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PRODUCTIVITY OF POTATO-*BORO* RICE CROPPING PATTERN IN *HAOR* ECOSYSTEM

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ABSTRACT

A study was conducted at PurbaTethulia village, in Dingaputa *haor* of Mohangonj Upazila in Netrakona district during the period from October 2011 to April 2012. The objective of the study was to diversify and intensify crops in the research site and to develop a more productive cropping pattern. In the trial, Potato-*Boro* rice-Fallow cropping pattern was followed. The experiment was laid out in a randomized complete block design with five replications. The agronomic productivity (rice equivalent yield t ha^{-1}) of the Potato-*Boro* rice-Fallow cropping pattern was 24.32 t $ha^{-1}$with economic productivity (gross margin Tk ha^{-1}) of 163210 and the benefit cost ratio of 1.80. Potato-*Boro* rice pattern may be disseminated in *haor* areas of similar environment.

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INTRODUCTION

Bangladesh claims to be self-sufficient in rice production. But other foods are deficit to a large extent. Even the rice food security is not achieved at the household level in many poor and extreme poor families in urban and rural areas including those of the highly food insecured areas of Bangladesh of which the flood prone areas of the Sylhet *haor* basin can be mentioned although the *haor* is a surplus area of rice and fish.

Haor is a bowl-shaped depression of typical low land area within the estuarine floodplain of the Surma, Kushiyara, Meghna, Dhenu and Ghorautre rivers. The *haor* of Bangladesh covers the districts of Kishoreganj (eastern part), Netrakona, Sunamganj, Habiganj, Moulabibazar and part of Sylhet and Brahmanbaria. The *haor*area extends as many as 43 upazilas of the aforesaid districts. The area of the *haor* is about 932793 hectares (Hossain *et al*., 2010). The *haor* goes under flooding (5-10 m) from late May to October while looks like a sea. There is only one cropping season in *haor* i.e. the *Rabi*, when *Boro*rice, potato, groundnut, sweet potato, mustard and pulses are grown. Sometimes in some years the crops of the *haor* areas are affected by natural calamities like flash flood, hailstorm and insect pests. The *haor* is a vital supplier of inland fresh water fisheries with a fishing area of 114793 hectares (Hossain *et al.,* 1987). The main communication to the *haor* is by boat with or without engine.

Crop diversification can be a useful means to increase crop output under different situations. Crop diversification can be approached in two ways. The main form and the commonly understood concept is the addition of more crops to the existing cropping pattern, which could be referred to as horizontal diversification. For instance, cultivation of field crops in rice fields or growing various types of other crops in uplands have been defined as crop diversification. The other type of crop diversification is vertical crop diversification, in which various other downstream activities are undertaken. This could be illustrated by using any crop species, which could be refined to manufacture products, such as fruits, which are canned or manufactured into juices or syrups as the case may be.

Intensification of crops is an agricultural production system characterized by a low fallow ratio and the high use of inputs such as capital, labour or heavy use of pesticides and chemical fertilizers relative to land area. Bangladesh has, by 2010/2011, achieved an estimated cropping intensity of about191 percent (BBS, 2011). Out of the net cropped area of 9.23 million hectares, about 43 percent is double cropped and approximately 14 percent triple cropped. However, about 30 percent is still single cropped (BBS, 2010). Since all the suitable land is already under cultivation, raising the intensity of land use is needed.

As evident in Benchmark Survey (LIFCHASA, 2010), crop species diversity in PurboTethulia is negligible. Although vegetable and spices are important food items for daily consumption, the area under vegetable and spice cultivation in PurboTethulia is limited and the yield status of different vegetables and spices is also low. As a result people taking fewer amounts of vegetables and for spices they are fully dependent on market. A study was, therefore, undertaken in PurboTethulia, a village of Dingaputa *haor* to diversify and intensify crops in the research site and to develop the multiple cropping patterns.

MATERIALS AND METHODS

The experiment was carried out at PurboTethulia village situated in the eastern side of Mohanganj upazila of Netrakona district, a village and ward of Tethulia union in Dingaputa *haor*, during the period from October 2011 to April 2012. The experimental site was a representative of flood prone *haor* area which covered 932793 ha i.e. about 6.5% area of Bangladesh. The experiment was laid out in a randomized complete block design with five farmers' replications.

According to experimental treatmentvegetable such as potato (*Solanum tuberosum*)was used as the first crop and *Boro* rice (*Oryza sativa* L.) variety BRRI dhan28 as the second crop.

Seeds (whole tubers) of potato cv. Challisha were collected from local market of Kaltapara, Gouripur, Mymensingh. For potato, land was prepared during the mid of October 2011 through ploughing followed byladdering. Fertilizers were applied at the rates of 250, 150, 250, 120, 10 and 10 kg ha^{-1}urea, TSP, MoP, gypsum, zinc sulphate and boron, respectively. Total TSP, MoP, gypsum, zinc sulphate and boron and one half of the urea were applied during final land preparation and the rest one half of urea was top dressed at 35 days

after seed planting. Seeds were sown on 24 October 2011 in lines at 30cm × 10cm spacing. Irrigation and weeding were done as and when necessary. To control late blight Ridomil gold was applied @ 1 kg ha^{-1}. Harvesting was done from 8 January 2012 to 12 January 2012.

BRRI dhan28 is a modern high yielding variety of Boro rice was developed by the Bangladesh Rice Research Institute. BRRI dhan28 matures within 140 days and attains a plant height of 90-95 cm and the average yield was found to be 6.0 t ha^{-1} (BRRI, 2013). In terms of total growth duration this variety is the best short duration variety for *boro* season so far released by BRRI (BRRI, 2011).

Boro rice cv. BRRI dhan28 was cultivated after harvesting the potato in the same fields. Land was prepared during the third week of January 2012 through ploughing and laddering. Fertilizers were applied at the rates of 220, 80, 100, 100 kg ha^{-1} as urea, TSP, MoP and gypsum, respectively. Total amount of triple super phosphate, gypsum and three-fourth of MoP were applied during final land preparation and urea was top dressed in three equal splits at 10, 30 and 45 days after transplanting. The rest of MoP was applied with urea at top dressing.
Forty-day old seedlings were uprooted carefully from the seed bed without causing any mechanical injury to the roots for transplantation. For easy uprooting seed beds were made wet by the application of water on the previous day of uprooting seedling.

Only the selected healthy seedlings were transplanted in the experimental plots on 12 January 2012 in 25 cm apart rows maintaining a distance of 15 cm from hill to hill @ 3 seedlings $hill^{-1}$.
Seedlings in some hills died off and those were replaced on 12 February 2011 with the seedlings from the same source.

Experimental field was irrigated to maintain a constant level of standing water up to 6 cm at early stage to enhance tillering and 10-12 cm at later stage to discourage late tillering. The experimental plots were irrigated as and when necessary. The irrigation was stopped before 20 days of harvest to enhance maturity. Rifit was applied @ 1L ha^{-1} to control weed.

Maturity of crop was determined when 90 per cent of the grains became golden yellow colour. Five hills (excluding border hills) were selected randomly from each unit plot and uprooted before harvesting for recording necessary data other than yields. After sampling the whole plot was harvested at maturity on 15 April 2012 by cutting the plants at the ground level with sickle. The harvested crop of each plot was separately bundled, properly tagged and then brought to the threshing floor. The harvested crops were threshed by pedal thresher and the fresh weights of grain and straw were recorded plot-wise. The grains were cleaned and sun dried to a moisture content of 14 per cent. Straws were similarly sun dried. Finally grain and straw yields $plot^{-1}$ were recorded and converted to t ha^{-1}.

Data were collected on yield and yield contributing characters of rice and yield of potato. Rice equivalent yield (REY), gross return, gross margin and benefit cost ratio (BCR) were also calculated.

RESULTS AND DISCUSSION

Results obtained from the present study have been presented and discussed comprising yield and yield contributing characters of rice, yield of potato, rice equivalent yield and economic performance.
Experimental results have been presented in Tables 1-3.

Potato was the first crop of the pattern. Average yield of potato was 21.22 t ha^{-1} Experimental results also revealed that in case of rice the highest plant height (98.48 cm), number of effective tillers $hill^{-1}$ (16.00), panicle length (22.66 cm), number of grains $panicle^{-1}$ (200.58), sterile grain $panicle^{-1}$(18.86), weight of 1000 grains (23.21 g), grain yield (6.68 t ha^{-1}), straw yield (9.97 t ha^{-1}), biological yield (16.65 t ha^{-1}) and harvest index (42.27%) were observed. The lowest plant height (94.4 cm), number of effective tillers $hill^{-1}$ (12.50), panicle length (16.44 cm), number of grains $panicle^{1}$ (179.54), sterile spikeletpanicle^{-1} (16.22), weight of 1000 grains (22.39 g), grain yield (5.85 t ha^{-1}), straw yield (8.29 t ha^{-1}), biological yield (14.14 t ha^{-1}) and harvesting index (40.12%) were studied. Number of plant height, tillers $hill^{-1}$, sterile grains $panicle^{-1}$, weight of 1000 grains did not differ significantly due to treatments.

Table 1. Crop characters and yield attributes of *Boro* rice (cv. BRRI dhan28) as influenced by the cropping pattern Potato-*Boro* rice-Fallow in Dingaputa *haor* ecosystem

Cropping pattern	Plant height (cm)	Tillers hill^{-1} (no.)	Effective tillers hill^{-1} (no.)	Panicle length (cm)	Grains panicle^{-1} (no.)	Sterile spikelets panicle^{-1} (no.)	Weight of 1000 grains (g)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})	Biological yield (t ha^{-1})	Harvest index (%)
Potato-*Boro* rice- Fallow (under seasonal flooding	98.48	18.74	16.00	22.66	200.58	18.86	23.21	6.68	9.97	16.65	40.12

In the Potato-*Boro* rice pattern more fertilizers were used for potato cultivation (the first crop of the pattern).
As a second crop, rice got some additional residual benefit of previous applied fertilizer which might contribute the enhanced yield of rice.

Table 2. Effect of cropping pattern on agro-economic productivity

Cropping pattern	Yield of 1st crop (t ha^{-1})			Yield of 2nd crop (t ha^{-1})			Total rice equivalent yield (t ha^{-1}) of the pattern
	Product	By product	Rice equivalent yield (t ha^{-1})	Product	By product	Rice equivalent yield (t ha^{-1})	
	1	2	3	4	5	6	3+6
Potato-*Boro* rice-Fallow	21.22	-	16.98	6.68	9.97	7.34	24.32

Table 3. Economic performance of the designed cropping patterns in Dingaputa *haor* ecosystem

Cropping pattern	Economic productivity (Tk ha^{-1})			Benefit-cost- ratio (Undiscounted)
	Total variable cost	Gross return	Gross margin	
Potato- *Boro* rice- Fallow	201530	364740	163210	1.80

During the dry season the seasonal flood water is completely drained out from the *haor* area by gravity and turns to very fertile land for crop production. Though the *haor* area is mainly rice based, but farmers can grow some vegetable, pulse and oil seed crops in medium low land.

Among the designed cropping patterns tried, one cropping pattern comprised short duration local variety of potato known as *Challisha* followed by cultivation of *Boro* rice gave rice equivalent yield of 24.32 t ha^{-1} with benefit cost ratio 1.80 indicating quite high profit along with growing more than one crop with the cultivation of rice as staple food crop in the *haor* area. In the case of potato and rice containing cropping pattern one can get a net benefit of Tk 163210 ha^{-1}. Thus the gross margin through cultivation of potato ensured his food security and also gave him two times higher income thus if his rice was supposed to be affected by flash flood or other natural disaster, he would get at least one crop of vegetable like potato in Potato-*Boro* rice-Fallow pattern. If *Boro* rice would be destroyed by flash flood the farmer would get 21.22 t ha^{-1} of potato from the pattern which was more than sole rice 7.16 t ha $^{-1}$.

CONCLUSION

Based upon our research findings, we can conclude that trial conducted on Potato-*Boro* rice-Fallow cropping pattern, it is clearly proved that double cropping of potato cv. Challisha and *Boro* rice cv. BRRI dhan28 can successfully be practiced in *haor* ecosystem where only one crop of *Boro* rice is generally grown. This pattern may be disseminated in *haor* areas of similar environment. For large scale dissemination this component technology needs further up scaling.

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