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Evaluation of production potential and economics of Radish-Potato/Maize-T. Aman cropping pattern in Rangpur region

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ABSTRACT

The study was conducted to determine the yield and economic consequences of two cropping patterns viz. improved cropping pattern (Radish-Potato/Maize-T. Aman rice) and farmers' pattern (Potato/Maize-T. Aman rice) through incorporation of modern high yielding varieties and improved management practices for crop production. The experiment was laid out in randomized complete block design with six dispersed replications in farmers' field condition in Domar, Nilphamari in three consecutive years 2009-12. Three years mean data showed that the improved management practices for the pattern provided significantly higher yield in improved pattern. The gross return (Tk. 4,32,990/ha) and net return (Tk. 1,98,324/ha) of improved pattern were 33.56 % and 24.93 % higher, respectively compared to that of farmers' pattern with 45.44% extra cost. The higher marginal benefit cost ratio, land use efficiency and production efficiency indicated the superiority of the improved pattern over the farmers' practices.

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I. Introduction

Bangladesh is an agriculture dependent country. Agriculture is the single most important sector of the economy in Bangladesh. More than 70 % people in the rural areas directly or indirectly are involved with agriculture (BBS, 2011 and MoEF, 2012).Bangladesh is predominantly a rice growing country and rice is the staple food. Rice occupies about 80 % of the total cropped area and is cultivated in three seasons a year. Rice as monoculture increasing staple food security but creates many problem. As a

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result, agriculture sector has been facing a number of problems like reduction of soil fertility, pests and diseases outbreaks in the crop fields and decline in water table etc. In addition, rice monoculture also reduces production of non-rice crops, erodes biodiversity, creates nutritional imbalance (Hussain et al, 2001). Rice monoculture has also made the farming activities complex and costly. Finally, it reduces farmers' net margin. Although Bangladesh is nearly self-sufficient in rice production, other foods such as wheat, vegetables, pulses, oil crops etc. are still deficit to a large extent. Even rice food security has not been achieved at the household level in many poor and extreme poor farm families. Crop diversification, increasing cropping intensity, raising the productivity of land and labor will eliminate food and nutritional insecurity and poverty of farming community in future. More than 95% of 9.11 million hectares of net cultivable area is now under cultivation (Alam *et al*., 1998). Rise the production level is essential for huge population of our own. Diversification and intensification of crop with modern production technology and supplemental input is indispensable in respect present situation. Most areas of Bangladesh at present under two crops based cropping pattern, but there prerequisite to increase crop number to meet up the demand. A number of reports on different cropping pattern are available in Bangladesh and abroad (Azad *et al*., 1982; Soni and Kaur, 1984; Malavia *et al*., 1986; Khan *et al*., 2005; Khan *et al*., 2006 and Nazrul *et al*., 2013) where an additional crop could be introduced without much changes or replacing the existing ones for considerable increase of the overall productivity as well as profitability of the farmers. Keeping these views in mind, the present study was designed to introduce radish in the fallow period, early potato varieties Granula instead of Diamant and alternate modern rice varieties like BINA dhan-7 instead of BR-11 for T. Aman rice.

II. Materials and Methods

The experiment was conducted at the farmers' field condition in Rangpur at Multi Location Testing (MLT) site, Domar, Nilphamari, belongs to Tista Meander Floodplain under the Agro-Ecological Zone (AEZ-03) of Bangladesh, in three consecutive years 2009-10, 2010-11, and 2011-12.The study was conducted to determine the economic consequences of two cropping patterns viz., ICP: Improved Cropping Pattern (Radish-Potato/Maize-T. Aman) and FECP: Farmers' Existing Cropping Pattern (Potato/Maize-T. Aman) through inclusion of radish crop along with high yielding varieties (HYV) of rice crops early variety of potato and improved management practices for crop production. Initial soil nutrient status, temperature and rainfall in Domar, Nilphamari during cropping season (2009-12) are presented in Table 01 and Figure 01, respectively. The soil was sandy loam with medium organic matter content (2.11%) and soil pH ranged 5.65-5.69. The status of N, P, K, S, B, and Zn were Low, very high, medium low, low, medium and medium, respectively. Bangladesh has tropical monsoon climate with unimodal rainfall pattern throughout the year (Ahasan, *et al*., 2010). The highest amount of country's average monthly rainfall occurs in June followed by May and September and lowest amount of rainfall occurs in January followed by that of December and February. In Nilphamari, the highest amount of average monthly rainfall occurs in June followed by that of August, July, and May, whereas lowest amount of rainfall occurs in November followed by that of December and January. Rainfall increases gradually from the month of January to June and then decreases. Annual total rainfall was 831mm, 2001mm and 852mm respectively during the period 2009- 2012. Average maximum and minimum temperature were 30.54 and 20.93^{0}C, respectively (Figure 01).

The experimental design was randomized complete block with six dispersed replications. Two plots of 660 m^2 were selected for each replication. One plot was under the improved cropping pattern and the other was farmer's pattern. In the improved pattern, the radish variety Rocky-40 was introduced against fallow period. The alternate modern potato variety Granula and Aman rice variety BINA dhan-7 instead of Diamant and BR-11 for Potato and T. Aman rice, respectively, were used in the improved cropping pattern. The agronomic management and cultural practices for crop production under improved and farmer's practices are presented in Table 02. All field operation and management practices of both farmer's and improved pattern were closely monitored and all the necessary data were recorded for agro-economic analysis. The mean data of yield were analyzed by using MS Excel software.

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Agronomic performance like field duration, land use efficiency, production efficiency and rice equivalent yield of cropping patterns were calculated by the following formula:

Land use efficiency: Land use efficiency is worked out by taking total duration of individual crop in a sequence divided by 365 days (Tomer and Tiwari, 1990). It is calculated by following formula.

$$\text{Land use efficiency} = \frac{d_1 + d_2 + d_3 + d_4}{365} \times 100$$

Where,

d1, d2, d3 and d_4 the duration of first, second, third and fourth crop of the pattern.

Production efficiency: Production efficiency values in terms of kg/ha/day were calculated by total production in a cropping sequence divided by total duration of crops in that sequence (Tomer and Tiwari, 1990).

$$\text{Production efficiency} = \frac{Y_1 + Y_2 + Y_3 + Y_4}{d_1 + d_2 + d_3 + d_4}$$

Where,

Y_1: Yield of 1st crop d_1= Duration of 1st crop of the pattern
Y_2: Yield of 2nd crop d_2= Duration of 2nd crop of the pattern
Y_3: Yield of 3rd crop d_3= Duration of 3rd crop of the pattern
Y_4: Yield of 4th crop d_4= Duration of 4th crop of the pattern

Table 01. Soil nutrient status of the experimental area (AEZ-3) of Domar, Nilphamari during 2009-12

Parameters	OM (%)	pH	Total N (%)	K(meq/100 g of soil)	P	S	Zn	B
					(µg/g soil)			
Range	1.99-2.23	5.65-5.69	0.10-0.12	0.21-0.48	54.98-99.14	5.08-14.84	0.75-0.99	0.21-0.34
Average	2.11	5.67	0.11	0.35	77.06	9.96	0.87	0.28
Critical limit	-	-	0.12	0.12	10.00	10.00	0.6	0.2
Interpretation	Medium	Slightly alkaline	Low	Medium low	Very High	Low	Medium	Medium

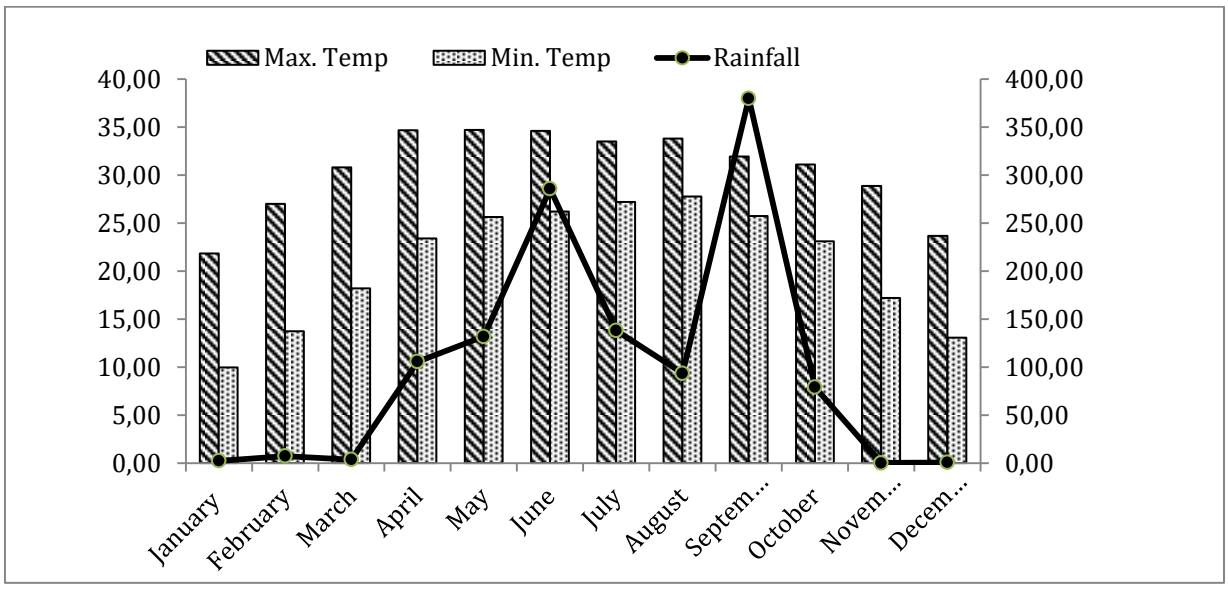

Figure 01. Average maximum temperature, minimum temperature and annual rainfall during the cropping seasons 2009-12.

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Rice equivalent yield (REY): For comparison between crop sequences, the yield of all crops was converted into rice equivalent yield on the basis of prevailing market price of individual crop (Verma and Modgal, 1983). The economic indices like gross and net returns and benefit cost ratio were also calculated on the basis of prevailing market price of the inputs and outputs (produces).

III. Results and Discussion

Yield of the Cropping Patterns

Results of the study have been presented in Table 02-05. It was revealed that the entire component crops of Radish-Potato/Maize-T. Aman rice cropping pattern under improved practices (IP) gave higher yield as well as by-product in consecutive three years (Table 03). The yield of improved pattern was higher due to change of variety with improved production technologies for the component crops. Highest Radish yield was recorded during 2009-10 (39.66 tha^{-1}) and lowest was in 2010-11 (37.50 tha^{-1}) and average yield was 38.55 tha^{-1}. Average Potato yield in improved pattern (28.30 tha^{-1}) was higher than farmers practice (23.67 tha^{-1}) due to improve management practices and optimum dose of Potato fertilizer. Average Maize yield of NK-40 variety was recorded and 7.87 tha^{-1} and7.93 tha^{-1}respectively in farmers practice and in improved pattern. Average yield of Aman rice was varied in both patterns and higher yield was recorded in farmers practice (4.20 tha^{-1}) over improved (3.57 tha^{-1}) due to long duration variety BR-11. Similar results were also obtained by Nazrul *et al.* (2013), Khan *et al.* (2006), Khan *et al.* (2005) and Hossain and Wahhab (1992). In both years, farmers' pattern gave lower grain yield of rice due to imbalance use of fertilizers and more population.

By-product Yield of the Cropping Patterns

From biomass yield by-product yield was counted. In improved cropping pattern by product yield was (13.8 tha^{-1}) and in the farmers practice it was (13.8 tha^{-1}).

Field Duration

Duration of crop in field denotes field duration of the particular crop. Total crop duration in improved cropping pattern was longer than farmers' cropping pattern due to three crops in existing pattern whereas in improved four crops were grown (Table 02). As a result, production efficiency and land use efficiency were higher in improved pattern than farmers' pattern.

Rice equivalent yield

Rice equivalent yield (REY) was recorded in both cropping pattern and higher mean REY was recorded in the improved cropping pattern (25.47) over the farmers pattern (19.07) (Table 4). Inclusion of extra one crop and improvement of management practices in the improved pattern increased the rice equivalent yield (25.47 tha^{-1}). Lower rice equivalent yield was obtained in the farmers' pattern (19.07tha^{-1}) due to variety and traditional management practices.

Production efficiency

Production efficiency indices per unit production in the cropping period. Maximum production efficiency (228.24) in terms of kg/ha/day was obtained from improved pattern in 2009-10 closely followed by improved pattern (226.89) in 2011-12 (Table 04). The higher production efficiency of improved cropping pattern might be due to the modern varieties and management practices. The lowest production efficiency was observed in farmers' pattern due to modern management practices was absent. Mean production efficiency (225.61) in terms of kg/ha/day was higher in improved pattern and lower (118.73) in farmers' pattern. Similar trend were noted by Nazrul *et al.* (2013), Khan *et al.* (2006), Khan *et al.* (2005) and Krishna and Reddy (1997).

Land use efficiency

Effective land use in a cropping year throughout the cropping season indicates the land use efficiency in a cropping year. Mean land use efficiency indicated that farmers' pattern used the land for 91.69 % period of the year, whereas improved pattern used the land for 95.34% period of the year (Table 4).

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The improved cropping pattern leads to higher land use efficiency due to longer period field occupied by the crops (348 days), whereas the farmers practice occupied the field for 334 days of the year.

Table 02. Agronomic parameters considered in Radish-Potato/Maize-T. Aman and Potato/Maize-T. Aman cropping pattern at Ulipur, Kurigram, during 2009-12

Parameters	C1= Fallow/ Radish C2= Potato C3=Maize C4= T. Aman	Farmers Pattern (FP)			Improved Pattern (IP)		
		2009-10	2010-11	2011-12	2009-10	2010-11	2011-12
Variety	C1	Fallow	Fallow	Fallow	Rocky-40	Rocky-40	Rocky-40
	C2	Diamant	Diamant	Diamant	Granula	Granula	Granula
	C3	NK-40	NK-40	NK-40	NK-40	NK-40	NK-40
	C4	BR-11	BR-11	BR-11	BINA dhan-7	BINA dhan-7	BINA dhan-7
Sowing/ Transplanting date	C1	-	-	-	14-16 Oct, 2009	09-12 Oct, 2010	10-12 Oct, 2011
	C2	23-25 Nov, 2009	21-24 Nov, 2010	24-26 Nov, 2011	18-22 Nov, 2009	16-19 Nov, 2010	15-20 Nov, 2011
	C3	24-25 Dec, 2009	24-27 Dec, 2010	25-27 Dec, 2011	10-12 Jan, 2010	08-10 Jan, 2011	05-07 Jan, 2012
	C4	25-27 July, 2010	24-26 July, 2011	26-28 July, 2012	13-16 July, 2010	12-14 July, 2011	3-5July, 2012
Seed rate (Kg ha^{-1})	C1	-	-	-	2.5-3.0	2.5-3.0	2.5-3.0
	C2	1000	1000	1000	1500	1500	1500
	C3				25-30	25-30	25-30
	C4						
Planting Method	C1	-	-	-	Broadcast	Broadcast	Broadcast
	C2	Line sowing	Line sowing	Line sowing	Line sowing	Line sowing	Line sowing
	C3	Line sowing	Line sowing	Line sowing	Line sowing	Line sowing	Line sowing
	C4	Line sowing	Line sowing	Line sowing	Line sowing	Line sowing	Line sowing
Spacing (cm) (Row x Hill)	C1	-	-	-	Broadcast	Broadcast	Broadcast
	C2	60 cm × 25 cm	60 cm × 25 cm	60 cm × 25 cm	60 cm × 25 cm	60 cm × 25 cm	60 cm × 25 cm
	C3	75 cm x25 cm	75 cm x25 cm	75 cm x25 cm	75 cm x25 cm	75 cm x25 cm	75 cm x25 cm
	C4	25 cm x15 cm	25 cm x15 cm	25 cm x15 cm	25 cm x15 cm	25 cm x15 cm	25 cm x15 cm
Seedling age (days)	C1	-	-	-	-	-	-
	C2	-	-	-	-	-	-
	C3	-	-	-	-	-	-
	C4	45 days	45 days	45 days	25 days	25 days	25 days
Seedlings (no. hill^{-1})	C1	-	-	-	-	-	-
	C2	-	-	-	-	-	-
	C3	-	-	-	-	-	-
	C4	3	3	3	3	3	3
Fertilizer dose (Kg ha^{-1}) (N-P-K-S-Zn-B)	C1	-	-	-	172.81-45-112.5-16-0-1.73	172.81-45-112.5-16-0-1.73	172.81-45-112.5-16-0-1.73
	C2	140-30-90-10			115.2-25-75-8-2.87-2.04-10 f-10t	115.2-25-75-8-2.87-2.04-10 f-10t	115.2-25-75-8-2.87-2.04-10 f-10t
	C3	200-45-90-30-4-1			230.41-42-80-27.2-3.58-1.2	230.41-42-80-27.2-3.58-1.2	230.41-42-80-27.2-3.58-1.2
	C4	100-0-0-15-0-0			114-35-80-22-0-0	114-35-80-22-0-0	114-35-80-22-0-0
Fertilizer application method	C1				All PSB & half of N and K as basal and rest at	All PSB & half of N and K as basal and	All PSB & half of N and K as basal and rest at 25

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Parameters	C1= Fallow/ Radish C2= Potato C3=Maize C4= T. Aman	Farmers Pattern (FP)			Improved Pattern (IP)		
		2009-10	2010-11	2011-12	2009-10	2010-11	2011-12
	C2	All PKSZn & N as basal and rest N at 25 and 45DAP	All PKSZn & N as basal and rest N at 25 and 45DAP	All PKSZn & N as basal and rest N at 25 and 45DAP	25 and 35DAP All PKSZn & N as basal and rest N at 25 and 45DAP	rest at 25 and 35DAP All PKSZn & N as basal and rest N at 25 and 45DAP	and 35DAP All PKSZn & N as basal and rest N at 25 and 45DAP
	C3						
	C4	All PKS basal & N in equal splits at 20 and 45DAP	All PKS basal & N in equal splits at 20 and 45DAP	All PKS basal & N in equal splits at 20 and 45DAP	All PKS basal & N in equal splits at 20 and 45DAP	All PKS basal & N in equal splits at 20 and 45DAP	All PKS basal & N in equal splits at 20 and 45DAP
Weeding (no.)	C1	-	-	-	2	2	2
	C2	1	1	1	1	1	1
	C3	1	1	1	1	1	1
	C4	1	1	1	1	1	1
Weeding time AT (after top dress)	C1						
	C2	1	1	1	1	1	1
	C3	1	1	1	1	1	1
	C4	1	1	1	1	1	1
Irrigation/ Rainfed	C1				2	2	2
	C2	2	2	2	2	2	2
	C3	3	3	3	3	3	3
	C4	1	1	1	1	1	1
Insect-pest control	C1				C	C	
	C2	Chemical	Chemical	Chemical	IPM	IPM	
	C3	Chemical	Chemical	Chemical	IPM	IPM	
	C4	Chemical	Chemical	Chemical	Chemical	Chemical	
Harvest time (date)	C1	_	_	_	21-24 Nov, 2009	23-25 Nov, 2010	22-23 Nov, 2011
	C2	09-12Feb, 2010	10-11Feb, 2011	12-14 Feb, 2012	09-11 Feb, 2010	05-08 Feb, 2011	03-07 Feb, 2012
	C3	26-29 May, 2010	23-27 May, 2011	28-30 May, 2012	05-07 June, 2010	04-07 June, 2011	06-09 June, 2012
	C4	07-09 Nov.10	12-14 Nov.11	13-16 Nov.	06-11 Oct, 2010	04-07 Oct, 2011	07-10 Oct, 2012
Field duration (days)	C1				37	43	42
	C2	76	79	78	81	79	78
	C3	152	149	153	145	146	142
	C4	102	108	107	83	82	87

Table 03. Productivity of Radish-Potato/Maize-T. Aman and Potato/Maize-T. Aman cropping pattern

Year	Cropping pattern	Tuber/Grain yield (tha^{-1})				Straw yield (tha^{-1})			
		Radish	Potato	Maize	T. Aman	Radish	Potato	Maize	T. Aman
2009-10	FP		23.00	7.6	4.7	-	-	9.4	5.1
	IP	39.66	27.50	7.8	4.01	-	-	9.6	4.8
2010-11	FP		24.00	7.8	3.8	-	-	8.5	4.3
	IP	37.50	28.80	8.1	3.2	-	-	9.2	3.7
2011-12	FP		24.00	8.2	4.1	-	-	9.4	4.7
	IP	38.50	28.60	7.9	3.5	-	-	8.5	4.1
Mean	FP		23.67	7.87	4.20	-	-	9.1	4.7
	IP	38.55	28.30	7.93	3.57	0.36	0.25-	9.3	4.2

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Table 04. Rice-equivalent yield, production efficiency and land use efficiency of farmers' and improved cropping pattern

Year	Cropping pattern	Rice equivalent yield (t ha^{-1})	Production efficiency Kg. $ha^{-1}day^{-1}$	Land use efficiency (%)
2009-10	FP	19.16	119.09	90.41
	IP	25.67	228.24	94.79
2010-11	FP	18.69	117.86	92.05
	IP	25.22	221.71	95.89
2011-12	FP	19.36	119.23	92.60
	IP	25.52	226.89	95.62
Mean	FP	19.07	118.73	91.69
	IP	25.47	225.61	95.34

Yield, cost and return of alternate pattern (Radish-Potato/Maize-T. Aman) and existing pattern (Radish/Maize-T. Aman rice) are shown in Table 05. Gross return and gross margin of improved pattern were Tk. 4,32,990 $ha^{-1}$and Tk. 1,98,324 ha^{-1}whereas in existing pattern these were Tk. 3,24,190 $ha^{-1}$and Tk. 1,36,357 ha^{-1}, respectively. As a result, gross return was higher by Tk. 1,08,800 ha^{-1} and gross margin was higher by Tk. 61,967 ha^{-1} in improved pattern over existing pattern (Table 02).

Table 05. Cost benefit analysis of Radish-Potato/Maize-T. Aman and Potato/Maize-T. Aman rice cropping pattern

Year	Cropping pattern	Gross Return (Tk. ha^{-1})	Total variable cost (Tk. ha^{-1})	Gross margin (Tk. ha^{-1})	MBCR
2009-10	FP	325720	182501	143219	1.78
	IP	436390	226096	210294	1.93
2010-11	FP	317730	193800	123930	1.64
	IP	428740	244200	184540	1.76
2011-12	FP	329120	187200	141920	1.76
	IP	433840	233700	200140	1.86
Mean	FP	324190	187833	136357	1.73
	IP	432990	234666	198324	1.85

Cost benefit analysis

Cost and return analysis done based on prevailing market price during the crop Season. Improved cropping pattern showed its superiority over farmers' pattern during three consecutive years. On an average, gross return of the improved pattern was Tk.4,32,990 ha^{-1} which was more than 33.56% higher than farmers' pattern of TK. 3,24,190 ha^{-1} (Table 5). The production cost of the improved pattern (Tk. 2,34,666 ha^{-1}) was higher than farmers' pattern (Tk.187833 ha^{-1}) due to labour intensive, cost of fertilizer and other inputs. The net return was substantially higher in the improved pattern (Tk.1,98,324 ha^{-1}) than farmers' pattern (Tk. 1,36,357 ha^{-1}). The higher net return of the improved pattern was achieved mainly higher yield advantages of the component crops. In the improved pattern 24.93 % additional net return was achieved by adding 45.44 % additional cost. Marginal benefit cost ratio for both patterns was counted and comparatively higher performance was find out in improved cropping pattern over the farmers existing.

IV. Conclusion

Considering higher rice-equivalent yield, net monetary return and more sustainability of the improved cropping pattern (Radish-Potato/Maize-T. Aman Rice) with additional crop in improved technologies could be suggested for medium high land of the Teesta Meander Floodplain Agro-ecological Zone (AEZ-

3) of Bangladesh. Therefore, four crops based cropping pattern *viz*., Radish-Potato/Maize- T. Aman Rice are suitable for the light textured soil of Domar, Nilphamari. Radish-Potato/Maize- T. Aman Rice can be recommended for the region, especially for the marginal farmers.

V. References

[1]. Alam, Q. M., Nazrul Islam, M., Haque, A. K. M. H. & Kundu, T.K. (1998). Economic Profitability of growing mustard/potato as an additional crop between two rice crops in Bogra district of Bangladesh. *Bangladesh Journal of Agricultural Research*, 23(4), 717-730.

[2]. Azad, A. K., Talukder, F. A. H., Wahhab, M. A. & Khan, M. A. (1982). Progress and prospect of jute based cropping systems research in Bangladesh. Proc. Expert Cons. Jute and Kenaf Improvement: pp. 244-267.

[3]. BBS (2011). 2011 Y*earbook of agricultural statistics of Bangladesh*. Dhaka: Bangladesh Bureau of Statistics, Statistics Division, Ministry of Planning, Government of the People's Republic of Bangladesh.

[4]. Hossain, M. A. & Wahhab, M. A. (1992). Demonstration-cum-assessment of recommended and farmers technologies in jute cultivation. Abs. of Research. Agril. Res. On Jute, Bangladesh Jute Research Institute. p. 250.

[5]. Hussain, A. M. M., Hossain, M. & Janaiah, A. (2001). Hybrid rice adoption in Bangladesh: Socio-economic assessment of farmers' experiences. *BRAC Research Monograph* Series No. 18. BRAC, Dhaka, Bangladesh.

[6]. Khan, M. A. H., Quayyum, M. A., Nazrul, M. I., Sultana, N. & Mollah, M. R. A. (2005). On-Farm evaluation of production potential and economics mustard-rice based improved cropping system. *Bangladesh J. Socio. Res. Dev.* 2(1), 37-42.

[7]. Khan, M. A., Hossain, S. M. A. & Khan, M. A. H. (2006). A study on some selected jute based cropping patterns at Kishoregonj. *Bangladesh Journal of Agricultural Research*, 31(1), 85-95.

[8]. Krishna, A. & Anand Reddy, K. (1997). Production potential and economics of different rice (*Oryza sativa*) based cropping systems in Andhra Pradesh. *Indian Journal of Agricultural Science*, 67(12), 551-553.

[9]. Malavia, D. D., Singh, M. P., Vyas, M. N., Patel, J. C. & Kalaria, K. K. (1986). Production potential and economic feasibility of different crop sequences. *Indian Journal of Agronomy*, 31(1), 75-78.

[10]. MoEF. (2012). Rio + 20: National Report on sustainable development. Dhaka: Ministry of Environment and Forest, Government of the Peoples' Republic of Bangladesh.

[11]. Nazrul, M. I., Shaheb, M. R., Khan, M. A. H. & Khan, A. S. M. M. R. (2013). On-Farm evaluation of production potential and economic returns of potato-rice based improved cropping system. *Bangladesh Agronomy Journal*, 16(2), 41-50.

[12]. Soni, P. N. & Rajinder, K. (1984). Studies on production potential of different cropping systems. *Indian Journal of Agronomy*, 29(3), 367-378.

[13]. Tomer, S. S. & Tiwari, A. S. (1990). Production potential and economics of different crop sequences. *Indian Journal of Agronomy,* 35(1&2), 30-35.

[14]. Verma, S. P. & Modgal, S. C. (1983). Production potential and economics of fertilizer application as resources constraints in maize, wheat crop sequence. *Himachal Journal of Agricultural Research*, 9(2), 89-92.

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