RN + Weeding at 20 DAE). The highest BCR (1.81) and gross margin (Tk.49550/ha) were found in the same treatment due to highest gross return (110400 Tk./ha) and grain yield. Fertilizer dose of 125-45-31-25-2-1 kg/ha of N-P-K-S-Zn-B (125% RN) + Weeding at 20 DAE were found suitable for better yield and economic return from wheat at Chalan Beel area.

Table 28. Plant height, spikes/m², grains/spike and 1000-grain weight of wheat as influenced nutrient level and weeding at Chalan Beel

Treatment	Plant height (cm)	Spikes/m ² (no.)	Grains/spike (no.)	1000-grain weight (g)
T ₁	88	361	34.21	44.70
T ₂	96	385	36.52	49.50
T ₃	81	343	31.09	40.20
LSD (0.05)	NS	27	1.68	4.13
CV (%)	6.88	4.42	2.88	5.34

Table 29. Seed yield, straw yield, harvest index and field duration of wheat as influenced nutrient level and weeding at Chalan Beel

Treatment	Grain yield (t/ha)	Straw yield (t/ha)	Harvest index (%)	Field duration (day)
T ₁	4.41	4.66	48.62	109
T ₂	5.52	5.39	50.60	111
T ₃	3.98	4.27	48.24	106
LSD (0.05)	0.68	0.53	0.66	2.53
CV (%)	5.83	6.44	3.09	1.35

Table 30. Cost and returns analysis of wheat as influenced nutrient level and weeding at Chalan Beel

Treatment	Cost of cultivation (Tk./ha)	Gross return (Tk./ha)	Gross margin (Tk./ha)	BCR
T ₁	55430	88200	32770	1.59
T ₂	60850	110400	49550	1.81
T ₃	54620	79600	24980	1.46

T₁= 100-36-25-20-1.8-1 kg/ha of N-P-K-S-Zn-B (RN) + W (20 DAE), Wheat: Tk.20.00/kg

T₂=125-45-31-25-2-1 kg/ha of N-P-K-S-Zn-B (125% RN) + W (20 DAE),

T₃=80-40-60-0-0-0 kg/ha of N-P-K-S-Zn-B (FP), Wheat: Tk.20/kg grain

Experiment-11

Fertilizer and weed management of onion in Monglarbeel area(Boalmari, Faridpur)

Plant population/m², plant height, pseudo stem yield, individual bulb weight, bulb yield and field duration of onion (Var. BARI Piaj-4) as influenced by nutrient level and weeding at Monglarbeel have been presented in Table 31 and Table 32. Individual bulb weight, bulb yield and field duration were influenced significantly by fertilizer and weed management. The highest bulb yield (19.96 t/ha) was observed when onion was fertilized with N₁₅₀P₇₅K₂₀₀S₅₀Zn_{5.6}B_{2.5} kg/ha + weeding at 30 days after emergence. The highest cost of cultivation was observed in 125% RN + W 30 DAE (Tk. 400150 /ha) and the lowest was observed in farmer's practice (N₁₀₀P₆₀K₁₄₀S₃₀ kg/ha) (Table 33). The highest BCR (2.01) and gross margin (Tk. 398250 /ha) were found in 125% RN + W 30 DAE treatment due to highest gross return (Tk.798400/ha). The lowest BCR (1.88) was observed in farmer's practice (Table 33). Nutrient dose, 150-75-200-50-5.60-2.5 kg/ha of N-P-K-S-Zn-B (125% RN) + Weeding at 30 DAE produced the highest bulb yield (21.23 t/ha) with higher economic returns in Monglarbeel.

Table 31. Plant population/m², plant height, and pseudo stem (leaf) yield of onion as influenced by nutrient level and weeding at Monlarbeel

Variety	Population/m ² (no.)	Plant height (cm)	Pseudo stem yield (t/ha)
T ₁	94	39	1.73
T ₂	94	42	1.77
T ₃	93	37	1.66
LSD _(0.05)	NS	NS	NS
CV (%)	5.59	8.67	4.11

Table 32. Individual bulb weight, bulb yield and field duration of onion as influenced nutrient level and weeding at Monlarbeel

Variety	Individual bulb weight (g)	Bulb yield (t/ha)	Field duration (day)
T ₁	19.70	18.49	96
T ₂	21.23	19.96	99
T ₃	18.41	17.01	93
LSD _(0.05)	0.91	1.45	1.73
CV (%)	2.63	4.55	1.05

Table 33. Cost and returns analysis of onion as influenced nutrient level and weeding at Monglarbeel

Variety	Cost of cultivation (Tk./ha)	Gross return (Tk./ha)	Gross margin (Tk./ha)	BCR
T ₁	386000	739600	353600	1.92
T ₂	400150	798400	398250	2.01
T ₃	359800	680400	320600	1.88

T₁= 120-60-160-40-4.5-2 kg/ha of N-P-K-S-Zn-B (RN) + W (30 DAE), T₂=150-75-200-50-5.60-2.5 kg/ha of N-P-K-S-Zn-B (125% RN) + W (30 DAE), T₃=100-60-140-30-0-0 kg/ha of N-P-K-S-Zn-B (FP), Onion bulb: Tk.40/kg

Experiment- 12

Fertilizer management of *ratoon* rice at Chalan beel area

Panicle/m², length of panicle, grains/ panicle, 1000-grain weight, grain yield and straw yield rice (Local variety) were significantly differed due to different fertilizer doses except plant height and field duration (Table 34 and Table 35). The highest panicle /m² (271), length of panicle (20 cm), grains/ panicle (95), 1000-grain weight (26 g), grain yield (2.10 t/ha) and straw yield (2.17 t/ha) were found in the highest fertilizer dose and weeding treatment (T₂=40-20-10-5-0.8-0.5 kg/ha of N-P-K-S-Zn-B +HW (5-7 DAH). Cumulative effect of yield components contributed to higher yield in T₂ treatment. T₄ treatment gave the lowest yield due to cumulative effect of poor yield components. Field duration was same (65 days) in all treatments. Cost and return analysis was shown in Table 36. The highest gross return (Tk.46200 /ha), gross margin (Tk.34100/ha) and highest BCR (3.82) were observed in the highest fertilizer dose and weeding treatment (T₂=40-20-10-5-0.8-0.5 kg/ha of N-P-K-S-Zn-B +HW (5-7 DAH). The highest yield (2.10 t/ha) with better economic returns was observed in 40-20-10-5-0.8-0.5 kg/ha of N-P-K-S-Zn-B +HW (5-7 DAH)for *ratoon* rice cultivation in Chalanr beel area. Farmers are very much interested to cultivate *ratoon* rice with good management practices.

Table 34. Plant height, Panicle/m², length of panicle and grain/panicle of *ratoon*rice (Chalan Beel)

Treatment	Plant height (cm)	Panicle/m ² (no.)	Length of panicle (cm)	Grain/panicle (no.)
T ₁	78	265	18	84
T ₂	88	271	20	95
T ₃	75	240	17	81
T ₄	73	222	15	70
LSD _(0.05)	NS	5	1.41	8
CV (%)	6.42	4.69	1.19	2.44

Table 35. Weight of 1000-grain, grain yield, straw yield and field duration of *ratoonrice* (Chalan Beel)

Treatment	1000-grain weight (g)	Grain yield (t/ha)	Straw yield (t/ha)	Field duration (days)
T ₁	24	1.95	2.02	65
T ₂	26	2.10	2.17	65
T ₃	22	1.41	1.98	65
T ₄	20	1.22	1.07	65
LSD _(0.05)	2.35	0.13	0.11	NS
CV (%)	3.55	4.71	6.29	0.00

Table 36. Cost and return analysis of *ratoon rice* (Chalan Beel)

Treatment	Total cost of cultivation (Tk/ha)	Gross return (Tk./ha)	Gross margin (Tk./ha)	Benefit cost ratio
T ₁	11800	42900	31100	3.64
T ₂	12100	46200	34100	3.82
T ₃	10800	31020	20220	2.87
T ₄	8000	22220	14220	2.78

T₁= 50-30-20-8-1.5-1 kg/ha of N-P-K-S-Zn-B (RN) + W (5-7 DAH),

T₂=40-20-10-5-0.8-0.5 kg/ha of N-P-K-S-Zn-B +W (5-7 DAH),

T₃=20-13-11-0-0-0 kg/ha of N-P-K-S-Zn-B (FP), T₄=Control

Experiment-13

Fertilizer and weed management of *B. aman* in Beel area

Location: Chalan Beel

Panicle/m², length of panicle, grains/ panicle, 1000-grain weight, grain yield, straw yield and field duration of rice (Sarsaridigha) were differed significantly due to different fertilizer dose and weed management except plant height (Table 37 and Table 38). The highest panicle /m² (74), length of panicle (21 cm), grains/ panicle (139), 1000-grain weight (34 g), grain yield (1.61 t/ha), straw yield (2.39 t/ha) and field duration (178 days) were found in the highest fertilizer dose with hand weeding (T₂=26-11-11-5-0.8-0.8 kg/ha of N-P-K-S-Zn-B + HW at 20 DAE and 50- 60 DAE). Cumulative effect of yield components contributed to higher yield in T₂ treatment. T₄ (control) treatment gave the lowest yield due to cumulative effect of poor yield components. Storm during harvesting of crop reduced the harvested yield although the field performance was good. Cost and return analysis was shown in Table 39. The highest cost of cultivation (18600 Tk/ha), gross return (35475 Tk/ha), gross margin (16875 Tk/ha) and highest BCR (1.91) were observed in the highest fertilizer dose with hand weeding (T₂=26-11-11-5-0.8-0.8 kg/ha of N-P-K-S-Zn-B + HW at 20 DAE and 50- 60DAE). The highest yield (1.61 t/ha), gross return (Tk.35475/ha) and BCR (1.91) were observed in broadcast *aman* rice when applied the highest fertilizer

dose along with weeding in Chalan beel area. Farmers are interested to cultivate broadcast *aman* rice with good management practices.

Location: Monglarbeel

Panicle/m², length of panicle, grains/ panicle, 1000-grain weight, grain yield, straw yield and field duration of rice (Modhudigha) were significantly influenced by different fertilizer dose and weed management except plant height (Table 40 and Table 41). The highest panicle /m² (317), length of panicle (28 cm), grains/ panicle (190), 1000-grain weight (38 g), grain yield (1.59 t/ha), straw yield (3.64 t/ha) and field duration (170 days) were observed in the highest fertilizer dose and weed management treatment (T₂=26-11-11-5-0.8-0.8 kg/ha of N-P-K-S-Zn-B + HW at 20 DAE and 50- 60DAE). Cumulative effect of yield components contributed to higher yield in T₂ treatment. T₄ treatment gave the lowest yield due to cumulative effect of poor yield components. Storm during harvesting of crop reduced the harvested yield although the field performance was good. Cost and return analysis was given in Table 42. The highest gross return (Tk.41976/ha), gross margin (Tk. 22076/ha) and highest BCR (2.11) were observed in the highest fertilizer dose with weeding treatment (T₂=26-11-11-5-0.8-0.8 kg/ha of N-P-K-S-Zn-B + HW at 20 DAE and 50- 60DAE). Lower economic returns were computed in the other treatments as compared to T₂. It is concluded that the highest yield (1.59 t/ha), gross return (Tk. 22076/ha) and BCR (2.11) were observed in broadcast *aman* rice when applied the highest fertilizer dose along with weeding in Monglar beel area. Farmers are interested to cultivate broadcast *aman* rice with good management practices.

Table 37. Plant height, Panicle/m², length of panicle and grain/panicle of broadcast *aman* rice (Chalan Beel)

Treatment	Plant height (cm)	Panicle/m ² (no.)	Length of panicle (cm)	Grain/panicle (no.)
T ₁	126	72	20	130
T ₂	131	74	21	139
T ₃	124	70	19	127
T ₄	123	67	18	122
LSD _(0.05)	NS	2	0.95	7
CV (%)	4.91	3.58	1.23	2.65

Table 38. Weight of 1000-grain, grain yield, straw yield and field duration of broadcast *aman* rice (Chalan Beel)

Treatment	1000-grain weight (g)	Grain yield (t/ha)	Straw yield (t/ha)	Field duration (days)
T ₁	32	1.48	2.18	176
T ₂	34	1.61	2.39	178
T ₃	31	1.46	2.01	175
T ₄	29	1.09	1.04	171
LSD _(0.05)	1.22	0.11	0.17	1.58
CV (%)	2.38	5.32	8.21	1.03

Table 39. Cost and return analysis of broadcast *aman* rice (Chalan Beel)

Treatment	Cost of cultivation (Tk/ha)	Gross return (Tk./ha)	Gross margin (Tk./ha)	Benefit cost ratio
T ₁	17600	33275	15675	1.89
T ₂	18600	35475	16875	1.91
T ₃	17800	32450	14650	1.82
T ₄	14000	23925	9925	1.89

T₁= 21-9-9-4-0.6-0.6 kg/ha of N-P-K-S-Zn-B (RN) + HW (20 DAE and 50-60DAE), T₂=26-11-11-5-0.8-0.8 kg/ha of N-P-K-S-Zn-B (125% RN) + HW (20 DAE and 50-60DAE), T₃=14-5-8-3-0-0 kg/ha of N-P-K-S-Zn-B (FP) + HW (20 DAE and 50-60DAE), T₄=Control

Table 40. Plant height, Panicle/m², length of panicle and grain/panicle of broadcast *aman* rice (Monglarbeel)

Treatment	Plant height (cm)	Panicle/m ² (no.)	Length of panicle (cm)	Grain/panicle (no.)
T ₁	311	311	26	179
T ₂	317	317	28	190
T ₃	306	308	24	162
T ₄	304	301	20	142
LSD _(0.05)	NS	8.12	1.20	9
CV (%)	7.12	3.29	1.19	1.97

Table 41. Weight of 1000-grain, grain yield, straw yield and field duration of broadcast *aman* rice (Monglarbeel)

Treatment	1000-grain weight (g)	Grain yield (t/ha)	Straw yield (t/ha)	Field duration (days)
T ₁	35	1.37	3.27	167
T ₂	38	1.59	3.64	170
T ₃	33	1.29	3.15	167
T ₄	29	0.89	2.89	165
LSD _(0.05)	2.85	0.19	0.33	1.87
CV (%)	2.69	4.91	5.55	1.11

Table 42. Cost and return analysis of broadcast *aman* rice (Monglarbeel)

Treatment	Cost of cultivation (Tk./ha)	Gross return (Tk./ha)	Gross margin (Tk./ha)	Benefit cost ration
T ₁	18500	36168	17668	1.96
T ₂	19900	41976	22076	2.11
T ₃	17800	34056	16256	1.91
T ₄	14000	23496	9496	1.68

T₁= 21-9-9-4-0.6-0.6 kg/ha of N-P-K-S-Zn-B (RN) + HW (20 DAE and 50-60DAE), T₂=26-11-11-5-0.8-0.8 kg/ha of N-P-K-S-Zn-B (125% RN) + HW (20 DAE and 50-60DAE), T₃=14-5-8-3-0-0 kg/ha of N-P-K-S-Zn-B (FP) + HW (20 DAE and 50-60DAE), T₄=Control

12. Research highlight/findings:

- Hybrid maize varieties like NK-40, 900 M Gold and Miracle (Grain yield: 10.02-10.64 t/ha), HYV mustard varieties of BARI Sarisha-14 (Seed yield: 1.67 t/ha) and BARI Sarisha-15 (Seed yield: 1.60 t/ha), wheat variety of BARI Gom-30 (Grain yield: 5.02 t/ha), garlic variety of BARI Rashun-3 (Bulb yield: 12.54 t/ha) and onion variety of BARI Piaj-4 (Bulb yield: 19.61 t/ha) showed better yield performance at beel area.
- Seed dibbling at 7 days after recession water was found suitable for higher grain yield (12.10 t/ha) and higher BCR (2.19).
- Fertilizer dose like 325-90-185-60-5-2.5 kg/ha of N-P-K-S-Zn-B + Weeding at 20 days after emergence (DAE) (Grain yield: 12.98 t/ha and BCR: 2.24) for maize, Fertilizer dose of 140-44-70-30-1.8-1 kg/ha of N-P-K-S-Zn-B + Weeding at 15 DAE for mustard (Seed yield: 1.75 t/ha and BCR: 1.69), Fertilizer dose of 125-45-31-25-2-1 kg/ha of N-P-K-S-Zn-B + Weeding at 20 DAE for wheat (Grain yield: 5.52 t/ha and BCR: 1.81), Fertilizer dose like 150-75-200-50-5.60-2.5 kg/ha of N-P-K-S-Zn-B + Weeding at 30 DAE for onion (Bulb yield (19.96 t/ha and BCR:2.01) were found suitable for higher yield and BCR.
- Fertilizer dose of 125-190-206-25-5 -2.5 kg/ha of N-P-K-S-Zn-B + Weeding at 30 days after dibbling (Garlic equivalent yield: 25.22 t/ha and BCR: 2.84) was found profitable for Garlic+ Watermelon intercropping in Chalan beel area.
- Fertilizer dose of 40-20-10-5-0.8-0.5 kg/ha of N-P-K-S-Zn-B + Weeding at 5-7 days after harvest of main rice for ratooning (Grain yield: 2.10 t/ha and BCR: 3.82) and Fertilizer dose of 26-11-11-5-0.8-0.8 kg/ha of N-P-K-S-Zn-B + Hand weeding at 20 DAE and 50-60 DAE (Grain yield: 1.59-1.61 t/ha and BCR: 1.91-2.11) for B. *aman* rice were found profitable in beel area.

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B. Implementation Position

1. Procurement:

Description of equipment and capital items	PP Target		Achievement		Remarks
	Phy (#)	Fin (Tk)	Phy (#)	Fin (Tk)	
(a) Office equipment	Computer and Accessories	125000	Computer and Accessories (100%)	125000 (100%)	Completed
(b) Lab & field equipment					
(c) Other capital items	Office Furniture	104500	Office Furniture (100%)	104500 (100%)	Completed

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	96	24	120	1 days	Completed
(b) Workshop	-	-	-	-	-

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	655990	655990	655990	0	100%	
B. Field research/lab expenses and supplies	980710	961517.5	961517.5	0	100%	
C. Operating expenses	350000	291820	291820	0	100%	
D. Vehicle hire and fuel, oil & maintenance	200000	200000	200000	0	100%	
E. Training/workshop/seminar etc.	150000	150000	150000	0	100%	
F. Publications and printing	150000	14526.5	0	14526.5	0%	No fund release of RPA
G. Miscellaneous	210000	183234	183234	0	100%	
H. Capital expenses	303300	303300	303300	0	100%	

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)
Identify/validation Technology	Trial on hybrid maize, short duration mustard, wheat, garlic and onion varieties	Eight varieties (BARI Sarisha-14, BARI Sarisha-15, BARI Gom-30, Maize var. NK-40, 900 M Gold and Miracle, BARI Rashun-3 and BARI Piaj-4) were found suitable for cultivation in beel area	Short duration mustard variety (BARI Sarisha-14) before <i>boro</i> rice is cultivated by the farmer. NK-40, BARI Rashun-3 and BARI Piaj-4 are cultivated by the farmers. These would improve crop productivity in beel area.
Adaptation of HYV and management	Experiment on management of the mentioned varieties and garlic+watermelon intercropping, B. aman after <i>boro</i> rice and ratoon rice as chance crop	Short duration mustard before <i>boro</i> rice, dibbing technique for maize, garlic+watermelon intercropping, B. aman after <i>boro</i> rice; Fertilizer and weed management of the mentioned varieties and cropping system	Proper management would improve yield of respective crop in the pattern. Total productivity would improve in beel area.
Improvement of knowledge	Training and field day, group discussion, field visit	120 farmers aware of technology	Farmers knowledge improved and would help in technology dissemination in beel area. Increased farmers income.

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.	2		2 booklet was not published due to not receiving fund
Journal publication	1		Would submit
Information development			
Other publications, if any		1	web site and advertisement

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

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

No-Commodity: Technologies would help to improve crop productivity in beel area. Technology would be water saving and eco friendly. Information about technologies are given in Sl. No. 12. of PCR

Short duration HYV mustard could be grown before *boro* rice in upper land of beel area. Broadcast *aman* could be grown after *boro* rice in beel area as a chance crop. This system would improve crop productivity in beel area. New knowledge would be helpful to the agricultural scientists of the country for designing their future research projects in order to technology generation as well as increasing production and productivity for sustainable food and nutrition security in Bangladesh.

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

Short duration HYV mustard (BARI Sarisha-14) could be grown before *boro* rice by farmers in upper land of Chalan beel area. Broadcast *aman* could also be grown after *boro* rice in beel area as a chance crop. Best yield performing varieties of onion, garlic, maize would be grown by farmers with best management practices in beel area. Intercropping of Garlic+Watermelon would be practiced by the farmers in Chalan beel area. Project activity helped to transfer the technologies for improving crop productivity in beel area. Ultimately farmers' income would be increased.

iv. Policy Support

Findings of the project would help to take action plan or pilot production programme of maize, mustard, onion, garlic, broadcast *aman*, garlic + watermelon intercropping in Chalan beel area and Mongalar beel area (onion in Faridpur) for increasing crop productivity. There is possibility of growing short duration HYV mustard before *boro* rice in upper land of beel area. Broadcast *aman* could be grown after *boro* rice as a chance crop in beel area. There is scope of improving cropping system or developing two or three crop based cropping pattern rather than single *boro* rice in beel area. Research findings would assist the policy makers of the agricultural sub-sectors for setting their future research directions. Govt. can take action plan regarding the relevant fact.

G. Information regarding Desk and Field Monitoring

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

Report on sup-project (ID-688) activities are good on the basis Field monitoring, desk monitoring, monitoring workshop and evaluation workshop.

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

Field monitoring team visited on 10 March 2018 with two members of BARC named Dr. Md. Awal, Chief Scientific Officer, BARC, Farmgate, Dhaka 1215 and Dr. Kabir Uddin Ahmad, Principal Scientific Officer, BARC, Farmgate, Dhaka 1215. They were highly satisfied observing the field performance of the experiments in Chalan beel. They have submitted their field monitoring report to PIU, NATP-2, BARC accordingly. They also expressed their field observation and experience of field visit in the subsequent progress workshop held at BARC by PIU, NATP-2.

H. Lesson Learned/Challenges (if any)

- i) Recession of stagnant water at late in beel area makes delay of sowing the crops like mustard, maize, garlic, onion, wheat and watermelon. As a result mustard cultivation before *boro* rice is sometime delaying the *boro* rice cultivation.
- ii) Delaying of crop cultivation in beel area is sometime partially damaged the crops by natural hazard like storm, hailing and excessive rainfall.
- iii) Sometime broadcast *aman* cannot be grown due to excessive rainfall in May after harvest of *boro* rice in upper land of beel area.

I. Challenges (if any)

Crop establishment is sometime delay due to late recession of stagnant water in beel area. Consequently, crop might be damaged partially or fully by natural hazards. Excesses rainfall may hamper the sowing of broadcast *aman* rice in May after harvest of *boro* rice. Sometime excessive rainfall may cause early flood and can damage the crops. Management of crops in natural stress is some time challenging and risky.

Signature of the Principal Investigator
Date
Seal

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

Enclosure-1

Base line survey

A quick survey for base line information was completed. Data was collected through focal group discussion (FGD) at four locations of experimental sites like (1) Dobila and (2) Khalkhula, Tarash-Sirajgonj (3) Charkadaho, Gurudashpur-Natore, and (4) Monglarbeel (Surjack-Katagor), Boalmari-Faridpur. Total 60 farmers were participated in the survey. The base line information was summarized as follows.

Cropping patterns

Major cropping patterns at Chalan beel area are: *Boro* rice-Fallow, Garlic-Broadcast *aman* rice, Mustard-*Boro* rice-Fallow, Winter vegetables- Broadcast *aman* rice, Maize-Fallow. *Boro* rice-Broadcast *aman*, Major cropping patterns at Monglarbeel area are: *Boro* rice-Fallow, Onion-Jute, Onion- Broadcast *aman* rice, *Boro* rice-Broadcast *aman* rice.

Yield of crops

Boro rice yield: 3.96 t/ha, Bulb yield of garlic: 6.74 t/ha, Mustard yield: 0.08-1.01 t/ha, Wheat yield: 2.78 t/ha, Maize yield: 7.16t/ha, Onion yield: 9.85 t/ha, Broadcast *aman* rice yield: 1.20 t/ha and Ratoon rice yield: 1.49 t/ha (Appendix Table -1).

Price of crops

Boro rice: Tk.20/kg, Garlic: Tk. 55/kg, Mustard: Tk.37/kg, Wheat: Tk. 21/kg, Maize: Tk. 11/kg, Onion: Tk.18 kg/ha, Broadcast *aman* rice: Tk.17 /kg and Ratoon rice yield (Minicate): Tk.35/kg.

Crop varieties

Wheat: Prodig and BARI Gom-26, Mustard: Local Tori, Maize: NK-40, Garlic: *Itali*, Onion: Thaherpuri/Lalteer variety, Broadcast *aman* rice: Modhudigha, Sorsoradigha, Ashinadigha, Sylatadigha, lokchidigha, Ratoon rice: Pajam.

Fertilizer dose

Mustard: 86-45-75 kg/ha of N-P-K, Wheat: 89-48-76 kg/ha of N-P-K, Maize: 207-60-131 kg/ha of N-P-K, Garlic: 90-112-70-2.7-1.92 kg/ha of N-P-K-Zn-B. Broadcast *aman* rice: 105-37-22 kg/ha of N-P-K kg/ha, Ratoon rice:100-35-60-22 kg/ha of N-P-K-S, Onion: 63-36-54-17 kg/ha of N-P-K-S.

Water depth

In general, about 1-1.4 meter flooding water depth in medium low land. But about maximum: 2.30-3.00 meter at the bottom of the beel at normal flooding condition. Severe flooding time water depth may be recorded maximum 6-8 meter.

Scio-economic condition

Farmer mostly depends on Agriculture. Some are engaged in other profession like small business or fishing. People are poor. Flood, storm and other natural calamities causes damage of crops. *Boro* rice is the main crop in this area. At present maize has been introduced in some areas. There is a scope of improving crop productivity and their livelihood through adopting HYV of crops and improved production technology as well as fallow land after harvesting of *boro* rice can be utilized by seeding Broadcast *aman* rice in medium low land.

Constrains

Drainage is a problem of beel area. Late recession of stagnant water results in delay cropping. Early flood causes crop damage. Weed problem in Broadcast *aman* rice specially water hyacinth. Marketing problems and farmer does not get actual prices of crops. Communication is a problem in distant places from road side. Imbalance use of fertilizer doses and do not use S, Zn and B.

Appendix Table-1.Yield of crops (Base line information) are given bellow:

Sl. No.	Crop	Yield (t/ha)
1	<i>Boro</i> rice	3.96
2	Garlic	6.74
3	Mustard	0.8-1.01
4	Wheat	2.78
5	Maize	7.16
6	Onion	9.85
7	Broadcast <i>aman</i>	1.20
8	<i>Ratoon</i> rice	1.49

Enclosure-2

Soil Analysis and it’s interpretation of different experimental locations

Interpretation of soil analytical results

Soil analytical results have been given in Appendix-2. Soil pH varies from 6.14 to 7.60 values indicating alkalinity of all locations except Charkadaho. Organic matter ranged 2.09-2.30%. Nitrogen was very poorer at all locations except Khalkhola. P ranged 28.96-36.88 ppm and K ranged 0.171-0.274 (meq/100g) where Charkadaho showed lower value. S showed higher value at Khalkhola (27.22 ppm)

but Zn showed higher value at Charkadaho (0.826 ppm). B ranged 0.235-0.267 ppm indicating higher value at Surjack. Overall performance of soil samples of different locations is moderately good.

Appendix Table-2. Soil characteristics of different experimental locations

Location	Analytical values of soil samples							
	pH	OM (%)	N (%)	P (ppm)	K (meq/100g)	S (ppm)	Zn (ppm)	B (ppm)
Khalkhula	7.60	2.30	0.117	33.03	0.241	27.22	0.446	0.236
Dobila	7.24	2.11	0.088	36.88	0.274	17.08	0.673	0.235
Charkadaho	6.14	2.02	0.082	28.96	0.171	11.11	0.826	0.247
Surjack	7.28	2.09	0.099	34.16	0.243	18.05	0.702	0.267

Enclosure-3



Plate 1: BARI Sarisha-14



Plate 2: BARI Sarisha-15



Plate 3: Fertilizer and Weed management



Plate 4: 125% of RN+ Weeding at 15 DAE



Plate 5: BARI Gom-28



Plate 6: BARI Gom-30

RN=Recommended nutrient dose



Plate 7: Fertilizer and Weed management



Plate 8: 125% RN+ Weeding at 20 DAE



Plate 9: Variety selection of hybrid maize



Plate 10: Miracle higher yielder of maize



Plate 11: RN +Weeding at 25 DAE



Plate 12: 125% RN +Weeding at 25 DAE

RN=Recommended nutrient dose



Plate 13: Varietal performance of onion



Plate 14: BARI Piaj-4 at Monglarbeel



Plate 15. Fertilizer and weed management



Plate 16. 125% of RN + weeding at 30



Plate 17: 125% of RN + weeding at 20 and 50 DAE in *B. aman* rice

RN=Recommended nutrient dose



Plate 18: 125% of RN + weeding at 20 and 50 DAE in *ratoonrice*

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Plate 19: Performance of garlic varieties at Chalan beel



Plate 20: 125% of RN + weeding at 20 DAE in garlic



Plate 21. Monitoring Team



Plate 22. Field day on maize



Plate 23: Base line Survey



Plate 24: Farmer's Training

RN=Recommended nutrient dose

Enclosure-4

Weather data (2017-2018) of the experimental location at Chalan Beel (Sirajganj)

Month	Monthly average temperature °C		Total Sun shine hour (TSSH)	Total rainfall (mm)	Relative humidity (%)
	Maximum	Minimum			
December 2017	27	19	127	8.65	60
January 2018	24	15	230	0.00	46
February 2018	30	19	220	0.55	41
March 20108	34	23	314	8.63	40
Total	Av. 28.75	Av.19.00	891	17.83	Av. 46.75

Source: Adapted from <https://www.worldweatheronline.com/sirajganj-weather-averages/bd.aspx>(Sirajganj Monthly Climate Averages: visited on 19 .7.2019), * Av.=Average value