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Agro-economic performance of boro rice cultivation at farmers' level of *haor* area in Bangladesh

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Abstract

The present study is an attempt to see the boro rice cultivation and agro-economic performance in *haor* area. A total number of 65 farmers' were randomly selected by using random sampling technique. Data were collected from the sampled farmers' through direct interview method using a questionnaire. The study was carried out to list down the available 31 boro rice variety cultivated in the *haor* area. Most of the farmers had low capital consuming agricultural machinery. Considering all farmers, per hectare labourer required for boro rice cultivation in *haor* area was 149 man day^{-1} ha^{-1}. The highest per hectare labourer required for boro rice cultivation in *haor* area was found 157 man day^{-1} ha^{-1} in case of medium farmers followed by large (154 man day^{-1} ha^{-1}), small (149 man day^{-1} ha^{-1}), marginal (147 man day^{-1} ha^{-1}) and landless (138 man day^{-1} ha^{-1}) farmers, respectively. Considering full cost, the average cost of rice production was Tk. 38153 ha^{-1} under the all sampled farmers'. Farmers' average cost of rice production for land preparation, intercultural operation, seed, fertilizer, irrigation, pesticide, harvesting, threshing, carrying and others were of Tk. 3735, 6882, 1913, 6309, 2523, 782, 9277, 3421, 3074 and 237 ha^{-1}, respectively. The average all sampled farmers' net-return earned form boro rice production was Tk. 52646 ha^{-1} and yield was 5.31 t ha^{-1}. The economic returns earned from rice production of Tk. 49137, 52595, 50777, 56338 and 55003 ha^{-1} against the yield of 4.97, 5.26, 5.24, 5.60 and 5.45 t ha^{-1} for landless, marginal, small, medium and large farmers' categories, respectively. Productivity of boro rice is low due to imbalance use of fertilizers but yield showed higher than that of national average production in Bangladesh due to one cropped area in *haor*.

Keywords: Agro-economic, Variety, Farmers' level, Yield, Haor

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Introduction

Bangladesh is densely populated and agriculture based country. Total rice growing area was 11.38 million ha in Bangladesh which covers 74.85% of the total cultivable area and the total production of rice was 34.71 million metric tonnes (BBS, 2016). Agriculture is the single largest producing sector of economy since it comprises about 14.1% of the country's GDP and employing around 62.1% of the total labor force (BBS, 2017). There are as many as 373 small or large *haors* in Bangladesh (Master Plan of *Haor* Area, 2012). There are many *haors* (basin like structure) where water remains either stagnant or in flash flooding condition during the months of May to October and mainly Boro rice is grown in the Rabi season using irrigation. Geographically, most of the *haors* are situated in seven districts of the North-East Bangladesh. The districts are Sunamganj, Kishoreganj, Netrokona, Sylhet, Habiganj, Maulavibazar and B. Baria. The Hakaloki *haor*, Sumir *haor*, *Dakar haor*, Tanguyar *haor*, Gungiajuri *haor*, Mukhar *haor*, Kaowadighir *haor* etc are the prominent *haors* in Bangladesh. The total cultivated area in those *haor* districts is about 1.26 million hectares of which 0.68 million ha (nearly 66%) is under *haor*. Almost 80% of this area (i.e. 0.68 million ha) is covered by Boro rice, while only about 10% area is covered by T. Aman production (Huda, 2004). Out of these, 95 *haors* are in Sunamganj district of which about 70% area has now been turned into cultivated land (Master Plan of Haor Area, 2012). Boro-Fallow-Fallow and Fallow-Fallow-T. Aman are the major cropping patterns practiced in the area. So, there is a great possibility of growing modern variety rice as well as other rice and non-rice crops in the *haor* areas. One of the major reasons for nutrient stress is the use of imbalance fertilizers. Among the improved cultural practices, to insure proper growth, large amount of chemical fertilizers are applied in different crops field (Shakouri *et al*., 2012). Judicious and proper use of fertilizers can markedly increase the yield and improve the quality of rice (Alam *et al*., 2009). Farmers' of *haor* area do not apply balance doses of fertilizers because of higher yield of rice comparison to other areas of Bangladesh. It is most important that the actual fertilizer application should be known to manipulate the adequate fertilizer input supply for higher production and social appreciation to apply balance

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doses of fertilizers in their crops land. Human labour was the most important and extensively used input for producing boro rice. Production of boro rice required different operations such as land preparation, transplanting, weeding, fertilizer & insecticides application, irrigation, harvesting, carrying, threshing, winnowing and drying etc. So, boro rice is the main crop and even the only crop of those haor areas due to lengthy water logging condition. In those areas, rice cultivation is mainly dependent on the natural water although artificial irrigation is managed in some possible localities. The production of such areas is confined under the choice of the nature. Sometimes the ripen rice is damaged by the uncertain floodwater in the very low areas. Due to lengthy water logging those *haor* areas are mostly single cropped areas. The study was undertaken to see the boro rice varieties practiced in *haor* area with their production technology and agro-economic performance.

Materials and Methods

The study was carried out at Bahadurpur village under Sunamganj sadar upazila of Sunamganj district during November 2014 to July 2015 to examine the boro rice production in *haor* area. In Sunamganj Sadar upazila, the highest rainfall occurs in the months of end of May to mid-August while drought was prolong during end of November-mid February. Severe flood was reported in end of June to mid-August while warm weather persists at the end of end of March to mid-July. The list of all farmer in the selected village was prepared with the help of local village leader and SAAO. There were 230 households are situated in the Bahadurpur village. Sample farmers were selected following simple random sampling method. The numbers of sample farmers were 65. A semi-structured questionnaire was used as the data gathering instrument based on the objectives of the study. The questionnaire contained both open and closed form of questions. The questions in the schedule were simple, direct and easily understandable by farmers. Prior to final data collection, the questionnaire was pre-tested in the study area in the actual field situation. Based on their reactions the questionnaire was then finalized and multiplied to collect data. All possible efforts were made to explain the purpose of the study to the farmers' in order to get valid and pertinent information from them. While starting interview with a farmer, the researcher took all possible care to establish rapport with him so that he did not feel hesitant or hostile to provide responses to the questions and statement in the questionnaire. In some cases the investigator failed to meet the farmers' at their homes for interviews. However, this problem was resolved by repeating the visit. Only a single questionnaire was carried out with each farmer. The data collections were based on the rice varieties, labourer used in rice production, cost of rice cultivation and rice yield and economic returns. The collected data were compiled, tabulated, farmers categories, means and percentage according to objectives of the study.

Results and Discussion

Boro rice varieties cultivation in *haor* area

Haor is deeply flooded from May to October while winter is the single cropping season. The major crop is boro rice. In this study, boro rice is divided into three types such as local, modern and hybrid. Data found from the study, it was revealed that 17 local rice varieties, 13 modern rice varieties and 3 hydrid rice varieties were cultivated in *haor* area under Sunamjanj district, respectively (Table 1). The *haor* areas are naturally hazardous compared to those of the other irrigated areas of the country. A boro rice in the *haor* area generally encounters the difficulties like a failure of timely crop establishment, cold injury in the reproductive stage of an early crop, flash flood damage at the premature to mature stage of a crop etc. The normal seeding time in the seedbed is early November for a long-duration variety like BRRI dhan29 and mid to end-November for a short-duration variety like BRRI dhan28. The seedbed preparation depends on the time of receding of flood water in the *haor* area. Generally, the October seeded crop was to encounter cold shock at the reproductive phase from late February to early March. On the contrary, the late established (seedbed preparation in December) crop have the probability to encounter flash flood at the late growth stage of the crop. So the farmers have to play with the wheel of fortune for their survival in the area. Similar results were also observed by Singh (2008), Hossaio *et al.* (2006).

Table 1. Boro rice varieties cultivated at farmers' level in *haor* area

Variety type	Name of the variety		
Local	Rata boro	Birun	Rangilatapi
	Tapi boro	Laldinga	Kali boro
	Begun bichi	Khaia boro	Kalojira
	Atobshail	Bichibaroi	Lalkhai
	Gochi	Sona rata	Chinigura
	Laphaia	Pashushail	
Modern	BR 16	BRRI dhan50	Binadhan 10
	BR18	BRRI dhan58	Binadhan 14
	BRRI dhan28	BRRI dhan63	Binadhan 18
	BRRI dhan29	Binadhan 8	
Hybrid	Hybrid SL-8H	Hybrid Hira	BRRI hybrid dhan 2

Technology used of boro rice cultivation

Boro rice production is depending on different type technology. In this study that most of the farmers had low capital consuming agricultural machinery. But heavy capital consuming machinery was possessed only by the large farmers (Table 2). Animal power and power tiller was used for land preparation in boro rice cultivation. But the rate of using power tiller for land preparation was more than that of plough. The farmers were found to use fertilizers in their boro rice field namely Cowdung, Urea, TSP and MoP. It was observed from the study that 100% of the farmers used Urea in their rice field. Almost all farmers were used both mechanical and manual weeding to remove weeding in their rice field. Generally manual weeding was given to the very low land where minimum number of weeding was required. Irrigation is mainly dependent on the natural water although artificial irrigation is managed in some possible localities. Insecticides and weedicide were used by some farmers. Probably for this reason most of the farmers did not want to make any production loss due to insects in their farms. For threshing, most of the farmers used traditional hand beating and some thresher. The results are in close agreement with those of Abdullah *et al.* (2007), Hyun (2007), Zaman *et al.* (2007) Rosegrant and Pingali (2006) Myint and Kyi (2005).

Labourer of boro rice cultivation

The labour required for rice cultivation was 149 man day^{-1} ha^{-1} in average per farms. Farmers' had required labour of seedling uprooting, seedling transplanting, weeding,

irrigation, fertilizer application, harvesting, threshing and carrying as of 10, 35.96, 27.53, 10.09, 3, 37.11, 13.68 and 12.29 man-day ha^{-1}, respectively (Table 3). Labourers for producing boro rice at farmers' level were transplanting (man-day 30.46, 33.96, 36.59, 39.79 and 38.97 ha^{-1}), weeding (man-day 24.70, 26.37, 27.10, 30.46 and 29.29 ha^{-1}), irrigation (man-day 9.22, 10.50, 9.51, 10.98 and 9.99 ha^{-1}), harvesting (36.56, 36.84, 37.69, 37.32 and 36.45 ha^{-1}), threshing (14.00, 14.20, 13.54, 13.17 and 13.50 ha^{-1}) and carrying (11.03, 12.14, 12.44, 12.90 and 12.94) in case of landless, marginal, small, medium and large farmers, respectively. Result shows that the highest number of labour was used for seedling, transplanting, weeding and harvesting. The result also supported by Chowdhury (2009), Mahabub *et al.* (2005), Khan (2004) and Miah (2002).

Table 2. Technology used of boro rice cultivation at farmers' level in *haor* area

Technology	Use
Power tiller Plough Yoke Ladder Rake Spade	Land preparation
Cowdung, Urea, TSP, MoP	Commonly used fertilizer
Dul Cheuti Water pump	Irrigation purpose
Insecticides	Insect control
Weedicide Japanese rice weedier	Weed control
Niri Spade Sickle Pearching Wood or bamboo Sticks Hand picking of harmful insects Removal diseased infected plants by hands	Intercultural operation
Sickle	Boro rice harvesting purpose
Dam Wood girth Threshing machine	Boro rice threshing purpose

Table 3. Labourer in boro rice cultivation of sampled farmers' land in *haor* area of Bahadurpur village under Sadar upazila of Sunamganj district
(Man-day ha^{-1})

Farmers category	Labour distribution in rice cultivation								Average
	Seedling uprooting	Transplantig	Weeding	Irrigation	Fertilizer application	Harvesting	Threshing	Carrying	
Landless (10)	10	30.46	24.70	9.22	3	36.56	14.00	11.03	138
Marginal (16)	10	33.96	26.37	10.50	3	36.84	14.20	12.14	147
Small (18)	10	36.59	27.10	9.51	3	37.69	13.54	12.44	149
Medium (15)	10	39.79	30.46	10.98	3	37.32	13.17	12.90	157
Large (6)	10	38.97	29.29	9.99	3	36.45	13.50	12.84	154
Total (65)	10	35.96	27.53	10.09	3	37.11	13.68	12.29	149

Figures within the parentheses indicate farmers' number

Cost of boro rice cultivation

The total farming operations costs per hectare of cultivable land in landless, marginal, small, medium and large categories of farmers were Tk. 35618, 37732, 38028, 40241 and 38659 respectively (Table 4). The average cost of rice cultivation was Tk. 38153 ha^{-1} in the study area. Farmers' average cost of rice cultivation for land preparation, intercultural operation, seed, fertilizer, irrigation, pesticide, harvesting, threshing, carrying and others were of Tk. 3735, 6882, 1913, 6309, 2523, 782, 9277, 3421, 3074 and 237 ha^{-1}, respectively. Intercultural operation was also shown that cost of boro rice per hectare varied from Tk. 6175 to 7322. The average seed, fertilizer, irrigation and pesticide highest costs per hectare land were Tk. 2121, 6529, 2744 and 1235 for medium categories of farmers respectively, and lowest costs per hectare land were 1540, 6014, 2305 and 371 in landless, respectively. From the study, harvesting cost per hectare area was highest than all other parameters. Finding showed that the cultivation of boro rice was of 9.68 t ha^{-1} in BARI dhan29 and 9.89 t ha^{-1} in BRRI dhan58. The gross return was of Tk. 116684 and 115598 for BARI dhan29 and BARI dhan58, respectively. It was observed that the balanced application of recommendation fertilizers gave the higher return as well as soils keep fertile (Al-amin, 2016). Khan (2004) observed that the costs of production of boro rice were Tk. 26814, 24914 and 24341 ha^{-1} for small, medium and large farms, respectively. In general labour, power tiller, seedlings, fertilizers, irrigation and insecticides emerged as the very crucial contributors to increase income from boro rice production. Similar results were also observed by Alam *et al.* (2011), Rahman (2000), Nantu (1998) and Bhuiyan (1986).

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Table 4. Cost of boro rice cultivation for sampled farmers' land in *haor* area in Bahadurpur village under Sadar upazila of Sunamganj district
(Tk. ha^{-1})

Farmers category	Cost of rice cultivation										Total cost
	Land preparation	Intercultural operation	Seed	Fertilizer	Irrigation	Pesticide	Harvesting	Threshing	Carrying	Miscellaneous	
Landless (10)	3735	6175	1540	6014	2305	371	9139	3499	2758	82	35618
Marginal (16)	3735	6592	1888	6246	2624	618	9211	3551	3036	232	37732
Small (18)	3735	6774	2028	6303	2379	686	9423	3385	3110	206	38028
Medium (15)	3735	7616	2121	6529	2744	1235	9331	3293	3225	412	40241
Large (6)	3735	7322	1737	6434	2497	1070	9112	3376	3211	165	38659
Total (65)	3735	6882	1913	6309	2523	782	9277	3421	3074	237	38153

Figures within the parentheses indicate farmers' number

Boro rice yield and economic returns

Return was calculated by multiplying the total production with market unit price (Tk kg^{-1}) of rice and straw. The average economic return form boro rice production was Tk. 52646 ha^{-1} and yield was 5.31 t ha^{-1} in the study area (Table 5). The economic return from rice production of Tk. 49137, 52595, 50777, 56338 and 55003 ha^{-1} against the yield of 4.97, 5.26, 5.24, 5.60 and 5.45 t ha^{-1} for landless, marginal, small, medium and large farmers' categories, respectively. The average per hectare benefit-cost ratio was highest in large farmers' categories followed by medium, marginal, landless and small farmers' categories, and these were 2.42, 2.40, 2.39, 2.38 and 2.34, respectively. The average benefit-cost ratio of those categories was 2.38. It varied from 2.34 to 2.42 for the various categories of farmers. The highest return indicated the profitability of rice production. The average boro rice productivity of the study area was of 5.31 t ha^{-1} which was higher than that of national average (3.965 t ha^{-1}) in Bangladesh (BBS, 2015). Per hectare net return was found 11.7308.50/ha. The highest per hectare net return was found Tk.8161.02 in case of large farms followed by medium (Tk.7570.86) and small (Tk.6404.98) farms, respectively (Khan, 2004).

Table 5. Rice yield and economic returns of sampled farmers' in *haor* area in Bahadurpur village under Sadar upazila of Sunamganj district

Farmers' category, No.	Rice details and income				Gross Return (3+5) (Tk. ha^{-1})	Cost of rice cultivation (Tk. ha^{-1})	Economic return (6-7) (Tk. ha^{-1})	BCR (6/7)
	Grain yield		Straw yield					
	Grain yield (t ha^{-1})	Total (Tk. ha^{-1})	Straw yield (t ha^{-1})	Total (Tk. ha^{-1})				
1	2	3	4	5	6	7	8	
Landless, 10	4.97	67631	6.85	17125	84756	35618	49137	2.38
Marginal, 16	5.26	71577	7.50	18750	90327	37732	52595	2.39
Small, 18	5.24	71305	7.00	18000	88805	38028	50777	2.34
Medium, 15	5.60	76204	8.15	20375	96579	40241	56338	2.40
Large, 6	5.45	74162	7.80	19500	93662	38659	55003	2.42
Total, 65	5.31	72213	7.49	18737	90799	38153	52646	2.38

Local market price: Grain @ 13.61 Tk. kg^{-1}; Straw @ 2.5 Tk. kg^{-1}

Conclusion

A *haor* is a wetland ecosystem in the north-eastern part of Bangladesh which physically is a bowl or saucer shaped shallow depression, also known as a backswamp. Boro rice cultivation in *haor* area was required labourer of 149 man-day ha^{-1}. The average annual income from rice production of sampled farmers was 52646 Tk. ha^{-1}. Productivity of boro rice is low (5.31 t ha^{-1}) due to imbalance use of fertilizers but yield showed higher than that of national average production in Bangladesh due to one cropped area in *haor*.

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