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Irrigation Practices under Boro Rice Cultivation in Haor Areas of Sunamganj, Bangladesh

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Authors' contributions

This work was carried out in collaboration among all authors. Author DC designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors PKS and MAK managed the analyses of the study and managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

A field study was conducted in the 'haor' areas of Sunamgonj district, Bangladesh, aimed to investigate the present irrigation practices to identify the related problems for 'Boro' rice cultivation. The primary field data were collected by interviewing 120 farmers (landless, small, medium, and large farmers) through survey. Most of the farmers used 'beel' (37.5%) as the main source of irrigation water. As water-lifting devices, they mostly used Low Lift Pumps (77.5%). The cost of irrigation was observed the lowest at Derai [Tk. 12,232 ($ 146.784) per season] and the highest was at Dakshin Sunamganj [Tk. 46109 ($ 553.31) per season], respectively. The highest benefit-cost ratio (BCR) was observed at Derai (2.48) and the lowest was at Dowarabazar (2.01). The financial problem, less water supply, lack of irrigation equipment, and knowledge about operating the equipment were identified as the main problems suffered by the farmers. These problems can be solved by distributing irrigation equipments at a reasonable price, and arranging training programs to develop the farmers' skills.

Keywords: Benefit-cost ratio; irrigation cost; low lift pump; shallow tube well.

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1. INTRODUCTION

Rice is the main staple food of Bangladesh, and this country's geography and climate are favorable for the cultivation of rice [1]. Aus, Aman, and Boro are the main varieties of rice are cultivated in Bangladesh throughout the year [2]. Irrigation is essential for Boro rice production in the dry period in Bangladesh. As water is an important factor for the successful cultivation of Boro rice, it affects the physical characters of rice plant-like growth, yield, and nutrient status of the soil [3]. The water requirement of rice is not static. It varies widely with soil type, water table, weather condition, and saturation of variety, soil, and water management practice. Boro rice alone contributed the highest share of total rice production [4]. The main irrigation method for Boro rice is the conventional flood irrigation method, where 3000 to 5000 liters of water is used for the production of 1 kilogram of rice, but it can be lower by adopting the AWD method to 2000 liters [5]. By using the flood irrigation method, the world's 75 % rice is produced, and the largest yield is also obtained in this method [6]. A haor is a wetland ecosystem in the northeastern part of Bangladesh which is physically a bowl or saucer-shaped shallow depression, also known as a back swamp [7]. 858460 hectares is the total area of the haor-type wetland ecosystem. The haor basin is situated in Sunamganj, Habiganj, Moulovibazar, Sylhet, Kishoreganj, Netrokona, and Brahmanbaria districts outside the core haor area. Among the total 373 haors of Bangladesh, 95 haors are situated in the Sunamganj district which covers 268531 hectares area [8]. Boro is the only crop that grown in the study area throughout the cropping year. In haor areas, farmers use water from beels for irrigation, and submersible dyke for water management [9]. Poor irrigation facility is the major hindrance for higher productivity of Boro rice. The main aim of the study is to help to increase agricultural production in haor areas using modern irrigation practices. To achieve this, the focus will be given to the specific objectives: (i) to investigate water source for irrigation, irrigation methods used and its utilization pattern, (ii) to analyze present irrigation practices, and (iii) to explore different problems related to irrigation of Boro rice and find out their probable solutions.

2. MATERIAL AND METHODS

The field survey was done at 5 upazilas of Sunamganj district from February to September 2018. The upazilas were Dakshin Sunamganj (Dekhar Haor), Dowarabazar (Dekhar Haor), Derai (Shormongol Haor), Jagannathpur (Gachtolar Haor and Kapnar Haor), and Chhatak (Dekhar Haor). Primary data were collected from a total of 120 farmers and twenty-four samples from each upazila by field survey. The samples were classified into four groups viz. landless farmers, small farmers, medium farmers, and large farmers. Six farmers from each group of each location were interviewed. Pre-testing of the questionnaire was done to identify any ambiguities in the questions and to identify the range of probable responses for each question [10]. The questionnaire was tested with five farmers of Kaikharpar village at Joykolosh union in Dakshin Sunamganj upazila of Sunamganj district on 10 October 2017. The questionnaire was amended after the session. This procedure made the questionnaire unequivocal, suitable, and acceptable to the final respondents. Only a single questionnaire was carried out with each farmer and thus the reliance was placed on the ability of the farmers to recall the answers. Microsoft Excel software was used for data processing and analysis. Analyzed data were organized in tabular and graphical form. The local units of data were converted into international units before analysis.

3. RESULTS AND DISCUSSION

3.1 Sources of Irrigation Water

Table 1 shows the sources of irrigation water used in the study area for rice production. Beel (37.5%) was the main source of irrigation water in the Sunamganj district, while the dam of BADC (almost 1%) used the least for irrigation. River (21.67%) was the second-highest used source of irrigation water as opposed to groundwater (19.17%). The other small scale used irrigation sources were khal (13.33%), pond (8.33%), and small depression (duba) (3.33%).

In Dowarabazar upazila, most of the farmers used khal water (62.5%) for irrigation. A very little amount of BADC dam water (4.17%) and pond water (4.17%) were used. Farmers also used river water (Surma River) (29.17%) and beel water (12.5%) for irrigation. In Dakshin Sunamganj upazila, groundwater (95.83%) was the most used source than small depression (duba) which was only used by 4.17%. In Derai upazila, the most used source was beel (62.5%) which was higher than river water (Kalni River) (29.17%) compared to small depression (duba) (8.33%) which was least used. In Jagannathpur

upazila, most of the farmers used river water (Etakhula River) (50%) for irrigation. A very little amount of khal water (4.17%) and small depression (duba) water (4.17%) were used. Farmers also used beel water (29.17%) and pond water (20.83%) for irrigation. In Chhatak upazila, beel water (local name: Hourwa Beel) (83.33%) was the most used source than pond water which was only used by 16.67% (Table 2).

3.2 Irrigation Equipment Used

From Table 3, Low Lift Pump (77.5%) and Shallow Tube Well (20%) were used in the highest numbers. On the other hand, traditional equipment likes don, and swing baskets were used the lowest (4.17%) as shown in Fig. 1. Most of the farmers used 150 to 250 feet pipes to supply water by LLP and the depth 350 feet from which STW sucked water. In the low land, water remains in the field all time so the farmers did not use machines rather than using traditional equipment like don and swing basket. Their irrigation requirements were almost fulfilled by rainwater. Comparatively high lands were irrigated by power-operated equipment.

Most of the farmers used these machines from mid-December to mid-March while only a few numbers were used from mid-November to mid-March or mid-February. The farmers prepared their land during mid-October, transplanted it during mid-December, and harvested in mid-March for the Boro rice.

Table 1. Sources of irrigation water in Sunamganj district

Source of irrigation water	Number of respondents	% of respondent
Beel	45	37.5
River	26	21.67
Groundwater	23	19.17
Khal	16	13.33
Pond	10	8.33
Small depression (Duba)	4	3.33
Dam of BADC	1	0.83

Data source: Field survey- 2018; Total number of respondents: 120 (Some farmers used more than one source for irrigation water)

Table 2. Sources of irrigation water in study areas

Source of irrigation water	Number of respondents (% of respondent)				
	Dowarabazar	Dakshin Sunamganj	Derai	Jagannathpur	Chhatak
River	7 (29.17%)		7 (29.17%)	12 (50%)	
Khal	15 (62.5%)			1 (4.17%)	
Pond	1 (4.17%)			5 (20.83%)	4 (16.67%)
Small depression (Duba)		1 (4.17%)	2 (8.33%)	1 (4.17%)	
Beel	3 (12.5%)		15 (62.5%)	7 (29.17%)	20 (83.33%)
Dam of BADC	1 (4.17%)				
Groundwater		23 (95.83%)			

Data source: Field survey- 2018; Total number of respondents- 24 from each upazila (Some farmers used more than one source for irrigation water)

Table 3. Irrigation equipment used in Sunamganj district

Irrigation equipment use	Number of respondents	% of respondent
LLP	93	77.5
STW	24	20
Traditional equipment	5	4.17

Data source: Field survey- 2018; Total number of respondents: 120 (Some farmers used two types of equipment for irrigation at a time because they cultivated both in low land and high land together)

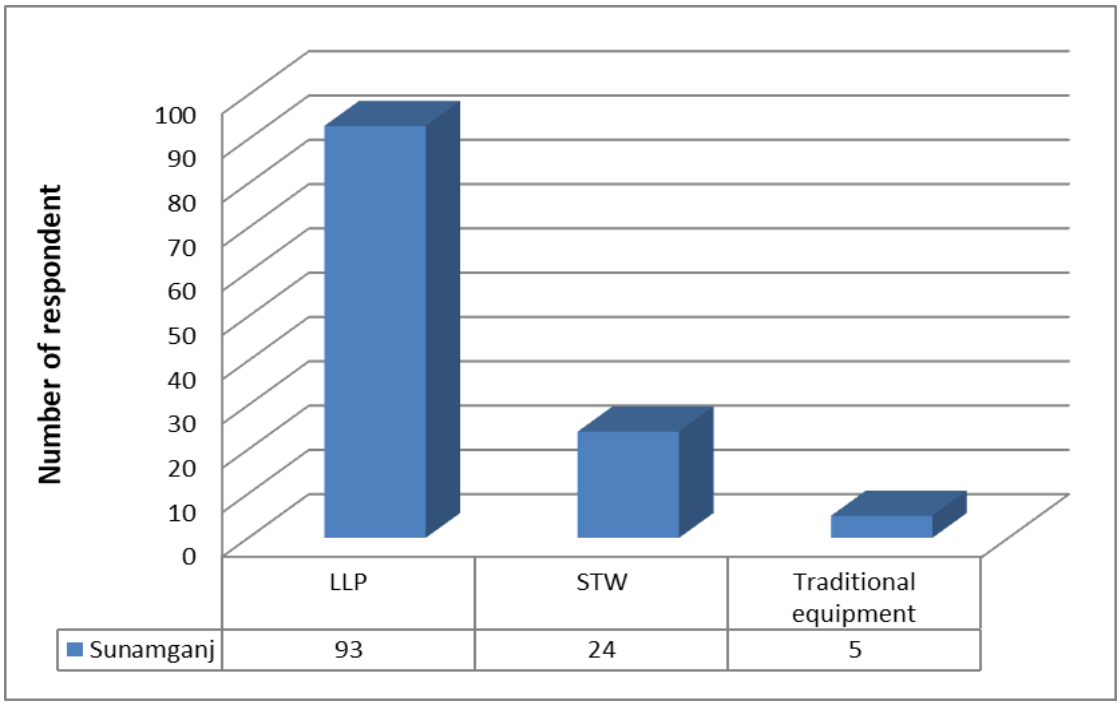

Fig. 1. Irrigation equipment usage pattern in Sunamganj district

Table 4. Irrigation equipment used in the selected study areas

Upazila	Number of respondents			% of respondent		
	LLP	STW	Traditional equipment	LLP	STW	Traditional equipment
Dowarabazar	22	-	3	91.67	-	12.5
Dakshin Sunamganj	-	24	-	-	100	-
Derai	23	-	2	95.83	-	8.33
Jagannathpur	24	-	-	100	-	-
Chhatak	24	-	-	100	-	-

Data source: Field survey- 2018; Total number of respondents- 120 (24 respondents from each upazila)

From Table 4, it is observed that only in Dakshin Sunamganj upazila, farmers used STWs while the other four upazilas LLPs were used because surface water was available there all the time. Some farmers used two types of equipment (LLP+ Traditional equipment) at a time because they cultivated both in low land and high land together.

3.3 Mode of Operation of the Power-Operated Irrigation Equipment

From Table 5 and Fig. 2, it is observed that most of the machines run by diesel (56.41%) which was slightly more than those operated by electricity (39.32%). The lowest number of equipment was operated by Kerosene (4.27%).

Table 5. Mode of operation of the power-operated irrigation equipment in Sunamganj district

Source of power for irrigation	Number of respondents	% of respondent
Diesel	66	56.41
Electricity	46	39.32
Kerosene	5	4.27

Data source: Field survey- 2018; Total number of respondent: 117 (3 respondent out of a total of 120 respondents did not use power-operated irrigation machine rather than used manually operated traditional equipment)

Table 6. Mode of operation of the power-operated irrigation equipment in the selected study areas

Upazila (Number of respondents)	Number of respondents			% of respondent		
	Electricity	Diesel	Kerosene	Electricity	Diesel	Kerosene
Dowarabazar (22)	15	7	-	68.18	31.82	-
Dakshin Sunamganj (24)	-	24	-	-	100	-
Derai(23)	-	21	2	-	91.3	8.69
Jagannathpur (24)	15	6	3	62.5	25	12.5
Chhatak (24)	16	8	-	66.67	33.33	-

Data source: Field survey- 2018; Total number of respondent: 117 (3 respondent out of a total of 120 respondents did not use power-operated irrigation machine rather than used manually operated traditional equipment)

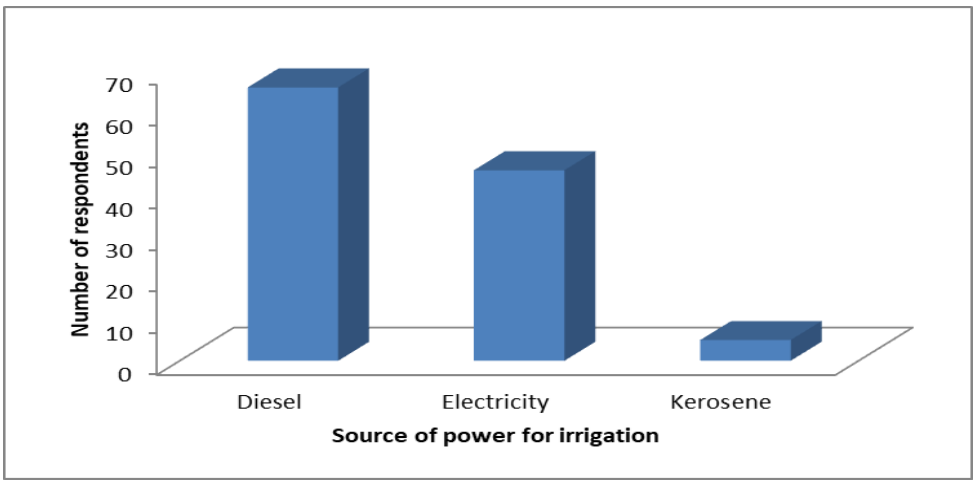

Fig. 2. Mode of operation of the power-operated irrigation equipment in Sunamganj district

In Dakshin Sunamganj and Derai upazila, farmers used diesel as the main power source for irrigation machines while electricity was used highly in the other three study areas (Table 6).

3.4 Ownership of the Power Operated Irrigation Equipment

Most of the machines were taken from pump owners (70.83%) while own machines were only 25%. Some machines (1.67%) were taken from organizations like BADC as presented in Table 7 and Fig. 3. Mainly most of the large farmers and some medium farmers had their own machines. On the other hand, small and landless farmers used machines from others in exchange for money or paddy, or both. These machines were mostly operated from morning to evening, almost 14 hours day^{-1}.

From the survey, it was observed that only in Dakshin Sunamganj upazila, farmers used STWs which were all rented from pump owners. In other upazilas, most of the irrigation machines were taken from pump owners, while only in Dowarabazar some irrigation machines were taken from organizations like BADC. In Chhatak upazila, own machines were used highly compared to other upazilas as shown in Table 8.

Table 7. Ownership of the power operated irrigation equipment in Sunamganj district

Ownership of irrigation equipment	Number of respondents	% of respondent
Rented from pump owner	85	70.83
Own	30	25
Rented from organization	2	1.67

Data source: Field survey- 2018; Total number of respondent: 117 (3 respondent out of a total of 120 respondents did not use power-operated irrigation machine rather than used own manually operated traditional equipment)

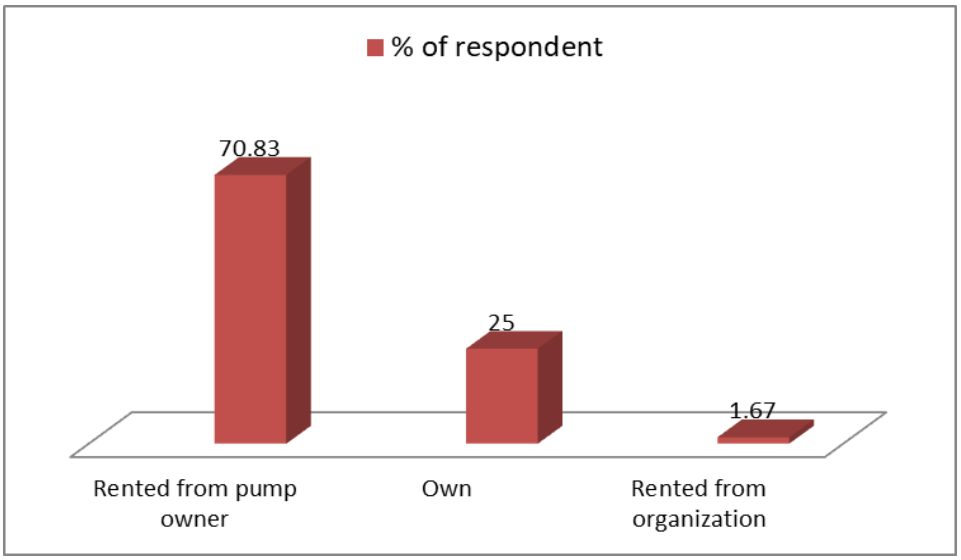

Fig. 3. Ownership of the power operated irrigation equipment in Sunamganj district

3.5 Irrigation Cost and Benefit-Cost Analysis

Irrigation water is sold to the farmers in different pricing systems. So, there exists a variation in water pricing and crop irrigation cost. If the farmer himself is not the owner of the machine, then he purchases irrigation water from the machine owner paying money, paddy, or both. Most of the farmers in the study area hired machines and purchased water in exchange for money.

Irrigation costs varied in different places in the study area. From Table 9, it was observed that the total irrigation cost was the highest in Dakshin Sunamganj upazila which was Tk. 46,109 ($ 553.31) per hectare. On the contrary, the total costs of irrigation of the other four upazilas were Tk. 32,933 ($ 395.196) per hectare in Dowarabazar, Tk. 12,232 ($ 146.784) per hectare in Derai, Tk. 29,640 ($ 355.68) per hectare in Jagannathpur, Tk. 19,764 ($ 237.168) per hectare in Chhatak, respectively. The total irrigation cost was observed at the lowest at Derai upazila. The difference in irrigation cost can be caused due to the type of irrigation equipment use, operating time of the machine, land size etc. The highest irrigation cost was in Dakshin Sunamganj upazila may be due to use of Shallow Tube Well whereas other four upazilas used Low Lift Pump as irrigation equipment.

The highest BCR (Benefit-Cost Ratio) was in Derai which was 2.48 and the lowest was in Dowarabazar which was 2.01. The BCR of other upazilas were 2.23 in Dakshin Sunamganj, 2.12 in Jagannathpur, and 2.14 in Chhatak (Table 10). BCR rate is changing every year because the price and production of yield, seasonal costs vary every year. Here in the selected study areas, BCR was greater than 1 means, the revenue from the rice production was economically satisfactory.

3.6 Common Irrigation Problems Suffered by the Farmers

A reasonable number of farmers (75% farmers from all the five upazilas) reported that they did not have any problems related to irrigation. Some farmers (15.83%) opined that they did not have enough money to purchase irrigation water. On the other hand, fewer (4.17%) reported that water supply was another problem for irrigation (Table 11). Due to this problem, the irrigation cost increased. The common problems observed were:

(i) Water is not available for irrigation almost every year. Water supply decrease in September due to khal's water dried up. Sometimes due to drought, water is not available. On the other hand, beel is leased and people cultivated fish there. As a result, beel dried up and water is unavailable. Similarly, sometimes water does not enter from haor to beel and small depression (duba), and then this problem occurs.

Table 8. Ownership of the power operated irrigation equipment in the selected study areas

Upazila (Number of respondents)	Number of respondents			% of respondent		
	Own	Rented from pump owner	Rented from organization	Own	Rented from pump owner	Rented from organization
Dowarabazar (22)	5	15	2	20.8	62.5	8.33
Dakshin Sunamganj (24)	-	24	-	-	100	-
Derai (23)	7	16	-	29.17	66.67	-
Jagannathpur (24)	8	16	-	33.33	66.67	-
Chhatak (24)	10	14	-	41.67	58.33	-

Data source: Field survey- 2018; Total number of respondent: 117 (3 respondent out of a total of 120 respondents did not use power-operated irrigation machine rather than used own manually operated traditional equipment)

Table 9. Irrigation cost analysis of Boro rice

Upazila	Operating cost (Tk. /hour)	Cost of irrigation (Tk./ha)	Total number of irrigation	Total irrigation cost (Tk./ha)	Yield (t/ha)	Yield price (Tk./t)
Dowarabazar	Tk. 50 ($ 0.6) (machine with current use), Tk. 100 ($ 1.2) (machine with diesel use)	Tk. 5492 ($ 65.904)	6	Tk. 32,933 ($ 395.196)	4	Tk. 18,000 ($ 216)
Dakshin Sunamganj	Tk. 130 ($ 1.56) (machine with diesel use)	Tk. 6587 ($ 79.044)	7	Tk. 46,109 ($ 553.31)	5.22	Tk. 18,000 ($ 216)
Derai	Tk. 80 ($ 0.96) (only machine use) Tk. 150 ($ 1.8) (machine with diesel use)	Tk. 1112 ($ 13.344)	11	Tk. 12,232 ($ 146.784)	5.65	Tk. 18,000 ($ 216)
Jagannathpur	Tk. 150 ($ 1.8) (machine with diesel use), or giving rice 1 mound/kiar (0.31 ton/hectare)	Tk. 3705 ($ 44.46)	8	Tk. 29,640 ($ 355.68)	4.61	Tk. 18,000 ($ 216)
Chhatak	Tk. 100 ($ 1.2) (machine with diesel use)	Tk. 1647 ($ 19.764)	12	Tk. 19,764 ($ 237.168)	4.92	Tk. 18,000 ($ 216)

Data source: Field survey- 2018; Total number of respondents: 120

Table 10. Benefit-Cost analysis of Boro rice

Upazila (1)	Cost of irrigation (Tk./ha) (2)	Other costs (Tk./ha) (3)	Total production cost (Tk./ha) (4)= (2)+(3)	Total benefit (Tk./ha) (5)	BCR (Benefit-Cost Ratio) (6)= (5)/(4)
Dowarabazar	Tk. 5492 ($ 65.904)	Tk. 30,303.26 ($ 363.639)	Tk. 35,795.26 ($ 429.543)	Tk. 72,000 ($ 864)	2.01
Dakshin Sunamganj	Tk. 6587 ($ 79.044)	Tk. 35,543.78 ($ 426.525)	Tk. 42,130.78 ($ 505.569)	Tk. 93,960 ($ 1127.52)	2.23
Derai	Tk. 1112 ($ 13.344)	Tk. 39827.68 ($ 477.93)	Tk. 40,939.68 ($ 491.276)	Tk. 1,01,700 ($ 1220.4)	2.48
Jagannathpur	Tk. 3705 ($ 44.46)	Tk. 35,367.6 ($ 424.41)	Tk. 39,072.6 ($ 468.87)	Tk. 82,980 ($ 995.76)	2.12
Chhatak	Tk. 1647 ($ 19.764)	Tk. 39,827.68 ($ 477.93)	Tk. 41,474.68 ($ 497.696)	Tk. 88,560 ($ 1062.72)	2.14

Data source: Field survey- 2018; Total number of respondents: 120 (Other cost includes total fixed cost and total variable cost. Total variable cost includes labor cost, seed cost, power tiller cost, cost of urea, TSP, MP, fertilizer and insecticide cost, weeding cost. Total fixed cost includes land use cost and interest on operating capital).

Table 11. Problems faced by the farmers related to irrigation of Boro rice in Sunamganj district

Sl. No.	Problems faced by the farmers	Frequency	% of respondent
1	None	90	75
2	Lack of money	19	15.83
3	Less water supply	5	4.17
4	Lack of knowledge about operating irrigation equipment	4	3.33
5	Lack of irrigation equipment	2	1.67

Data source: Field survey- 2018; Total number of respondents- 120

(ii) In these areas, irrigation equipment is available in less number but at a high price so farmers cannot afford to buy those types of equipment due to lack of money as well as they do not know how to operate these types of equipment. So they have to use irrigation equipment from others mainly rented from pump owners as a result irrigation cost increased.

3.7 Probable Solutions for Irrigation Related Problems Faced by the Farmers

Based on the findings obtained from the study, the probable solutions are as below:

(i) If Government and non-government agencies provide training about the operation of irrigation equipment and knowledge of irrigation of Boro rice (quantity of irrigation water, irrigation interval, and method of irrigation in which water can be used efficiently etc.), farmers will be skilled in irrigation technology.
(ii) If Government distributes irrigation equipment at a reasonable price and starts to give loans from banks at less or no interest for farmers, then farmers can afford irrigation technology and buy them.
(iii) If Government or other organization starts irrigation project in those areas and starts to supply irrigation water at an affordable price to the farmers, then irrigation cost and total production cost will reduce.
(iv) The problem of less water supply of irrigation can be solved by developing rainwater harvesting facilities during monsoon for use at dry periods.

3.8 Problems of Boro Rice Cultivation

Natural calamities including flash floods, hail storms, and drought were the most common problems (54.17 %). Flash floods affect Boro rice production in the low-lying haor areas during harvesting. The two main phases of flood in haor basin are the early flood (pre-monsoon) phase and the deeply flooded (monsoon) phase. Early flood occurs in April and extends until June whereas deep flood remains from June to November. Early flood results in flash flood cause huge damage to the standing crop of Boro rice while deeply flood gets the little crop in the field to damage. The flash flood poses a high risk of damage to the standing winter Boro rice crop just 2 to 3 weeks before harvesting. Flash flood remains the major climate risk to thousands of rice farmers in the region over years. Flash flood occurs in the area almost every year. Severity depends on the time and quantity of rainfall in the hill and drains out the capacity of main rivers. Due to hail storms, Boro rice crop production hampers every year in haor areas of Sunamganj. Farmers of these areas had little knowledge about cultivation. Due to the lack of knowledge of agricultural farming practices, farmers do not know the appropriate ratio of application of fertilizer and pesticides in time. For the inappropriate application of fertilizer and pesticides, soil nutrients are degrading. Hence the production is hampered. The Labour crisis was another problem during the harvesting season. Even though labourers were available in little amount, then they charged a high wage rate which was another problem (Table 12). The cost of agricultural input (i.e. seed, fertilizer, diesel, etc.) is increasing day by day. The cultivable land is decreasing due to continuous construction of new buildings, making nursery or planting trees in the cultivable land. The farmers do not get expected production as per the cost of irrigation. As a result, they despair from agricultural activities. The farmers in the study areas cannot bring their products to the market in time properly due to a lack of transportation facilities. The farmers get fewer prices of their produced crops than production cost and bear loss. The storage facility is another most important constraint for crop production. In haor areas, due to the frequent occurrence of flash floods, the farmers have to store their products immediately, but they do not have enough storage facility. Again, they

do not have enough platforms for the boat to transport their produced crops for the purpose of storage or marketing, so they cannot take their products to the market timely and sell them. As a result, large quantities of products get damaged, and they have to bear losses. The produced rice are both internally consumed and exported from the market to the other districts of the country. BRRI dhan 28, BRRI dhan 29, BRRI dhan 82, Hira 1, Hira 2, Hira 5, Jonokraj, BRAC 444 are the varieties of Boro crop cultivated by the farmers.

Farmers identified many problems associated with Boro rice cultivation. Quality seed crisis in the sowing period, fertilizer crisis, shortage of hired labour in the peak period, high wage rate, high irrigation cost, low output price, lack of capital, and lack of co-operation from SAAO were the most severe among those problems [11]. The top five constraints identified in a study and their rank order were: a) lack of storage facilities for products and seeds, b) high price of inputs, c) non-availability of credit for other crops, d) lack of sufficient training programs in different aspects of crop diversification and e) most of land were low areas, and not suitable for CDP crops [12]. An extensive study conducted on twenty-four problems of farm youth in Mymensingh villages relating to different problems in crop cultivation, and out of twenty-four problems the top four problems in rank order were: (i) NGO takes the high rate of interest against a loan, (ii) Lack of agricultural machinery and tools, (iii) Lack of cash, (iv) Financial inability to arrange improved seeds, fertilizers, and irrigation [13]. The present findings agreed with their statement.

3.9 Steps Should be Under Taken for the Development of Boro Rice Cultivation

During the participatory research, a wide range of suggestions came from the individual respondents for the overall development of haor people, its nature, and environment. These suggestions are very useful to improve the livelihood of the people in the area. The important suggestions under specific areas of concern are presented in tabular form below:

Due to high cost of agricultural inputs, total production cost increases and many landless and small farmers cannot afford it. So most of the farmers want help from Government i.e. free seeds, fertilizers and insecticides, financial help. As well as they want real and low price of insecticide, fertilizer and seed at local market (9.17 %) and good sale price of paddy in market (15.8 %). By providing institutional support as well as financial support such as giving loan at low interest, proper training to the farmers regarding crop production, providing good quality seed, fertilizer, pesticides etc. at low cost can also help in Boro rice cultivation (Table 13). On the other hand, improving the storage facility (5 %) is another demand from the farmers, which can be solve by constructing storage room, improving road network for facilitating transportation of products.

Table 12. Problems faced by the farmers during Boro rice cultivation in Sunamganj district

Sl. No.	Problems faced by the farmers	Frequency	% of respondent
1	Natural calamities	65	54.17
2	Attack of insects	50	41.67
3	Different diseases of paddy	31	25.83
4	Lack of quality seed	28	23.33
5	Lack of money	21	17.5
6	Lack of fertilizer and insecticides	17	14.17
7	Lack of knowledge about cultivation	15	12.5
8	High price of seed, fertilizer and insecticides at local market	14	11.67
9	Lack of land	13	10.83
10	Labour crisis and high wage rate	11	9.17
11	Low sale price of paddy in the market	6	5
12	Lack of storage facilities	5	4.17

Data source: Field survey- 2018; Total number of respondent- 120
** some farmers had more than one problem related to Boro rice cultivation*

Table 13. Solutions from the opinion of farmers about Boro rice cultivation and its development in Sunamganj district

Sl. No.	Solutions from the opinion of farmers	Frequency	% of respondent
1	If Government gives free seed, fertilizer and insecticide	40	33.33
2	Providing training about Boro rice cultivation	27	22.5
3	Giving loan from bank	24	20
4	Ensure good sale price of paddy in market	19	15.8
5	Ensure real and low price of insecticide, fertilizer and seed at local market	11	9.17
6	Provide good seed for rice production	11	9.17
7	Increasing storage facility	6	5
8	Build embankment around the haor side	5	4.17
9	Providing new and modern equipment for Boro rice cultivation	4	3.33
10	Repair the broken dams of haor	3	2.5
11	Financial help from Government to the farmers	3	2.5
12	Providing facility for irrigation	1	0.83

Data source: Field survey- 2018; Total number of respondent- 120

** some farmers gave more than one solution for development of Boro rice cultivation*

4. CONCLUSION

'Beel' water was the main source of irrigation and the most used irrigation equipment was LLP (Low Lift Pump) in Sunamganj district. Most of the irrigation machines are run by diesel and they were taken from the pump owners. The highest irrigation cost was observed in Dakshin Sunamganj compared to Derai whose irrigation cost was the lowest and BCR was the highest. The lowest BCR was observed in Dowarabazar. The main problems faced by farmers were financial crisis, low water availability, and lack of awareness about the use of irrigation equipments. The Government agencies and non-government organizations may come forward to solve these problems by distributing irrigation equipment at a reasonable price, arranging training programs to develop the farmers' skills, providing loans at low interest etc.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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