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FEASIBILITY OF PREPAID IRRIGATION AT RAJSHAHI REGION IN BANGLADESH

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Abstract

Since water is scarce and essential resource for crop production, Barind Multipurpose Development Authority (BMDA) in Bangladesh has invented and has implemented prepaid irrigation program -a new an efficient irrigation program. This study was conducted to identify the better irrigation program for crop production. BRRI-Dhan-28 was selected and cultivated using equal quantity and ratio of similar fertilizers for all the sample plots. The results showed that per Bigha (1350 m^2) average irrigation charge for prepaid irrigation program was Tk. 699 and for private irrigation program was Tk.1480 which was about 112% higher than the prepaid irrigation program. The amount of water per Bigha for Boro rice cultivation were 59 and 82 bigha-inches for prepaid and private irrigation programs, respectively. It showed that about 39% excess water was used by the private irrigation program. Volumetrically the loss of water for using the private irrigation was about 780 m^3 per bigha. Average yield per bigha was increased about 9% in the prepaid over private irrigation. Net income per bigha in the prepaid and private irrigation programs were Tk.5700 and Tk.4000, respectively. Benefit–cost ratios of prepaid and private irrigation programs were 2.36 and 1.79, respectively. Total loss of irrigation water due to private irrigation program was found about 19830 million cubic meters per year which could produce about 9.46 Million Metric Ton rice. This study confirms that prepaid irrigation program is an economic and environment friendly program to grow more rice in the study area.

Keywords: *feasibility, prepaid irrigation, economic.*

Introduction

About 80% percent peoples depend on agriculture and agricultural works in Bangladesh. Among the total employment on agriculture, 42 percent generates from own farm, 35 percent from other farm and the remaining 23 percent from other agricultural services (Habibul, 2005). So, the development in agriculture and agricultural production technology in Bangladesh is very essential for growing more food for her rapidly growing population. The proper amount of water and its application is a key factor for crop production. Tushaar *et al.* (2008) urged that "Getting prices right" is the silver bullet widely advocated to developing countries in fighting waste, misallocation and scarcity of water (Tushaar *et. at.*, 2008). Kaldellis and, Kondili (2007) found that increased water demand due to economic growth, irrigation needs, declining precipitation levels and over-abstraction of groundwater are all factors that create fresh water shortage problems in the Aegean Archipelago islands (Kaldellis and Kondili, 2007). Fischer *et al.* (2007) commented that mitigation reduced the impacts of climate change on agricultural water requirements by about 40% or 125-160 billion m^3 (Gm^3) compared with unmitigated climate. Simple estimates of future changes in irrigation efficiency and water costs suggest that by 2080 mitigation may translate into annual cost reductions of about 10 billion USD. Hossain (2010) discussed the benefits of using the modelling tools for optimum utilization of water resources in irrigation and drainage management of command area development projects. In the Teesta Barrage Project, he observed that during Kharif-II season, the full supply levels (FSL) could not be achieved in a dynamic head for the required water flow in both the Teesta and the Rangpur main canals. FSL was also not achieved during Rabi and Kharif-I as the water flow was not optimal in the Teesta. After modelling study he stated that to achieve FSL and required flow in the canal system, some interventions are required. TBP phase-I is now flood free and the annual return from paddy in that area is about Tk. 300.0 crore. Islam et al. (2004) observed that expansion of cropped area and use of HYV rice in the TBP have contributed to labor demand which increased wage rate by 24.5% and also increased purchasing power of landless households. They investigated that Teesta River water reduced the irrigation cost by one-fifth. They found that increase in rice yield level together with the decrease in irrigation cost, has doubled the farm income. They further studied that the present flow in the Teesta River is inadequate to meet the present irrigation requirement, while the fluctuation in the flow rate affects directly the availability of water in the TBP area. To give easement to the farmers for crop production, the irrigation and agricultural specialists developed the schedule of irrigation which save the irrigation water, reduce irrigation cost and get higher yield. From the starting

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to till now all the organizations Bangladesh Agricultural Development Corporation, Bangladesh Water Development Board, Local Government Engineering Department (LGED), deliver irrigation water to farmers land by seasonal contract irrigation charge basis. The farmers receive and use more water for crop production. They misuse the irrigation water. For using more irrigation, the yield of crops reduces, cost of production increases, profit of crops decrease, storage of water decreases and starts ecological imbalance. Moreover, at every irrigation scheme a lot amount of irrigation charge keeps as arrear, which is never possible to realize from the farmers. Considering all the factors BMDA has been developed a new eco-friendly, more profitable, easy to operate and sophisticated prepaid irrigation program in Bangladesh. It is a water delivering program where irrigation charge is taken instantly and the specific amount of water is provided to the farmers on the basis of prepaid card given to them. Using this card, total amount of water can be taken by splitting according to the irrigation scheduling of crops. The prepaid irrigation program is become very popular to the farmers for its various types of merits.

A comparative study of prepaid and private irrigation programs was taken to find out the merits and economics of the prepaid irrigation programs over the private irrigation program.

Methodology

The prepaid irrigation is conducting through BMDA of government irrigation equipment and the private irrigation is conducting through the private owners of the irrigation equipment. At first 25 Upazilla of three districts of Bangladesh named- Rajshahi, Chapai Nawabgonj and Naogaon districts had been taken as the main sample stations and under every station 10 numbers of sample plots had been chosen from prepaid Deep Tube Wells (DTWs) and private irrigation equipment especially from private Shallow Tube Wells (STWs) or private DTWs. The sample plots of prepaid and private irrigation programs had been selected at the nearby two separate irrigation equipment's command area of two irrigation programs. The 250 sample plots having 5 different soil types were cultivated with BRRI Dhan 28 following the recommended fertilizer doses for the prepaid and private irrigation program. Field data were taken by direct measurement and field survey with pretested questionnaire for the sample plots.

Results and discussion

Table 1. Irrigation charge per bigha in the prepaid and private irrigation program

Soil Texture	Average irrigation charge (Tk.)		Increment of irrigation charge	
	Prepaid	Private	(Tk.)	%
Silty clay	660	1334	674	102
Silty clay loam	687	1435	748	112
Silt loam	720	1517	797	111
Clay loam	655	1432	777	119
Loam	770	1684	914	119
Average	699	1480	781	112
SD	63.12	284.13		

The prepaid irrigation program of the BMDA has opened a new chapter to maximize yield and profit by reducing production costs for cultivating crops against the private irrigation program to the farmers. The obtained results on the basis of different specific objectives of prepaid irrigation program and the private irrigation program are discussed below:

Irrigation cost

The amount of irrigation cost per bigha at the private irrigation program over the prepaid irrigation program for Boro rice production was Tk. 699 and for private irrigation program was 1480. It shows that on and average Tk.781 per bigha excess irrigation cost required in the private irrigation program. This amount is about 112% higher than the prepaid irrigation program. So, farmers choose the prepaid irrigation program (Table 1). At the silty clay type soil per bigha average irrigation charge for prepaid and private irrigation program were Tk. 660 and Tk. 1334, respectively. That is per bigha irrigation cost Tk. 674 required more in the private irrigation program. Some of the locations the irrigation charge at the private irrigation program is showing very higher than the average. This happened due to the local water lords of private irrigation program. At the silty clay loam type soil per Bigha average irrigation charge for prepaid and private irrigation program were Tk.

687 and Tk. 1435, respectively. That is per bigha irrigation cost Tk. 748 required more in the private irrigation program. Average irrigation charges for prepaid and private irrigation program per bigha were Tk. 720 and Tk. 1517, respectively, for silt loam type soil. That is per bigha irrigation cost Tk. 797 required more in the private irrigation program. The private irrigation program required more amount of irrigation charge on comparison to the prepaid irrigation program to cultivate one bigha of Boro rice for clay loam soil (per bigha average irrigation charge for prepaid and private irrigation program were Tk. 655 and Tk. 1432, respectively). Maximum average irrigation charge for prepaid and private irrigation program were found (Tk. 770 and Tk. 1684, respectively) for loam type soil.

Table 2. Water used per Bigha in the prepaid and private irrigation program

Soil Texture	Average irrigation (in)		Increment of irrigation amount	
	Prepaid	Private	(in)	%
Silty clay	51	74	23	45
Silty clay loam	57	80	23	40
Silt loam	63	87	24	38
Clay loam	55	76	21	38
Loam	68	91	23	33
Average	59	82	23	39
SD	8.91	13.88		

Irrigation depth

The quantity of irrigation water which applied in the sample plots of prepaid and private irrigation programs also measured and calculated. The used irrigation water per bigha for Boro rice cultivation was 59 in and 82 in for prepaid and private irrigation programs, respectively in depth. It shows that about 39% excess irrigation water was used by the private irrigation program (Table 2). It was found that the minimum and maximum irrigation depth (51in, 74 in) and (68 in, 91 in) were needed for silty clay and loam soil, respectively. For using more irrigation water than the required quantity the tillers of the rice reduced in numbers. These less number of tillers hampers the yield of the rice. So, the results prove the prepaid irrigation is better than the private irrigation program. The Table 2 shows the at a glance result of the two irrigation programs about the quantity of irrigation used per bigha for producing Boro rice in different types of tested soil textures.

Table 3. Rice yield per Bigha in the prepaid and private irrigation program

Soil Texture	Average yield (Kg)		Increment of average yield	
	Prepaid	Private	(Kg)	%
Silty clay	799	737	62	8
Silty clay loam	891	817	73	9
Silt loam	944	856	88	10
Clay loam	866	800	66	8
Loam	952	893	59	7
Average	891	821	70	9
SD	76.26	77.88		

Yield of rice

Average yield per bigha in the prepaid and private irrigation programs were 891 and 821 Kg, respectively. That is about 70 Kg rice reduced in the private irrigation program which was about 9% less in production of rice in the private irrigation program. The prepaid irrigation produced more yield. Maximum yield (952 kg, 893 kg) were found in loam soil for prepaid and private irrigation program. The yield at two irrigation programs in different types of soil text ures are shown in Table 3.

Table 4. Per Bigha yield per Bigha-inch of irrigation water

Soil Texture	Average yield (Kg)		Increment of average yield	
	Prepaid	Private	(Kg)	%
Silty clay	16	10	6	60
Silty clay loam	16	11	5	45
Silt loam	15	10	5	50
Clay loam	16	11	5	45
Loam	15	10	5	50
Average	16	11	5	45
SD	1.97	1.73		

Average production of rice per inch of irrigation

The sample plots and schemes were 41 for silty clay type soil of each number of programs. It is identified that the private irrigation program unable to produce higher yield than the prepaid irrigation program for cultivating per bigha of Boro rice. At the silty clay soil per Bigha average yield per bigha-inch of irrigation water for prepaid and private irrigation programs were 16 Kg and 10 Kg, respectively. Per bigha average

yield reduced per bigha-inch irrigation water was 6 Kg in the private irrigation program than the prepaid irrigation program. The private irrigation program was unable to produce higher yield than the prepaid irrigation program for cultivating per bigha of Boro rice. At the silty clay loam soil per Bigha average yield per bigha-inch of irrigation water for prepaid and private irrigation programs were 16 Kg and 11 Kg, respectively. That is per bigha average yield reduced per bigha-inch irrigation water was 5 Kg in the private irrigation program than the prepaid irrigation program (Table 4).

Table 5. Amount of water used to produce one Kg Boro rice in prepaid and private irrigation program

Soil Texture	Average irrigation required (L)		Excess water used	
	Prepaid	Private	(L)	%
Silty clay	2156	3425	1269	59
Silty clay loam	2200	3313	1032	47
Silt loam	2281	3438	1157	51
Clay loam	2171	3353	1182	54
Loam	2402	3495	1093	46
Average	2250	3400	1150	51
SD	282.44	519.17		

Table 6. The Benefit-Cost Ratio of the prepaid and private irrigation program

Soil Texture	Average Gross income (Tk.)		Average Production cost (Tk.)		Benefit- Cost Ratio	
	Prepaid	Private	Prepaid	Private	Prepaid	Private
Silty clay	9047	8209	3962	4691	2.28	1.71
Silty clay loam	10024	9099	4143	4929	2.42	1.85
Silt loam	10458	9525	4456	5364	2.35	1.78
Clay loam	9491	8643	4224	5045	2.25	1.71
Loam	10569	9741	4211	5180	2.51	1.88
Average	9900	9050	4200	5050	2.36	1.79
SD	1037.9	1045.3	467.1	647.4	0.085	0.067

Quantity of water

The private irrigation program required more irrigation water to produce one Kg rice production than the prepaid irrigation program. On average 2250 L and 3400 L water were required in the study are for the prepaid and private irrigation program, respectively. Details water required are shown in Table 5. At the silty clay soil requirement of irrigation water for one Kg rice production for prepaid and private irrigation programs were 2156 L and 3425 L respectively. That is per Kg rice production required 1269 L excess irrigation water in the private irrigation program. At the silty clay loam soil requirement of irrigation water for one Kg rice production for prepaid and private irrigation programs were 2200 L and 3313 L, respectively. That is per Kg rice production required 1032 L excess irrigation water in the private irrigation program. For the silt loam soil, irrigation water needed for one Kg rice production for prepaid and private irrigation programs were 2281 L and 3438 L, respectively. That is per Kg rice production required 1157 L excess irrigation water in the private irrigation program. At the loam soil requirement of irrigation water for one Kg rice production for prepaid and private irrigation programs. The 2402 L and 3495 L water were required for prepaid and private irrigation programs, respectively.

Average gross income

It is identified that the private irrigation program failed to produce maximum gross income than the prepaid irrigation program. At the silty clay type soil total Gross Income generated for prepaid and private irrigation programs were Tk. 9047 and Tk. 8209, respectively per Bigha. That is per bigha gross income increased Tk. 838 in the prepaid irrigation program. It is identified that the private irrigation program failed to produce maximum gross income than the prepaid irrigation program. At the silty clay loam type soil gross income generated for prepaid and private irrigation programs were Tk. 10024 and Tk. 9099, respectively per bigha. Gross income was increased Tk. 925 in the prepaid irrigation program. The private irrigation program failed to produce maximum gross income than the prepaid irrigation program. At the loam type soil total gross income generated for prepaid and private

irrigation programs were Tk. 10569 and Tk. 9741, respectively per Bigha. Gross income increased Tk. 828 in the prepaid irrigation program (Table 6). Average production cost per bigha for producing Boro rice among the prepaid and private irrigation program were (Tk. 3962 and Tk. 4691), (Tk. 4143 and Tk. 4929), (Tk. 4456, Tk. 5364), (Tk. 4224, Tk. 5045), and (Tk. 4211, Tk.5180), for silty clay, silty clay loam, silty loam, clay loam and loam soil, respectively (Table 6).

Benefit –Cost Ratio(BCR)

The benefit –cost ratio is one of the main criteria to distinguish the irrigation program which one is better than the others. Table-6 shows the benefit –cost ratio of the two irrigation programs. It is found that the benefit –cost ratio of prepaid irrigation program always higher than the private irrigation program for all types of soils. The maximum and minimum BCR values were (2.51, 1.88), (2.28, 1.71) for Loam soil and silty clay soil for the prepaid and private irrigation programs, respectively. Only for the beauty and profitable corners of the of the prepaid irrigation program the numbers of the irrigation equipment of the prepaid irrigation program are increasing day by day. But the number of irrigation equipment of private irrigation program and alike to private irrigation program are decreasing day by day. The irrigated area also increased in the prepaid irrigation program.

The major problems with prepaid irrigation are found by the farmers in this study are: (i) faulty prepaid card and faulty card reader, (ii) Maintenace need special type technician (iii) may loss as it is very small in size and difficult to carry by the farmers. (iv) may damage by different ways i.e. fire, scratch, breaking, (v) difficult to pay all money at a time in advance, (vi) handling of prepaid card needs knowledge about irrigation scheduling.

Conclusion

The field data of the two irrigation programs were analyzed to compare them. The prepaid irrigation program proved that it is better than the private irrigation program. Irrigation costs per bigha rice production were Tk. 699 and Tk. 1480 for prepaid and private irrigation program, respectively. About 112% excess irrigation was required in the private irrigation program. This excess amount was the additional burden to the farmers. In this study it was also found that about 39% more irrigation water required in the private irrigation program. About 780 cubic meter water lost per bigha in the private irrigation program, which affects the eco-system. The yield of cultivated rice of the two programs were found 891 kg, 821 kg, which show that the prepaid irrigation program produced 9% more rice on comparison to the private irrigation program. Cultivation of Boro rice through prepaid irrigation, the state would achieve additional 9% of rice which can reduce the food crisis to some extent. On average 16 Kg and 11 kg rice were produced using 1 bigha-inch of water for prepaid and private irrigation. Prepaid irrigation program was able to increase of 45% yield over private irrigation. The benefit –cost ratios of the prepaid and private irrigation program were found 2.36 and 1.79, respectively, in the study area which was about 32% more than the private irrigation program. Loam soil in that area had maximum BCR (2.51, 1.88) for prepaid and private program and minimum BCR (2.25, 1.71) was found in clay loam soil. From this result it was proved that the farmers could earn more profit from the prepaid irrigation program. The production cost per Bigha was found lower (prepaid-Tk.4200, private- Tk.5050) and benefit was found higher (prepaid-Tk.9900, private-Tk.9050) in the prepaid irrigation program on average in the study area. It was found that about 43% income was saved in the prepaid irrigation program. The obtained results finally confirmed that the prepaid irrigation has the positive impact for cultivating Boro rice economically and environmentally. To improve the prepaid irrigation program, (i) development of more effective prepaid card, and (ii) more detail study should be done.

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