Project ID: 696

Competitive Research Grant

Sub-Project Completion Report

on

Improvement of Water Productivity for Enhancing Crop Production in Water Scare Area of North-West Bangladesh

Project Duration

July 2017to September 2018

Irrigation and Water Management Division
Bangladesh Rice 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-PhaseII Project (NATP-2)
Bangladesh Agricultural Research Council (BARC)
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Acronyms

BRRI	Bangladesh Rice Research Institute
BARC	Bangladesh Agricultural Research Council
PIU	Project Implementation Unit
NATP	National Agricultural Technological Project
REY	Rice Equivalent yield
WP	Water productivity

Table of Contents

Executive Summary

The Irrigation and Water Management Division of Bangladesh Rice Research Institute (BRRI) implemented the project funded by PIU-BARC, NATP-2, Bangladesh Agricultural Research Council (BARC),Dhaka from July 2017 to September 2018. The objectives of the project were to maximum utilization of water resources for crop production in water scarce areas and to improve water productivity by appropriate water management practices. Selection of sites and farmers was performed by participating in meeting and discussion with the farmers. Developed implementation plan, survey questionnaire for baseline information, crop economics of the existing and new cropping patterns and also to get perception of water management and agricultural activities that the project is proposing. Provided training on the characteristics of high yielding varieties of rice and cultivation procedure. The farmers of the project site opted to cultivate different HYV rice in aman season 2017. Based on their preferences, collected seeds of BRRI dhan51and BRRI dhan52, and distributed among the farmers.

During the project period, rainfall, ponding water depth in the field, groundwater level was monitored. Submergence tolerance variety BRRI dhan51 and BRRI dhan52 were compared with the local variety Zonakra. Water management treatments were followed to get maximum water productivity. Economic analysis was done to compare different crop sequences with different water management practices.

The highest groundwater level depth was about 8 m below the ground surface during last week of March, 2018. Due to rainfall occurred in the last week of March, groundwater level was back to upward and therefore, it was within suction limit and Shallow tube well (STW) was in working condition. Different water management practices were followed for the selected cropping patterns to improve water productivity.

Rice equivalent yield (REY) varied significantly ($P<0.05$) among the six cropping sequences in 2017-18. The maximum REY of 33.97, 32.93 and 26.82 t/ha was recorded in BRRI dhan51-onion seed- BRRI dhan48; BRRI dhan52-onion seed- BRRI dhan48, and Zonakra-onion seed-fallow, respectively. REY of different cropping sequences varied significantly ($P<0.05$) by irrigation regimes during 2017-18. The highest rice equivalent yield (36.32 t/ha) was recorded in T_2 irrigation regimes arranged for different crops of the different cropping sequences. REY was significantly ($P<0.05$) different by different cropping sequences with different irrigation regimes. Among the treatment combination, BRRI dhan51-onion seed-BRRI dhan48, BRRI dhan52-onion seed-BRRI dhan48 and Zonakra-onion seed-fallow with T_2 irrigation regimes gave higher REY of 38.67, 38.16 and 32.14 t/ha, respectively.

The maximum total water of 2647 mm was consumed by BRRI dhan51/52-onion seed-BRRI dhan48 cropping sequence under T_1 irrigation regimes assigned for the respective crops. Water productivity was significantly influenced by cropping system and irrigation regimes. The higher water productivity was found in onion seed based cropping system. Higher REY of onion seed raised the water productivity in onion seed based cropping system. Among the cropping sequences, the maximum water productivity of 23.75 kg/ha-mm was found in zonakra-onion seed-fallow cropping sequences with the water treatment of T_2 arranged for different crops of the different cropping sequences.

CRG Sub-Project Completion Report (PCR)

A. Sub-project Description

1. Titleof the Sub-project: Improvement of water Productivity for enhancing crop production in water scare area of North-West Bangladesh

2. Implementing organization: Irrigation and water Management Division, Bangladesh Rice Research Institute

3. Principal investigator: Dr. Shahana Parveen,
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4. Sub-project budget (Tk):

4.1 Total: Tk. 1500000.00
4.2 Revised: not applicable

5. Duration :

5.1 Start date: 12 July 2017
5.2 End date: 30 September 2018

6. Justification of undertaking the sub-project:

Groundwater is the main source of irrigation for increasing crop production as well as for climate change adaptation owing to sustainable agricultural intensification in the North-West region of Bangladesh.The North–West part (Rajshahi & Dinajpur) of Bangladesh is drought prone high land having lower annual rainfall. But the study area has a flood prone area and annual rainfall is slightly higher than that of the drought prone area. The cropping pattern of this region is low yielding broadcasted Aman followed by non-rice crops (onion, garlic, wheat etc.) and then broadcasted Aus/fallow. Low productivity of agricultural production system in the region causes by the cultivation of low yielding B Aman varieties currently grown during the rainy season.Lack of irrigation water availability during dry season results in drought which prevents the cultivation of MV Aus rice and as a result the area is partly covered with local

broadcasted Aus or kept fallow. Both the rice seasons are unstable, only rabi crops are cultivated successfully. However, there are tremendous opportunities to increase the productivity of the land and water resources within this region through the use of improved (submergence tolerant and earlier maturity) rice varieties followed by a range of non-rice dry season (rabi) crops and then establishment of Aus rice with irrigation facilities. The realization of these opportunities requires improved water management to cultivate the submergence tolerant and earlier maturity modern rice varieties. Establishment of non-rice dry season crops needs timely and proper practices of water management. The assessment of groundwater resources is needed to ensure the irrigation facilities during Aus rice cultivation (AIR, 2015).

Water productivity significantly influenced by cropping systems and irrigation regimes (Parveen et al., 2015). Therefore, water management practices are required for individual crops of different cropping pattern to improve water productivity in crop production system. Hence the present project is submitted with a view to utilize maximum water resources in the study area, improve water productivity by water management practices and obtain higher rice yield in the farmer's field.

7. Sub-project goal: Water and Land Productivity Improvement

8. Sub-project objectives:

The objectives of the project are as follows.

i) to utilize maximum water resources for crop production in water scare areas;
ii) to improve water productivity by appropriate water management practices

9. Implementing location:

A survey work has been done in different Upazilas of Pabna district (Annual Report, 2014, 2015; Annual Research Review report 2015-16). From the survey report the cropping sequences and assessment of groundwater resources of the region were documented. In this region,about35-40% area covers the cropping pattern with fallow land during aus season (Annual Research Review Report, 2016). Based on the survey report, study site was considered at Chhaikola village of Chatmohor Upozila in Pabna district (Fig. 1).

10. Methodology followed

The experiment was conducted at farmer's field of Chhaikola village under Chatmohor Upozila of Pabna district following RCBD design with three replications during 2017-18.Thirty decimal

lands for each pattern were selected. The improved cropping patterns were compared with the farmers' existing cropping pattern of T. aman (Zonakra)-Garlic/Onion having no Aus rice.

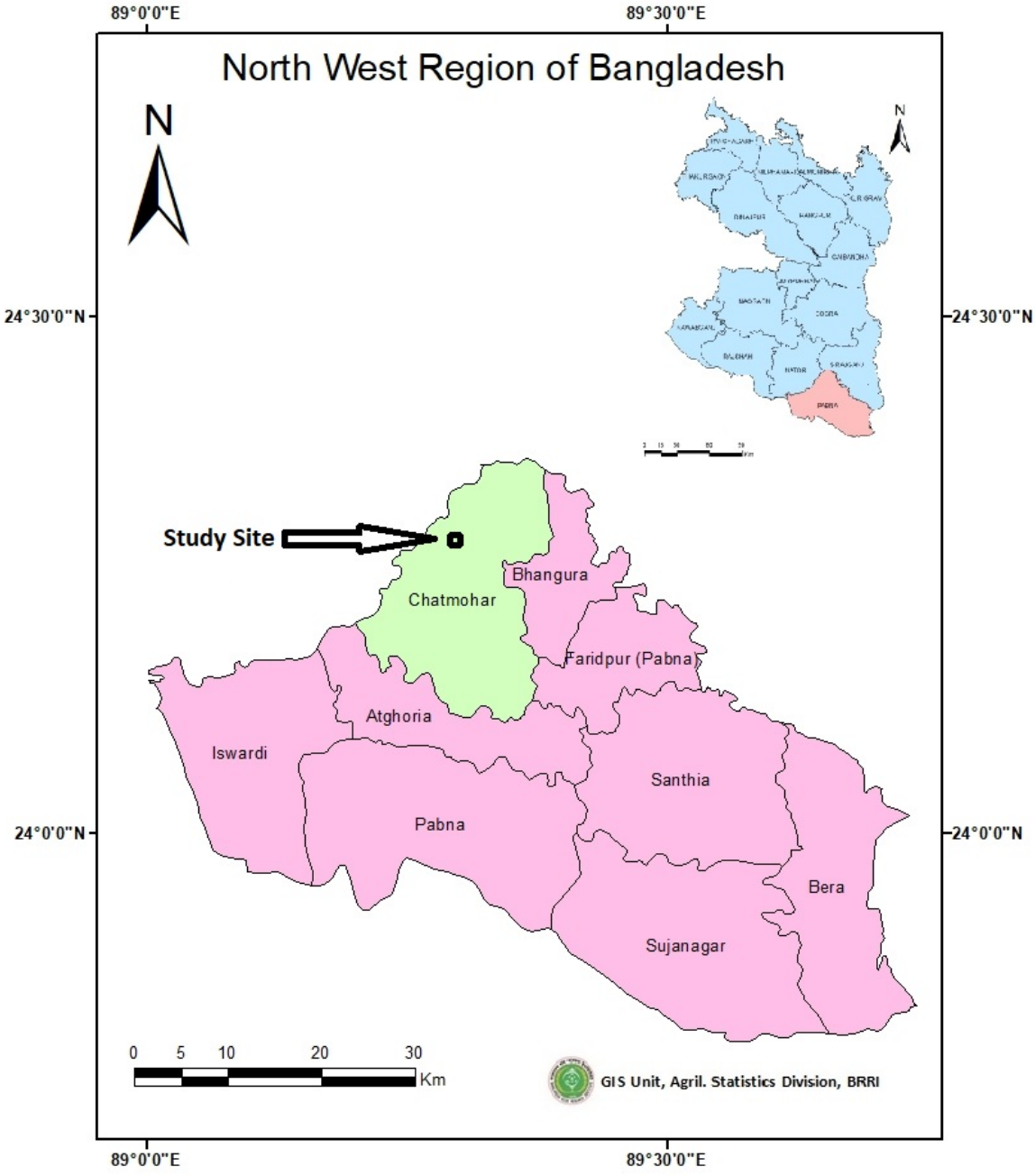


Fig 1a. Map of Pabna district showing the study site at Chhaikola, Chatmohor Upazila, Pabna.

Fig 1b. Study site at Chhaikola, Chatmohor Upzila, Pabna

The improved cropping patterns were compared with the farmers existing cropping patterns having no Aus rice. The treatments (cropping patterns) were – P_1 = T. aman rice (BRRI dhan51) – Garlic – Aus rice (BRRI dhan48) (Improved pattern), P_2 = T. aman rice (BRRI dhan51) – Onion – Aus rice (BRRI dhan48) (Improved pattern), P_3 = T. aman rice (BRRI dhan52) – Garlic – Aus rice (BRRI dhan48) (Improved pattern), P_4 = T. aman rice (BRRI dhan52) – Onion – Aus rice (BRRI dhan48) (Improved pattern), P_5 = T. aman rice (Zonakra) – Garlic – fallow (Farmers pattern) and P_6 = T. aman rice (Zonakra) – Onion – fallow (Farmers pattern). The patterns initiated in the latter part of July 2017 and planting and harvesting time of crops are given below in the Table 1.

Table 1: Planting and harvesting time of crops

P_1	T. aman rice (BRRI dhan51) 26 July 20 November	Garlic (Itali) 23 November 25 March	Aus. rice (BRRI dhan48) 20 April 16 July
P_2	T. aman rice (BRRI dhan51) 26 July 20 November	Onion (Taherpur) 2 December 2 April	Aus. rice (BRRI dhan48) 20 April 16 July
P_3	T. aman rice (BRRI dhan52) 26 July 30 November	Garlic(Itali) 23 November 25 March	Aus. rice (BRRI dhan48) 20 April 16 July
P_4	T. aman rice (BRRI dhan52) 26 July 30 November	Onion (Taherpur) 2 December 2 April	Aus. rice (BRRI dhan48) 20 April 16 July
P_5	T. aman rice (Zonakra) 12 August 25 November	Garlic (Itali) 23 November 25 March	-

P_6	T. aman rice (Zonakra) 12 August 25 Npvember	Onion (Taherpur) 2 December 2 April	-

Irrigation treatments and the fertilizer managements of different crops which were followed are presented in Table 2.

Table 2. Irrigation treatments used in different cropping patterns.

Crop	Irrigation	Fertilizer
T. aman	Rainfed	150+60+100+30 kg/ha urea, TSP, MOP and gypsum
Garlic	T_1 = irrigation at 15 days interval T_2 = irrigation at 20 days interval T_3 = irrigation at 25 days interval	217+267+333+110 kg/ha urea, TSP, MOP and gypsum
Onion	T_1 = irrigation at 15 days interval T_2 = irrigation at 20 days interval T_3 = irrigation at 25 days interval	260+220+200+180 kg/ha urea, TSP, MOP and gypsum
T. aus	T_1= AWD (at 10 cm water depth) T_2= AWD (at 15 cm water depth) T_3= Continuous standing water	130+60+100+30 kg/ha urea, TSP, MOP and gypsum

Farmer selection: About six farmers were selected for the study.

Organize meeting with farmers: Un-official meetings were held with the farmers about the project objectives, project activities, cropping patterns, cultural practices, crop varieties etc.

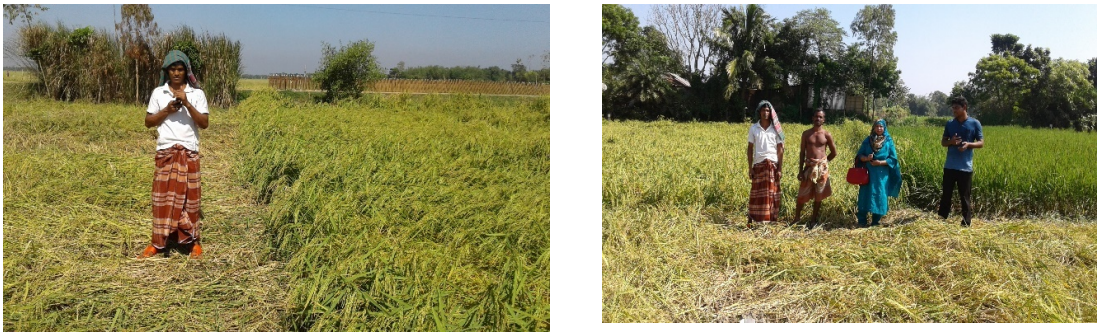
Monitoring groundwater level: Groundwater level was monitored in the study site to assess the water resources. Groundwater level was recorded in every week from November, 2017 to June, 2018 and presented in the fig 7.

Monitoring water level: Water related data like rainfall, standing water depth in the crop field and perched water table data have been recorded. A raingage was installed near to the field to record the rainfall data. An AWD pipe was installed in the field to monitor the water level below the soil surface to know when to irrigate. A measuring meter gage was fitted with label to monitor the ponding water depth.

(a) (b) (c)

Fig2. Monitoring water related data (a) raingage, (b) AWD pipe and (c) meter gage was installed near to the field at Chhaikola, Chatmohor, Pabna during Aman 2017

Monitoring crop performance: Crop performance has been monitored daily. Seeding date, transplanting date, flowering date, maturity date and harvesting date was monitored properly(Fig 3, 4, 5 and 6).



(a) Local rice variety Zonakra vs BRRI dhan52

(b) HYV BRRI dhan51, BRRI dhan52 and local variety Zonakra

Fig 3. Varietal performances of local variety Zonakra, BRRI dhan51 and BRRI dhan52 at Chhaikola, Chatmohor, Pabna during Aman season2017.

Grain per panicle of local variety Zonakra and BRRI dhan52 was presented in fig 4. Figures showed the number of grains were higher in BRRI dhna52 than Zonakra.

Fig 4. Grain per panicle observed in local variety (Zonakra) and BRRI dhan52

Garlic separated into cell, sowing in the soft soil after harvesting aman rice and mulching with straw are presented in the figure 5.

Fig5. Separating garlic, sowing and covered by rice straw at Chhaikola, Chatmohor, Pabna during rabi season, 2017-18

Onion

Germinated onion was seeded on dry bed for producing onion as a spice or vegetable. Onion seed was seeded on soaked bed for producing onion seed (Fig 6).

Fig6. Onion will be used for sowing and field ready for sowing onion

Equivalent Yield (EY) was calculated (Lal *et. al.*, 2017) by the following equation:

$$EY_{rice} \equiv \frac{\text{Price of crop (Tk/t)} \times \text{Yield (t/ha)}}{\text{Price of rice (Tk./t)}} \quad \text{---------- (1)}$$

Water productivity (WP) was computed (David *et. al*., 2010) by the following equation:

$$WP \equiv \frac{\text{Yield (kg/ha)}}{\text{water applied (mm)}} \quad \text{---------- (2)}$$

11. Results and discussion:

Maximum utilization of water resources for crop production in water scare areas of the study region

Water resources have been assessed to crop production in a water scare areas which is a part of north-west region of Bangladesh. To assess the water resources, groundwater level was monitored. Groundwater level was recorded at every week. The groundwater level is presented in the figure from November, 2017 to June, 2018 (Fig 7). The highest groundwater level was about 8 m below the ground surface during last week of March, 2018. Due to rainfall occurred in the last week of March, groundwater level was back to upward (Fig 8) and therefore, it was within suction limit of Shallow tube well (STW) which was in working in the field.

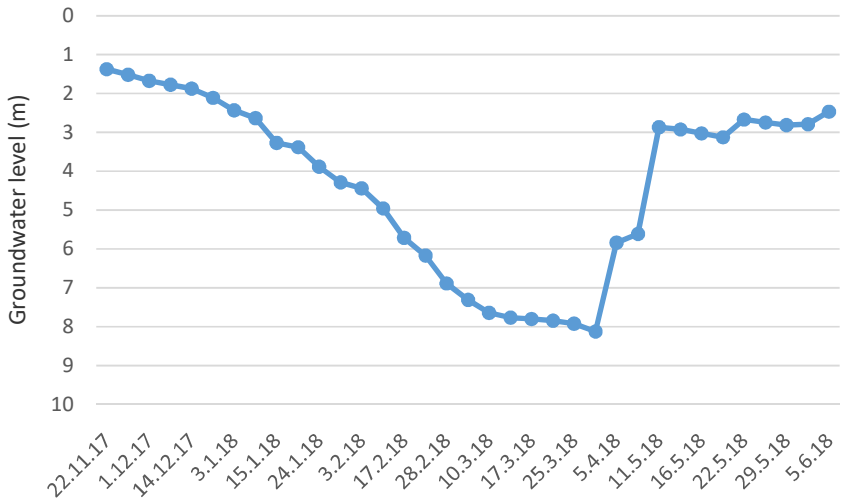


Fig 7. Depth to groundwater level in Chhaikola village of Chatmohor, Pabna during 2017-18.

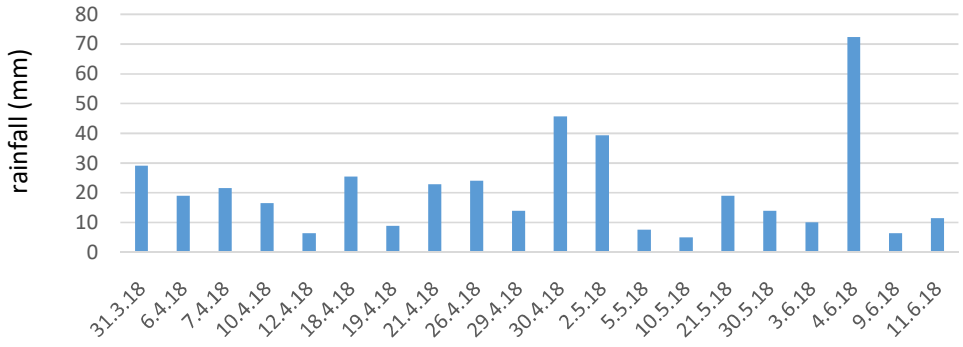


Fig 8. Rainfall occurred in Chhaikola village of Chatmohor, Pabna during March – June 2018.

Water productivity improvement by appropriate water management practices

The study sites were submerged at varying degree of water level upto mid-October, 2017 (Fig 9). Ponding water depth was measured at three levels of land. Irrigation was not required for Aman rice cultivation. Rabi crops and Aus crops were fully irrigated during the study period.

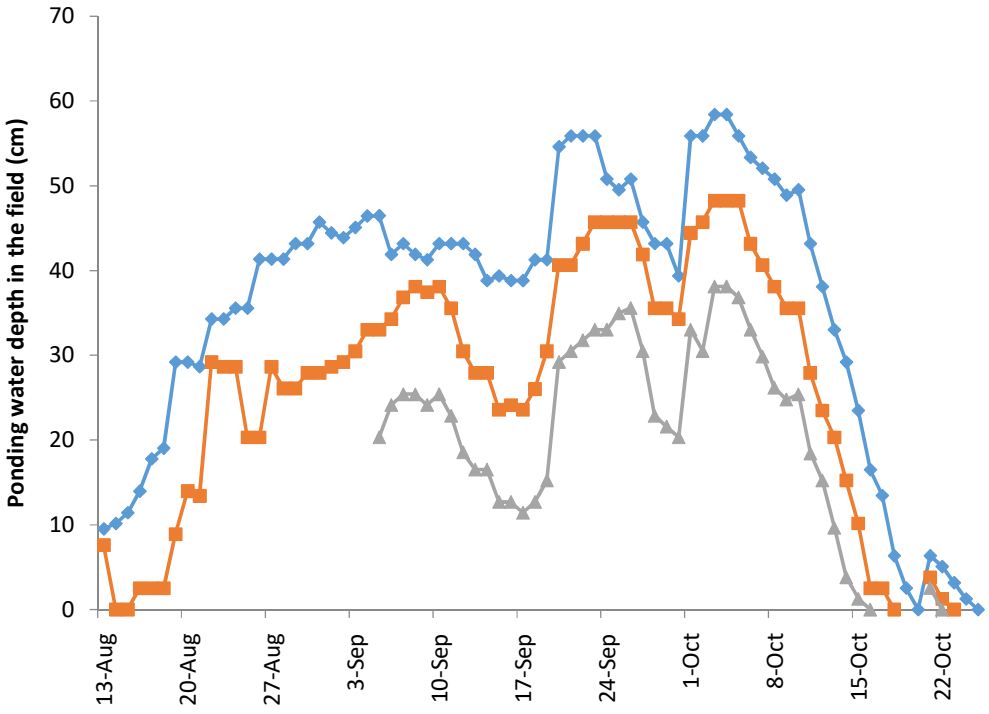


Fig 9. Ponding water depth in Chhaikola village, Chatmohor, Pabna during Aman season 2017

Cropping sequence

Rice equivalent (Equation 1) yield (REY) varied significantly (P<0.05) among the six cropping sequences in 2017-18 (Fig. 10). The maximum REY of 33.97, 32.93 and 26.82 t/ha was recorded in BRRI dhan51-onion seed- BRRI dhan48, BRRI dhan52-onion seed- BRRI dhan48 and Zonakra-onion seed- fallow, respectively. Average of onion seed based cropping sequence gave 45% higher REY than garlic based cropping sequences. In onion seed based cropping sequence, submergence tolerance BRRI dhan51 and BRRI dhan52 gave 21.05 and 18.55% higher REY than local rice zonakra. Similarly, in garlic based cropping sequences gave 35 and 34% higher REY by submergence tolerance BRRI dhan51 and BRRI dhan52 than local zonakra. Sharma et al (2015) reported that onion based cropping sequence gave higher REY than garlic based cropping sequence.

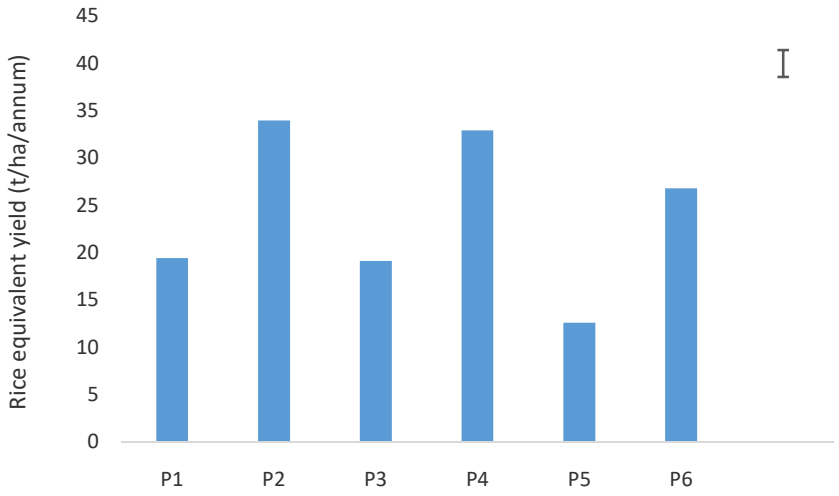


Fig 10. Rice equivalent yield under different cropping sequences

Irrigation regimes

Rice equivalent yield of different cropping sequences varied significantly (P<0.05) by irrigation regimes during 2017-18 (Fig 11). The highest rice equivalent yield (27.34 t/ha) was recorded in T_2 irrigation regimes arranged for different crops of the different cropping sequences. There was not significant difference of REY with the irrigation regimes of T_1 and T_2. The lowest (18.65 t/ha) REY was recorded in T_3 irrigation regimes.

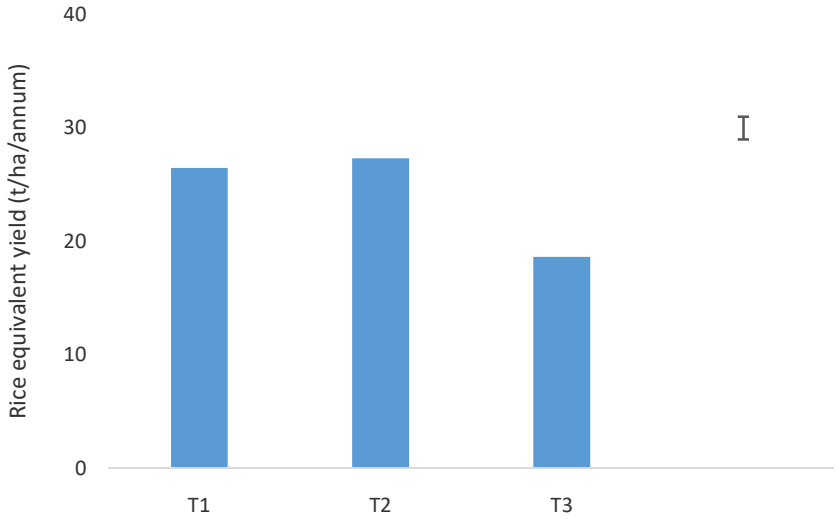


Fig 11. Rice equivalent yield of different irrigation regimes of different cropping sequences.

Interaction of cropping sequences and irrigation regimes

Table 3 presents the yields of different crops and their crop sequences with different levels of irrigation. Rice equivalent yield was significantly ($P<0.05$) different by different cropping sequence with different irrigation regimes. Among the treatment combination, BRRI dhan51-onion seed-BRRI dhan48, BRRI dhan52-onion seed-BRRI dhan48 and Zonakra-onion seed-fallow with T_2 irrigation regimes gave higher REY of 38.67, 38.16 and 32.14 t/ha, respectively. It might be due to the cumulative effect of all the component crops yields those yielded maximum. Due to ponding water in the field upto 15 October (Fig 9) and depression with rainfall occurred 19-21 October, irrigation was not needed for T. aman cultivation. Therefore, T.aman crop was cultivated with rainfed condition (Fig. 12).

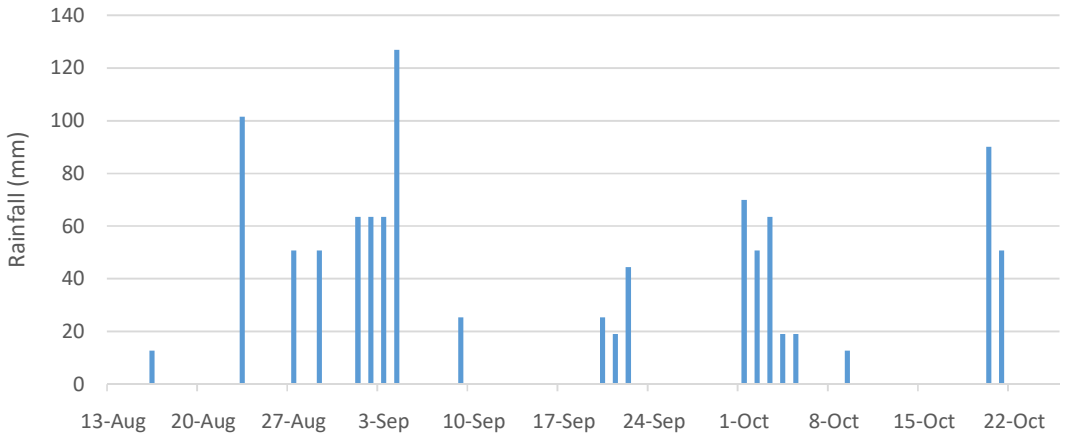


Fig 12. Rainfall occurred in Chhaikola village of Chatmohor, Pabna during August-October 2017.

The maximum T.aman rice yield of 5.33 t/ha observed by the variety of BRRI dhan51. T.aman rice yield was varied by variety used. Submergence tolerant BRRI dhan51 gave higher yield than BRRI dhan52 and local rice zonakra. So, the performance of BRRI dhan 51 was better than the other tested varieties. Average of 5.16, 4.07 and 2.73 t/ha was found by BRRI dhan51, BRRI dhan52 and zonakra, respectively. The maximum garlic yield of 7.88 t/ha was recorded with the irrigation at 20 days interval followed by irrigation at 15 days interval. Irrigation at 25 days interval gave the lowest yield. Similar trend was found in onion seed production. The maximum onion seed yield of 1.01 t/ha was recorded with the irrigation at 20 days interval followed by irrigation at 15 days interval. Irrigation at 25 days interval gave the lowest yield. The variations in yield equivalence were mostly governed by rabi crops. The highest yield equivalence (38.67 t/ha) was in BRRI dhan51-onion seed-BRRI dhan48 cropping system (P_2T_2), due to much higher price of onion seed than garlic.

Table 3. Rice equivalent yield (t/ha) of different crops in various rice based cropping systems during 2017-18

Crop sequences with water treatment		Yield of crops (t/ha)			Rice equivalent yield (t/ha)		
		T.Aman	Rabi	Aus	T.Aman	Rabi	Total equivalent yield (t/ha)
P_1	T_1	5.33	6.67	5.43	5.33	9.53	20.29
	T_2	5.00	7.88	4.14	5.00	11.26	20.39
	T_3	5.25	5.54	4.47	5.25	7.91	17.63
P_2	T_1	5.15	0.96	5.93	5.15	27.55	38.64
	T_2	5.07	1.01	4.63	5.07	28.97	38.67
	T_3	5.18	0.50	5.03	5.18	14.38	24.59
P_3	T_1	3.84	6.67	5.90	3.84	9.53	19.27
	T_2	4.42	7.88	4.77	4.42	11.26	20.44
	T_3	3.84	5.54	5.93	3.84	7.91	17.69
P_4	T_1	3.84	0.96	5.77	3.84	27.55	37.15
	T_2	4.42	1.01	4.77	4.42	28.97	38.16
	T_3	4.07	0.50	5.03	4.07	14.38	23.49
P_5	T_1	2.82	6.67	--	3.22	9.53	12.75
	T_2	2.57	7.88	--	2.94	11.26	14.20
	T_3	2.62	5.54	--	3.00	7.91	10.91
P_6	T_1	2.77	0.96	--	3.17	27.55	30.71
	T_2	2.77	1.01	--	3.17	28.97	32.14
	T_3	2.82	0.50	--	3.22	14.38	17.60
lsd0.05		ns	0.38	0.24	ns	2.42	2.46
cv%			6.0	4.3		8.8	6.1

Price of crops /kg: Aman rice=Tk 17.5, zonakra rice= Tk 20, garlic=Tk 25, onion seed=Tk 1000.

Irrigation water use and water productivity

Table 4 shows irrigation water used and water productivity of different cropping systems. Total water used and water productivity were significantly influenced by cropping systems and irrigation treatments. The maximum total water of 2647 mm was consumed by BRRI dhan51/52-onion seed-BRRI dhan48 cropping sequence under T_1 irrigation regimes assigned for the respective crops followed by BRRI dhan51/52-garlic-BRRI dhan48 cropping sequence under T_1 irrigation regimes assigned for the respective crops. Farmers' practice (zonakra-onion

seed/garlic-fallow) consumed less amount of irrigation water. Water productivity was significantly influenced by cropping system and irrigation regimes. The higher water productivity was found in onion seed based cropping system. Higher REY of onion seed raised the water productivity in onion seed based cropping system. Among the cropping sequences, the maximum water productivity of 23.75 kg/ha-mm was found in zonakra-onion seed-fallow cropping sequences with the water treatment of T_2 arranged for different crops of the different cropping sequences. Keeping the land fallow during aus season and deficit irrigation water used in rabi season made the higher water productivity in farmers' practice. In most of the cases water productivity is higher under deficit irrigation condition.

Table 4. Total water used (mm) and water productivity of different rice based cropping systems during 2017-18

Crop sequences with water treatment		Total water use (mm) (inclusive rainfall, mm)	Water productivity (kg/ha-mm)
P_1	T_1	2565	7.92
	T_2	2430	8.39
	T_3	2553	6.91
P_2	T_1	2647	14.6
	T_2	2176	17.79
	T_3	2225	11.07
P_3	T_1	2565	7.52
	T_2	2430	8.41
	T_3	2553	6.93
P_4	T_1	2647	14.04
	T_2	2176	17.55
	T_3	2225	10.58
P_5	T_1	1546	8.26
	T_2	1611	8.82
	T_3	1417	7.70
P_6	T_1	1627	18.89
	T_2	1657	23.75
	T_3	1090	16.22
lsd0.05		96.2	1.9
cv%		2.8	9.5

Economics of different crop sequence

A wide variation in net return was observed among the crop sequences (Table 5). Highestgross return of Tk676777 was recorded in BRRI dhan51-onion seed-BRRI dhan48 crop sequence under T_2 irrigation regimes of the respective crops. It was followed by T_1 irrigation regimes of the same crop sequence. Also the highest net return of Tk 391577 were calculated from same crop sequences with same irrigation regimes. The maximum benefit cost ratio of 3.03 was recorded from zonakra-garlic-fallow crop sequence under T_2 irrigation regimes of the respective crops. Gross return and net return was higher in research management practices but BCR was higher in farmers' practice due to higher water productivity.

Table 5. Benefit-cost ratio (BCR) of different rice based cropping systems during 2017-18

Crop sequence with water treatment		Gross return per year (Tk/ha)	Cost of cultivation (Tk)	Net return (Tk)	BCR
P_1	T_1	355100	126375	228725	2.81
	T_2	356910	124700	232209	2.86
	T_3	308516	127375	181141	2.42
P_2	T_1	676086	292875	383211	2.31
	T_2	676777	285200	391577	2.37
	T_3	430305	292125	138180	1.47
P_3	T_1	337177	126375	210802	2.67
	T_2	357744	124700	233044	2.87
	T_3	309556	127375	182182	2.43
P_4	T_1	650218	292875	357343	2.22
	T_2	667744	285200	382544	2.34
	T_3	411007	292125	118883	1.41
P_5	T_1	223102	82125	140977	2.72
	T_2	248513	81950	166563	3.03
	T_3	190911	80875	110036	2.36
P_6	T_1	537553	248625	288928	2.16
	T_2	562553	242450	320103	2.32
	T_3	307961	245625	62336	1.25

Return of improved patterns over the farmers patterns

Gross return of Tk131998, Tk108397 and Tk117605 achieved from BRRI dhan51-garlic-BRRI dhan48 over zonakra-garlic-Fallow crop sequence by different irrigation treatment, respectively. Similarly,gross return of Tk138533, Tk114224 and Tk122344 achieved from BRRI dhan52-garlic-BRRI dhan48 over zonakra-garlic-Fallow crop sequence by different irrigation treatment, respectively. Gross margin also higher by the same crop sequence.

Table 6. Return of improved patterns over the farmers patterns

Crop sequence with water treatment		Gross return (Tk/ha)	Production cost (Tk/ha)	Gross margin (Tk/ha)	BCR
P_1 over P_5	**T_1**	131998	44250	87748	2.98
	T_2	108397	42750	65646	2.54
	T_3	117605	46500	71105	2.53
P_3 over P_5	**T_1**	114075	44250	69825	2.58
	T_2	109231	42750	66481	2.56
	T_3	118645	46500	72146	2.55
P_2 over P_6	**T_1**	138533	44250	94283	3.13
	T_2	114224	42750	71474	2.67
	T_3	122344	46500	75844	2.63
P_4 over P_6	**T_1**	112665	44250	68415	2.55
	T_2	105191	42750	62441	2.46
	T_3	103046	46500	56547	2.22

Farmers' awareness program

Three farmers' awareness program was held on 3rd January 2018, 13 May 2018 and 14 May 2018 at Chhaikola village of Chatmohor upozila of Pabna district. About ninety farmers were present in the awareness program (Fig 13). The program was presided by the Principal Investigator of the project. Co-investigator, Md Hannan Ali was present in the program. The SAAO of the selected area, Md Sohrab hoaain also presented in the program. The detailed project activities were explained and discussions held in the program. Farmers were satisfied with the activities happened and with the future plan.

Fig 13. Pictorial view of farmers' awareness program at Chhaikola, Chatmohor, Pabna, 2018

12. Research highlight/ findings:

- Groundwater is the only source for irrigation water in the study area.
- Groundwater level declining rapidly during dry season.
- In most of the years groundwater is lowered upto 8 m (suction limit) during last week of March .
- About six crop sequences were evaluated with three water treatments.
- During T.Aman season, submerged tolerance BRRI dhan51 and BRRI dhan52 were introduced to compare the yield performance with local variety zonakra.
- Onion seed based crop sequence gave higher rice equivalent yield and water productivity.
- About four improved crop sequences were compared with two farmers practice.

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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	One executive chair and four front chair	26000/-	One executive chair and four front chair	25900/-	
(b) Lab & field equipment	Drainage pump (one) Electric balance (one) Submersible pump (one)	35000/- 25000/- 100000/-	Drainage pump (one) Electric balance (one) Submersible pump (one)	34800/- 24900/- 100000/-	
(c) Other capital items	Laptop (one) Digital camera (one)	60000/- 25000/-	Laptop (one) Digital camera (one)	60000/- 25000/-	

2. Establishment/renovation facilities:

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	70	20	90	one day long	
(b) Workshop				-	

C. Financial and physical progress

Item of expenditure/ activities	Total approved	Fund received	Actual expenditure	Balance/ unspent	Physical progress (%)	Reasons for deviation
A. Contractual staff salary	170331	170331	170331			
B. Field research/ lab expenses and supplies	749361	745990	745990			
C. Operating expenses	138049	135924	135924			
D. Vehicle hire and fuel, oil & maintenance	210749	208064	208064			
E. Training/ workshop/ seminar etc	0	0	0			
F. Publications and printing	63995	0	0			
G. Miscellaneous	31715	31416	31416			
H. Capital expenses	135800	132405	132405			

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**	**Outcome**
to maximum utilization of water resources for crop production in water scarce areas	monitor groundwater level recorded rainfall occurred measured ponding water depth	Groundwater level is within suction limit but not every year.	Farmers have been known about the irrigation water source
to improve water productivity by appropriate water management practices	improved cropping pattern evaluated over farmers practice appropriate water management practices on	BRRI dhan51/ BRRI dhan52-garlic/onion seed-aus rice cropping sequences gave higher REY, higher gross return and higher net return	Farmers were aware of submergence tolerance HYV variety, aus rice cultivation practice and appropriate water management practice.

	particular crops to improve water productivity	over zonakra–garlic/onion seed-fallow cropping sequences. Water management practice like T aman rice is rainfed, irrigation applied at 20 days interval in onion seed and garlic cultivation and irrigation applied when perched water table depth was 15 cm below the soil surface in aus rice cultivation is appropriate water management practice	

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

Publication	Number of publication		Remarks
	Under preparation	Completed and published	
Technology bulletin/ booklet/ leaflet/ flyer etc			
Journal publication	one		
Information development		two	
Other publications			

F. Technology/ Knowledge generation/ Policy Support:

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

-Utilization of groundwater source.

-BRRI dhan51/BRRI dhan52-onion seed-aus cropping pattern with irrigation of onion seed at 20 days interval and irrigation of aus rice when perch water level is 15 cm below the ground surface.

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

Sustainable groundwater use for crop production

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

Improved cropping pattern with appropriate water management practice

iv. Policy Support

Judicial use of groundwater for crop production

G. Information regarding Desk and Field Monitoring

i) Desk monitoring

Farmers mainly depends on cash crop. They are interested to cultivate rice in aman and aus season.

ii) Field monitoring

Farmers are interested to have irrigation facilities for crop production.

H. Lesson Learned/ Challenges

(i) Availability of water resources particularly groundwater at the study sites,
(ii) Availability of HYV seed,
(iii) Participation of stakeholder farmers to adopt irrigation for different cropping patterns in water scares areas,
(iv) Appropriate technology for crop protection.

I. Challenges

Sustainable groundwater use for irrigation is the biggest challenges for the water scare area.

Signature of the Principal Investigator
Date ……..
Seal

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