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COMPARATIVE ECONOMIC PROFITABILITY OF MV T. AUS RICE (*Oriza sativa* L.) CULTIVATION UNDER DIFFERENT CROP MANAGEMENT PRACTICES IN SOME SELECTED AREAS OF CHUADANGA DISTRICT

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Abstract

A study was conducted to estimate the productivity gap in MV T.Aus rice between potential farm and actual farm as well as examine the factors responsible for MV T.Aus rice yield gaps in Chuadanga. In the Aus season, 80 demonstration plots managed by Department of Agriculture Extension and 80 farmers' managed plots were selected from four villages of Chuadanga sadar upazila. Data were collected in two phases using structured questionnaire. Both tabular and statistical techniques were employed for analyzing the data. The analysis has further been extended to estimate the contribution of individual technical factors to the yield and the input-output relations. The average yield of MV Aus rice were 2.84 t/ha and 3.31 t/ha in the farmers' plots and demonstration plots, respectively, indicating 17% yield gain in the demonstration plots. The production cost per hectare on full cost and cash cost basis were 16 and 1% higher, respectively, in the demonstration plots than that in the farmers' plots. But the unit cost of production on full cost and cash cost basis were lower 0.60 and 15%, respectively, in the demonstration plots than that in the farmers' plots. The benefit cost ratio (BCR) was also higher on full cost and cash cost basis in the demonstration plots compared to farmers' plot. Analysis further indicated that there is ample scope of increasing modern Aus yield by 0.29 t/ha through adopting appropriate variety, timely sowing and proper irrigation as well as weeding at the farm level.

Keywords: Economic profitability, MV T. Aus rice, crop management.

Introduction

Bangladesh has a land area of more than 14 million hectares and total cultivable land is about 9.10 million hectares (BBS, 2010). More than 80% of the cultivable areas have been devoted to rice production in different agro-ecological zones. Rice is the staple food grain growing in three distinct seasons, namely: Boro (16th November to 15th April), Aman (June to 16th November), and Aus (16th April to August) accounting for 56, 38, and 6%, respectively, of the rice production. About 10 and 14 percent area of the total rice cropped and net cropped area, respectively, is under Aus rice cultivation in Bangladesh (BBS, 2011).

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The population of Bangladesh having already doubled from 75 million in 1970 to 146 million in 2010 (Bangladesh Economic Review, 2010) and which will further increase to about 223 million in 2030 requiring correspondingly 48 million tons of rice (Bhuiyan *et al*, 2002). Rice and wheat all together occupied over 88% of the total cropped area (BBS, 2009). HYV rice crops need new crop technology and more inputs to increase the productivity under the changing climate situations.

The drought prone areas are considered to be the problematic areas. It is presumed that crops can be raised successfully in these areas by providing due attention to new crop technologies. Chuadanga is a drought prone district of Bangladesh where Aus rice appeared to be an ideal crop in Kharif-I season. The newly evolved technology for growing Aus rice in drought prone areas do not reach properly to the farmers. Sometimes, the farmers in Bangladesh do not adopt those appropriate technologies due to their unawareness causing yield gap between the farmers' field and demonstration fields. There exists a big yield gap between the new technology and partial adoption as well as existing technology (Suryawanshi and N.S. Gaikward, 1984). It was also found that the yield of MV Aus rice could be increased by three folds if the new technologies disseminated in the drought prone areas (Quayum *et al.,* 1995).

The concept of yield gap originated from the constraints studies carried out by IRRI during 1970s which make quantitative differences between the potential yields and actual farm yield (Gomez *et al.,* 1979). Considering the farm level maximum and minimum yield, the rice yield gap is estimated at 1.44 t/ha or about 40% of the maximum yield (Alam and Hossain, 1998).

Thus a considerable gap between awareness and adoption of new technology has been observed at the farm level due to many reasons. As a result, there exists a gap between the potential yield and actual yield of MV T.Aus rice in Bangladesh. The study on estimation of aus rice yield gap was very scanty. Therefore, an attempt has been undertaken to estimate the yield gap in MV T.Aus rice and to find out the reasons of existing yield gaps in modern Aus (MV) rice at the farm level.

Specific Objectives

i) to estimate the productivity and profitability gap as well as input use differences in MV T.Aus rice between demonstration and farmers' plots.

ii) to examine the contribution of factors responsible for MV T.Aus rice yield gaps and assess farmers' choice/preferences towards selecting modern Aus variety, and

iii) to provide estimates on T.Aus yield loss as a vital factor of yield differentials at the farm level.

Methodology

The study is based on the farm level information obtained through sample survey of 160 farmers under 4 villages named Khajura, Sangkarchandra, Hatikata, and Belapara under Chuadanga sadar upazila of Chuadanga district during 2010-11. Data were collected in two phases: crop cut data was collected before harvesting the MV Aus rice crop and the other information were collected during the growing period using pre-designed questionnaire. After collecting data, it was checked and edited properly. The Department of Agricultural Extension (DAE) had conducted demonstration on different farms under Chuadanga Sadar. In the Aus season, 80 demonstration plots and 80 farmers' plots were randomly selected from those villages. All of the four varieties, such as BRRI dhan 28, BR 26, Purbachi, and Swarna were grown in both the farmers' plots and demonstrations' plots. Swarna was undertaken due to widely adopted by the farmers in the study areas. Data on yield, seed rate, fertilizer, labour use, price of different inputs, etc. were collected through interviewing the farmers. The collected data were coded, computed and tabulated and then analyzed for achieving the specified objectives of the study. Both tabular and statistical techniques were used for analyzing the data. In addition, partial budgeting analysis was done to determine the profitability gap.

The difference between the yield of demonstration plots and farmers' plots have been estimated as they provide the measures of yield gap due to technological and other factors. The analysis has been extended further to estimate the contribution of individual technical factors to the yield and the output input relations on the following lines:

Contribution of technical factors

Based on the technical factors adopted in the demonstration and farmers' plots during the period, different treatments have been devised to estimate the contribution of individual treatment factors. All the farmers were grouped into different treatments. Description of the treatments was given below:

V_1=	Improved variety (BRRI dhan 28, BR 26 and Purbachi) recommended in Bangladesh	F_1=	Recommended fertilizer rate
V_0 =	Introduced Improved variety Swarna (Indian variety)	F_0 =	Fertilizer rate other than recommended
S_1 =	Timely sowing (before 10 th June)	I_1 =	Inter cultural operations (two to three weeding after planting)
S_0 =	Late sowing (after 10 th June)	I_0 =	Less than two weeding after seeding
R_1=	Recommended seed rate (146-150 kg/ha)	M_1 =	Farmers used power tiller and tractor
R_0 =	Seed rate other than the recommended rate	M_0 =	Farmers not used power tiller and tractor

The different treatment combinations observed are as follows:

$T_1 = V_1S_1R_1F_1M_1I_1$ $T_{10} = V_0S_0R_1F_1M_1I_1$

$T_2 = V_1 S_1R_1F_1M_1I_0$ $T_{11} = V_0S_1R_0F_1M_1I_1$

$T_3 = V_1S_1R_1F_1M_0I_0$ $T_{12} = V_0S_1R_0F_0M_1I_1$

$T_4 = V_1S_1R_1F_0M_0I_0$ $T_{13} = V_1S_1R_0F_0M_0I_1$

$T_5 = V_1S_1R_0F_0M_0I_0$ $T_{14} = V_1S_0R_1F_0M_1I_1$

$T_6 = V_1S_0R_0F_0M_0I_0$ $T_{15} = V_1S_0R_1F_0M_0I_1$

$T_7 = V_0S_0R_0F_0M_0I_1$ $T_{16} = V_1S_0R_1F_0M_0I_0$

$T_8 = V_0S_0R_0F_0M_1I_1$ $T_{17} = V_1S_0R_1F_1M_0I_0$

$T_9 = V_0S_0R_0F_1M_1I_1$ $T_{18} = V_0S_1R_0F_1M_1I_0$

The differentials obtained between the yields of different treatment combinations are attributed as the contribution of the technical factors concerned.

Results and Discussion

Socio economic profile

The average family size of both farmers' plot and demonstration plot was same (Table 1). The percentage of illiterate person was higher among non-participant farmers compared to participant farmers and these were 39 and 20 percent, respectively. The average total owned land and total cultivated land were found higher under demonstration plot than those of farmer's plot in the study area. The average total owned land and operated/cultivated land were 1.08 and 0.99 ha under farmers' plots, while under demonstration plots these figures were 1.15 and 1.10 ha, respectively. This indicated that the farmers of both the groups rented out their some of lands. The sources of income of the farmers of both the categories of farms were mainly agriculture, business, and service. About 83 and 81 percent income was obtained from agriculture under farmers' plots and demonstration plots, respectively. Seventy six and 74 percent area of the total area of farmers' plots and demonstrations' plots were found under medium high land covering sandy loam soil (30-33%). The seed quality reported by the farmers' were more or less same for both the farmers' plots and demonstration plots. The sources of irrigation were shallow tubewell (STW) and low lift pump (LLP) where 94 and 96 percent farmers under farmers' plots and demonstration plots irrigated their land in Aus rice .

Table 1. Socio-economic profile and agronomic characteristics of the farmers in the study areas.

Items	Farmer's plot	Demonstrated plot
Socio-economic		
Family size	6	6
Adult male	2	3
Adult female	2	2
Children	2	2
Illiterate (%)	39	20
Farm size (ha)		
Average owned land (ha)	1.08	1.15
Average total cultivated/operated land (ha)	0.99	1.10
Total area of farmers survey plot (ha)	31.08	32.40
Sources of income (%)		
Agriculture	83	81
Business	10	12
Service	4	5
Laborer	3	2
Land type (% of area)		
High land	13	14
Medium high land	76	74
Medium low land	1	2
Soil type (% of area)		
Sandy	1	1
Sandy loam	33	30
Loamy	24	28
Clay loam	22	21
Clay	20	20
Quality of seed reported (% of farms)		
Good	97	98
Average	3	2
Sources of irrigation (% of farms)		
Shallow tubewell (STW)	94	96
Low lift pump (LLP)	6	4

Inputs utilization pattern

The total human required for T.Aus rice cultivation was higher (164 man-days/ha) in the demonstration plots than that in the farmers plot (142 man-days/ha) (Table 2). Use of bullock power and power tiller were also higher in the

demonstration plots than those of farmers' plots. The seeds used much higher rate in the farmers' plots compared to demonstration plots. In the demonstration plots, farmers used recommended seed rate (25 kg/ha) and fertilizers (urea 148, TSP 99, MP 69, Gypsum 59, and ZnSo4 10 kg/ha) but in farmers' plots also higher urea (322 kg/ha) fertilizer was used. Other fertilizer was used much less than the demonstration plots.

Table 2. Per hectare inputs used for MV T.Aus rice production in the farmers plot and demonstration plot at the study area.

Inputs used	Farmer's plot	Demonstrated plot	Difference (F-D) (%)
Labor (mandays/ha):	142	164	-15
Family	89	126	-42
Hired	53	38	28
Bullock power (hr/ha):	11	14	-27
Family	5	6	-20
Hired	6	8	-33
Power tiller (hr/ha):	14	22	-57
Owned	2	9	-350
Hired	12	13	-8
Seeds (kg/ha):	40	25	38
Owned	40	25	38
Purchased	-	-	-
Fertilizer (kg/ha):	322	385	-20
Urea	160	148	8
TSP	67	99	-48
MP	38	69	-82
Gypsum	19	59	-211
ZnSo4	2	10	-400

Cost and return

The average human labour cost were found Tk.25,560/ha and Tk.29,848/ha, respectively, in the farmers' plots and demonstration plots indicating 17 percent higher cost in the demonstration plots compared to farmers' plots (Table 3). The cost of bullock power, power tiller, irrigation, and fertilizer were also found higher in the demonstration plots than that of farmers' plots and these costs were,

respectively, 25, 87, 45 and 26 percent higher in the demonstration plots compared to farmers' plots. But the seed cost was found 65 percent lower in the demonstration plots compared to farmers' plots. Farmers used higher doses of insecticides in their plots than the demonstration plots. The total cost for Aus rice cultivation in the farmers' plots were Tk.50,385/ha and Tk.24,985/ha, respectively, on full cost and cash cost basis, while in the demonstration plots, these cost were Tk.58,369/ha and Tk.24,669/ha, respectively. Therefore, the total cost for MV T.Aus rice cultivation was 16 percent higher in the demonstration plots due to land preparation, fertilizer, and irrigation cost compared to farmers' plots on full cost basis.

Table 3. Comparative cost (Tk/ha) of MV T.Aus rice cultivation in the farmers' plots and demonstration plots.

Items	Farmer's plot (n=80)	Demonstration plot (n=80)	Difference (F-D) (%)
Human labour cost	25560	29848	-17
Family	16020	22932	-43
Hired	9540	6916	28
Bullock power	1974	2466	-25
Family	718	948	-32
Hired	1256	1518	-21
Power tiller cost (Tk./ha)	1930	3610	-87
Owned	334	1232	-269
Hired	1596	2378	-49
Seeds cost	1498	518	65
Owned	1498	-	65
Purchased	-		-
Fertilizer cost	4713	6841	-45
Irrigation	4750	5992	-26
Insecticides	394	228	42
Interest @ 10% for 4 months	806	796	1
Land rent for the season	8760	8070	8
Total cost			
Full cost basis	50385	58369	-16
Cash cost basis	24985	24669	1

Yield gap between farmers' plots and demonstration plots

The yield gap of Aus rice was found out without considering the different treatment combinations. Participant farmers in the study area practiced recommended technology in demonstration plots of MV T.Aus rice monitored by the Department of Agricultural Extension (DAE). It was observed that there were some yield gaps between demonstration plots and farmers' plots. The yield of aus rice was 2.84 t/ha and 3.31 t/ha in the farmers' plots and demonstration plots indicating 17% yield gain in the demonstration plots (Table 4). The results indicated that there is a potentiality of increasing aus yield in the study area. It was also observed that the gross return was also higher in the demonstration plots compared to farmers' plots due to management practices.

Comparative profitability

The gross return of MV T.Aus rice cultivation in the farmers' plots and demonstration plots were Tk. 52075/ha and Tk. 61281/ha, respectively (Table 4) which showed 18% higher in the demonstration plots than those of farmers' plots. The total cost of cultivation (15%) involved higher to 16 % on full cost and 1% on cash cost basis. The net return on full cost basis was Tk.1690/ha and Tk. 2912/ha in the farmers' plots and demonstration plots, while on cash cost basis, these were Tk.27090/ha and Tk.36612/ha, respectively. Therefore, the net return on full cost and cash cost basis were 72 and 35% higher in the demonstration plots than that of farmers' plots. The benefit cost ratio (BCR) were also higher, 2 and 19%, respectively, on full cost and cash cost basis in the demonstration plots compared to farmers' plots resulting that the relative economic performance was better in the demonstration plots. On the other hand, the production cost per kg of paddy on both full cost and cash cost basis were lower in the demonstration plots than that in the farmers' plots. The cost benefit analysis indicated that the cultivation of MV T.Aus rice in the drought prone areas was more profitable under demonstration plots compared to farmers' plots.

Partial budgeting analysis

Partial budgeting analysis was used to confirm the profitability of growing MV T. Aus rice in the study areas. Farmers plots versus demonstration plots showed that MV T.Aus rice cultivation under demonstration plots was found more profitable of Tk.1222/ha (Table 5). If demonstration was not practiced then Tk. 61281/ha would be forgone as return, while farmers' practice was not done then the farmers had to forgo Tk.52075/ha only, which was lower than the amount of demonstration plots. On the other hand, if the demonstration was not practiced then the cost of Tk.58369/ha would be saved, but if the farmers practice was not done for MV T.Aus rice cultivation then the cost of Tk.50385/ha would be saved, which was lower than the demonstration one. Therefore, taking

Table 4. Comparative profitability in MV T.Aus rice production at the farmers' plots and Demonstration plots.

Items	Farmer's plot (n=80)	Demonstration plot (n=80)	Difference (F-D) (%)
Grain yield (t/ha)	2.84	3.31	-17
Price of grain yield (Tk/kg)	17.00	17.10	-0.60
Straw yield (t/ha)	2.53	3.12	-23
Gross return (Tk/ha)	52075	61281	-18
Total cost (Tk/ha)			
Full cost basis	50385	58369	-15
Cash cost basis	24985	24669	1
Net return (Tk/ha)			
Full cost basis	1690	2912	-72
Cash cost basis	27090	36612	-35
BCR			
Full cost basis	1.03	1.05	-2
Cash cost basis	2.08	2.48	-19
Unit cost of production (Tk/kg)			
Full cost basis	17.74	17.63	0.60
Cash cost basis	8.80	7.45	15

balance of payment, debit was higher than the credit and Tk.1222/ha was needed to make equal. Thus it was clear that MV T.Aus rice cultivation under demonstration plots was found more profitable. Negative sign meant profitable while positive sign meant loss.

Farmers' varietal preference

Farmers in the study area grew different varieties of MV T.Aus rice like BRRI dhan28, BR26, Purbachi, Swarna, etc. (Table 6). Among the varieties grown in the aus season, BRRI dhan28 was the most popular variety in the study areas. The farmers' choice regarding rice variety BRRI dhan28 due to better yield, taste and high market value was 62, 56, and 46%, respectively, in demonstration plots than the farmers' plots. Thirty percent farmers of farmers' plots and 27% farmers of demonstration plots preferred BR 26 due to higher yield. Twenty percent farmers of farmers' plots and 24% of demonstration plots' farmers preferred Swarna for its early maturing trait. On the other hand, rice variety Purbachi was also preferred by 65 and 68% farmers of farmers' and

demonstration plots respectively. Farmers were interested to grow short duration variety because they could grow T.Aman rice in time after harvesting aus rice.

Table 5. Partial budget, farmers' plots versus demonstration plot.

Debit (Tk/ha)		Credit (Tk/ha)	
Farmers plot		Demonstration plot	
1. Cost of farmers plot	50385	1. Return from farmers plot	52075
2. Revenue for gone for not practicing demonstration plot	61281	2. Cost saved for not practicing demonstration plot	58369
3. Profit/loss	- 1222		
	110444		110444

Yield loss for different stresses

There are many biotic and abiotic stresses in rice production. In the Aus season, weed is the most important factor causing yield loss followed by soil related stress (mainly organic matter deficiency) as shown in the Table 7. The total yield loss per hectare in affected area was 877 kg and 335 kg in the farmers' plots and demonstration plots, respectively. Among the yield loss, 42 and 22% were caused by birds and soil related stress, respectively, in the farmers' plots, while 36 and 33% yield loss in the demonstration plots. Weeds caused 12 and 7% yield loss in farmers' plot and demonstration plots in Aus rice in the study area. Drought also affected 11-13% yield loss in both the situations.

Table 6. Reasons for varietal choice for different MV Aus rice varieties as reported by the sample farmers in the study area.

Adopted aus variety	Stated reasons for choice	% of sample farmers reported	
		Farmer's plot	Demonstration plot
BRRI Dhan28	Better taste	40	56
	Higher yield	45	62
	High market value	5	46
	Less insects and disease attack	5	12
	Not lodging	5	6
	Fine grain	10	23
	Short duration	5	20
BR26	Better taste	5	4
	Higher yield	30	27
	High market value	3	7

Table 6. Cont'd.

	Less insects and disease attack	2	2
	Not lodging	6	5
	Fine grain	3	2
	Short duration	4	6
Swarna	Better taste	10	12
	Higher yield	5	10
	High market value	3	2
	Less insects and disease attack	6	7
	Not lodging	8	9
	Fine grain	10	14
	Short duration	20	24
Purbachi	Better taste	7	8
	Higher yield	2	3
	High market value	3	2
	Less insects and disease attack	24	30
	Not lodging	54	62
	Fine grain		
	Short duration	65	68

Contribution of factors responsible for yield differentials

The details of treatment combinations with yield and value of output of MV T.Aus rice have been shown in Table 8. It was observed that the treatment T_1 which was early sown gave the highest yield (2.56 t/ha) followed by the treatment T_{13} which yield was 2.54 t/ha. This result indicated that early/timely sowing with proper intercultural operations/weeding increased yield for growing MV T.Aus rice in the study area. Variety was also important factor to increase the yield. Only recommended variety was also found important factor to increase the yield of 0.19 t/ha with additional gross return of Tk.3240/ha (T_6-T_7). Seed and fertilizer rate other than the recommended rate including farmers not used power tiller and tractor ($R_0F_0M_0$) did not reflect yield. The yield of treatments T_7 and T_{18} was more or less same although T_7 was late sowing, while T_{18} early sowing. From these two treatments, it was clear that improper intercultural operations with non-recommended variety and seed rate did not increase yield. Therefore, the most important factors for increasing MV Aus rice were early/timely sowing, recommended variety, and intercultural operations together.

Table 7. Estimates of yield losses due to insect, disease and soil related stresses in MV Aus rice at Chuadanga study areas.

Stresses	Farmers' plot			Demonstration plot		
	% of area affected	Yield loss in affected area (kg/ha)	% share of the constraint to total loss	% of area affected	Yield loss in affected area (kg/ha)	% share of the constraint to total loss
Insect pests	6	28	3	2	5	1
Diseases	9	5	1	3	2	1
Birds	22	372	42	12	120	36
Weeds	49	107	12	14	25	7
Small rat	1	6	1	1	3	1
Big rat	3	57	6	4	15	4
Drought	5	93	11	6	45	13
Soil related stress (organic matter deficiency)	27	197	22	20	112	33
Sterility	12	14	2	4	8	2
Total	-	877	100	-	335	100

The computed contributions of individual factors under different conditions for MV T.Aus rice was presented in Table 9. It was seen that among all the technical factors, the contribution of the recommended seed rate was the highest followed by the recommended fertilizer rate. Keeping other technical factors constant, the yield 0.29 t/ha can be increased with additional gross return (Tk.4945/ha) by adopting recommended seed rate in MV T.Aus rice cultivation. The next important factor was the fertilizer, which showed direct relationship with the yield of both recommended as well as non-recommended variety (Swarna). Weeding in the Aus season also plays an important role and contributes to increase yield to the extent of 0.18 t/ha with additional gross return of Tk.3069/ha. The highest additional gross return (Tk. 5007/ha) was obtained using timely sowing with 2-3 weedings after planting. It was interesting to observe that effect of fertilizer would be negative using only recommended seed rate and variety. Early sowing or timely sowing with recommended fertilizer rate and power tiller use would also result negative additional gross return (Tk.2897/ha).

Table 8. Details of treatment combinations with yield and value of output of MV T.Aus rice at Chuadanga study site.

Treatment combinations	Yield (t/ha)	Sowing time	Value of output (Tk/ha)	Rank
$T_1 = V_1S_1R_1F_1M_1I_1$	2.56	E	43648	1
$T_2 = V_1S_1R_1F_1M_1I_0$	2.38	E	40579	3
$T_3 = V_1S_1R_1F_1M_0I_0$	2.21	E	37681	7
$T_4 = V_1S_1R_1F_0M_0I_0$	1.95	E	33248	10
$T_5 = V_1S_1R_0F_0M_0I_0$	1.66	E	28303	13
$T_6 = V_1S_0R_0F_0M_0I_0$	1.64	L	27962	14
$T_7 = V_0S_0R_0F_0M_0I_1$	1.45	L	24723	18
$T_8 = V_0S_0R_0F_0M_1I_1$	1.63	L	27792	16
$T_9 = V_0S_0R_0F_1M_1I_1$	1.80	L	30690	12
$T_{10} = V_0S_0R_1F_1M_1I_1$	2.06	L	35123	8
$T_{11} = V_0S_1R_0F_1M_1I_1$	2.35	E	40068	5
$T_{12} = V_0S_1R_0F_0M_1I_1$	2.37	E	40409	4
$T_{13} = V_1S_1R_0F_0M_0I_1$	2.54	E	43370	2
$T_{14} = V_1S_0R_1F_0M_1I_1$	2.25	L	38363	6
$T_{15} = V_1S_0R_1F_0M_0I_1$	1.99	L	33930	9
$T_{16} = V_1S_0R_1F_0M_0I_0$	1.82	L	31031	11
$T_{17} = V_1S_0R_1F_1M_0I_0$	1.64	L	27961	15
$T_{18} = V_0S_1R_0F_1M_1I_0$	1.47	E	25064	17

E= Timely/early sowing L= Late sowing

Tabl.9. Effects of treatment combinations on yield of Aus rice at Chuadanga study area.

Sl. No.	Difference of treatment	Variety		Sowing time		Seed rate		Fertilizer		Power tiller& tractor		Weeding		Effect of treatment	Change in yield (t/ha)	Addi-tional gross return (Tk/ ha)
		V1	V0	S1	S0	R1	R0	F1	F0	M1	M0	I1	I0			
1	T_1-T_2	A	-	A	-	A	-	A	-	A	-	*	-	Weeding	0.18	3069
2	T_2-T_3	A	-	A	-	A	-	A	-	*	-	-	A	Power tiller	0.17	2899
3	T_3-T_4	A	-	A	-	A	-	*	-	-	A	-	A	Fertilizer	0.26	4433
4	T_4-T_5	A	-	A	-	*	-	-	A	-	A	-	A	Seed rate	0.29	4945
5	T_5-T_6	A	-	*	-	-	A	-	A	-	A	-	A	Sowing time	0.02	341
6	T_6-T_7	*	-	-	A	-	A	-	A	-	A	-	A	Variety	0.19	3240
7	T_8-T_7	-	A	-	A	-	A	-	A	*	-	A	-	Power tiller	0.18	3069
8	T_{10}-T_9	-	A	-	A	*	-	A	-	A	-	A	-	Seed rate	0.26	4433
9	T_{11}-T_{10}	-	A	*	-	-	A	A	-	A	-	A	-	Sowing time	0.29	4945
10	T_{13}-T_{12}	*	-	A	-	-	A	-	A	-	A	A	-	Variety	0.17	2961
11	T_{13}-T_{14}	A	-	*	-	-	A	-	A	-	A	A	-	Sowing time	0.29	5007
12	T_{14}-T_{15}	A	-	-	A	A	-	-	A	*	-	A	-	Power tiller	0.26	4433
13	T_{17}-T_{16}	A	-	-	A	A	-	*		-	A	-	A	Fertilizer	-0.18	-3070
14	T_{18}-T_{17}	-	A	*	-	-	A	A	-	A	-	-	A	Sowing time	-0.17	-2897

(A)- Adopted practices (-)—Not adopted (*)—Effect of treatment

Conclusion

Gap between demonstration plots and farmers' plots were positive due to human labour, animal labour, power tiller, and fertilizer dose. It indicated that these factors were responsible for higher yield of MV T.Aus rice in demonstration plots as compared to farmers' plots. The profitability analysis indicated that the gross return, net return, and benefit cost ratio were also higher in the demonstration plots than those of farmers' plots although the total cost of cultivation were higher on full cost basis. Partial budgeting analysis also

indicated that MV T.Aus rice cultivation was more profitable under demonstration plots compared to farmers' plots. In the aus season, weed is the most important constraint for yield loss followed by soil related stress (mainly organic matter deficiency). Among the varieties grown in this season, BRRI dhan28 is the most popular variety due to better taste and higher grain yield with wide yield difference between demonstration and farmers' plots. The yield could be increased by adopting recommended technologies with management practices. The contribution of yield depends upon many factors, such as recommended variety, use of fertilizers, timely sowing/planting, and weeding for profitable growing of MV T. aus rice. It was also observed that the high monetary returns were directly associated with the above technical factors.

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