

Economic performance of direct drum seeded and transplanted rice

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Abstract: An experiment was carried out at the Agronomy Field Laboratory, Bangladesh Agricultural University, Mymensingh from November 2005 to May 2006 to study economic performance of direct drum seeded and transplanted rice. Two factors were included in the experiment- methods of crop establishment viz., direct seeded thick row, direct seeded thin row and transplanting method and four time of herbicide application viz. herbicide application after 3, 5, 7 and 9 days of sowing or transplanting with one control. The experiment was laid out in a split plot design assigning methods of crop establishment in the main plot and time of herbicide application in the sub-plot with three replications. Transplanted rice required more investment (Tk. 1721.32 and Tk. 2166.32 more) than direct seeded thick and thin row, respectively. The non-material input cost was considerably higher in transplanted method (Tk. 11285) than those of direct seeded thick and direct-seeded thin row method (Tk. 9565). Material cost for all the methods of crop establishment were similar except seed cost. The higher cost involvement in transplanting method was due to extra labour required in seedling raising, uprooting and transplanting, accounting 8.40% of input cost. Direct seeding required an extra cost for guard against birds (Tk. 350) and for very smooth land preparation for direct seeding (Tk. 140). The gross and net income obtained from transplanting, direct seeded thick row and thin row sowing method were Tk. 44540, Tk. 52330, Tk. 50450 and Tk. 4013.62, Tk. 12179.96, Tk. 13524.94, respectively. The net income from each taka of investment was the highest (0.35) in direct seeded thick row method and the lowest (0.10) was in transplanting method, due to higher grain and straw yield in direct seeded thick row method and lower yield and higher labour requirement in transplanted method. Although transplanted method required more investment than direct seeded rice but return was more in direct wet seeded method, consequently direct seeded thick and thin row methods produced an additional profit of Tk. 9511.32 and Tk. 8166.34 over transplanting. The relative profitability of direct seeded thick and thin row sown rice was Tk. 9511.32 and Tk. 8166.34, respectively over transplanted rice because of labor saving and higher grain yield in the former case.

INTRODUCTION

Rice (*Oryza sativa* L.) is the staple food for the people of Bangladesh as well as for 3 billion people of the world and it is, therefore, playing an important role in the national economy of many developing countries (Trans, 2001). In Bangladesh rice contributes 9.05% of the national gross domestic product (BBS, 2004).

The agricultural land of Bangladesh is being reduced by about 1% per annum (Husain *et al.*, 2006) while the population is increasing at an alarming rate of 1.43% (Economic Review, 2006). Farmers are under continuous pressure for producing more and more rice from the reduced land. It is estimated that the world's annual rice production should increase from 520

to 880 million tons by the year 2025 to meet the rice demand of the over increasing population through improvement in agronomic practices and introduction of high yielding cultivars (Kundu and Ladha, 1999). There are three principal methods of rice establishment; dry seeding, wet seeding and transplanting. Transplanting is the dominant method of crop establishment in Southeast Asian countries (Pandey and Velasco, 2002). In Bangladesh traditional method of rice production is becoming less profitable than before due to rising cost of production associated with raising seedling, transplanting and other inputs (Husain *et al.*, 2006). Direct seeding, an alternative method of crop establishment (Coxhead, 1984) covering about 29 million hectares of lands in various Asian countries requires less labour, time, drudgery, and cultivation cost (Pandey and Velasco, 2002). This method requires only 34% of the total labour requirements of transplanting (Ho and Romil, 2002) and crop establishment cost reduced by 28 times (Wong and Morooka, 1996). Direct wet seeded method of rice cultivation increases grain yield by 2-30% (on an average 10-15%) giving an additional return of about Tk. 8000 per hectare over transplanted rice (Husain *et al.*, 2006). The present study, therefore, has been undertaken to evaluate the economic performance of direct drum seeded and transplanted rice.

Materials and Methods

The field lies in Old Brahmaputra Floodplain (Agro-ecological zone No. 9). The area of unit plot was 10 m² (4 m × 2.5 m). The experiment was laid out in a split plot design assigning

methods of crop establishment in the main plot and time of herbicide application in the sub-plot with three replications. The treatment included (i) three methods of crop establishment viz., direct seeded thick row, direct seeded thin row and transplanting method and (ii) four time of herbicide application viz. herbicide application after 3, 5, 7 and 9 days of sowing with one control. The cost of production unit⁻¹ of the product was calculated by the following formula (Mian and Bhuiya, 1977):

$$CPUP = \frac{TCP - VR}{YP}$$

Where, CPUP = Cost of production unit⁻¹ of the product, TCP = Total cost of production, VR = Value of the by-product, YP = Yield of the product

Results and Discussion

Economics of boro rice (BRRI dhan29) under different methods of crop establishment

The total cost of production ha⁻¹ and its distribution over different heads of expenditure under methods of crop establishment have been presented in Table 1. The percentage of total cost of production over different heads viz. labour, seeds, fertilizer, herbicide, irrigation water, insecticide, interest on input cost, interest on value of land and miscellaneous cost in direct seeded thick and thin row method were 24.65, 1.96, 16.29, 2.06, 13.40, 2.57, 3.81, 32.21, 3.05 and 24.94, 0.94, 16.48, 2.08, 13.56, 2.60, 3.79, 32.58, 3.03, respectively while they were 27.84, 0.98, 15.60, 1.98, 12.83, 2.47, 3.86, 31.35, 3.09 in transplanted method. It is evident that total cost of production (TCP) under transplanting,

direct seeded thick row and direct seeded thin row were Tk. 40526.28, Tk. 3880.06 and Tk. 38360.06, respectively. Total input cost were Tk. 25005, Tk. 23645 and 23245, respectively sharing 61.70, 60.93 and 60.60% of the TCP. It indicates that transplanted rice required more investment (Tk. 1721.32 and Tk. 2166.32 more)

than direct seeded thick and thin row sown method, respectively. The higher cost of production in transplanting was associated the higher labour requirement in seedling raising, uprooting and transplanting. Similar results were found by Pandey and Velasco (2002) and Ho and Romil (2002).

Table 1. Cost of production ha⁻¹ and its distribution over different heads of expenditure in boro rice under different methods of crop establishment

Heads of expenditure	Transplanted rice		Direct seeded rice			
	Actual cost (Tk ha ⁻¹)	% of TCP*	Thick row		Thin row	
			Actual cost (Tk ha ⁻¹)	% of TCP*	Actual cost (Tk ha ⁻¹)	% of TCP*
I. Input cost						
A. Non-material input						
1. Labour						
(a) Human	9310 (133)	22.97	7840 (112)	20.20	7840 (112)	20.44
(b) Animal	1125	2.77	875	2.26	875	2.28
(c) Mechanical (Tractor)	850	2.10	850	2.19	850	2.22
Non-material input cost	11285	27.84	9565	24.65	9565	24.94
B. Material inputs						
2. Rice seeds	400	0.98	760	1.96	360	0.94
3. Fertilizers	6320	15.60	6320	16.29	6320	16.48
4. Herbicide	800	1.98	800	2.06	800	2.08
5. Irrigation	5200	12.83	5200	13.40	5200	13.56
6. Insecticide	1000	2.47	1000	2.57	1000	2.60
7. Miscellaneous materials	-	-	-	-	-	-
Material input cost	13720	33.86	14080	36.28	13680	35.66
Total input cost (IC)	25005	61.70	23645	60.93	23245	60.60
II. Over head cost						
8. Interest on input cost	1562.80	3.86	147781	3.81	1452.81	3.79
9 a. Interest on value of land	12500	30.84	12500	32.21	12500	32.58
b. Interest on value of land for seedling raising	208.33	0.51	-	-	-	-
10. Miscellaneous overhead cost	1250.25	3.09	1182.25	3.05	1162.25	3.03
Total over head cost (OC)	15521.38	38.3	15160.06	39.07	15115.06	39.40
Total cost of production (TCP)	40526.38	100	38805.06	100	38360.06	100

*TCP, Total cost of production ha⁻¹

Figure in the parenthesis indicate the number of human labour

The distribution of labour (human and animal) over different operations of boro rice under different methods of crop establishment differed considerably with the method of crop establishment (Table 2). The number of human labour required in transplanting and direct seeding (thick and thin row) were 133 man-day and 112 man-day, respectively. The higher number of human labour required in transplanting method was due to the higher

labour involvement in transplanting (30 man-day ha⁻¹), 22.56% of the total labour requirement than those of direct seeding (8 man-day ha⁻¹). Direct seeding required an extra number of labour to prepare the field for direct seeding (levelling, drainout of water and removal of stubbles) and guard against birds (5 man-day ha⁻¹) which was compensatory to labour required in seedling raising in case of transplanting. Similar results were observed by Ho and Romil (2002) who

stated that direct seeded method required only 34% of the total labour requirement of transplanting. The non-material input cost was considerably higher in transplanted method (Tk. 11285) than those of direct seeded thick and direct-seeded thin row method (Tk. 9565) (Table 3). Material cost for all the methods of crop establishment were similar except seed cost. The higher cost involvement in transplanting method was due to extra labour required in seedling raising, uprooting and transplanting, accounting

8.40% of input cost. Direct seeding required an extra cost for guard against birds (Tk. 350) and for very smooth land preparation for direct seeding (Tk. 140). These results are in conformity with the findings of Wong and Morooka (1996) who stated that with the introduction of direct seeding crop establishment method, cost was reduced by 28 times. The analysis of cost and return ha⁻¹ of boro rice under different methods of crop establishment has been presented in the Table 4.

Table 2. Operation-wise break-up of the labour requirement ha⁻¹ for production of boro rice under different methods of crop establishment

Operation	Transplanted rice		Direct seeded rice			
	Human labour (man-days)	Animal labour (animal-days)/mechanical labour 8 hours day ⁻¹	Thick row		Thin row	
			Human labour (man-days)	Animal labour (animal-days)/mechanical labour	Human labour (man-days)	Animal labour (animal-days)/mechanical labour
1. Land preparation						
I. Mechanical labour (tractor-day of 8 hours)		0.5 (100)		0.5 (100)		0.5 (100)
II. Animal labor		7 (77.78)		7 (100)		7 (100)
III. Human labour	26 (19.55)		28 (25.00)		28 (25.00)	
2. Fertilizer application	6 (4.51)		6 (5.36)		6 (5.36)	
3. Seed soaking, water removing and sprouted seed sowing			8 (7.14)		8 (7.14)	
4. Guard against birds			5 (4.46)		5 (4.46)	
5. Seedling raising						
a) Human	6 (4.51)					
b) Animal		2 (22.22)				
6. Seedling uprooting and transplanting	30 (22.56)					
7. Weeding (herbicide application)	5 (3.76)		5 (4.46)		5 (4.46)	
8. Irrigation water application	10 (7.52)		10 (8.93)		10 (8.93)	
9. Harvesting	28 (21.05)		28 (25.25)		28 (25.25)	
10. Carrying the harvest	5 (3.76)		5 (4.46)		5 (4.46)	
11. Threshing by pedal thresher	7 (5.26)		7 (6.25)		7 (6.25)	
11. Cleaning, drying, winnowing, weighing and bagging of grains	5 (3.76)		5 (4.46)		5 (4.46)	
12. Straw drying and heaping	5 (3.76)		5 (4.46)		5 (4.46)	

Figure in the parenthesis indicate the percent of total labour of the kind (mechanical, human and animal)

The gross income obtained from transplanting, direct seeded thick row and thin row sowing method were Tk. 44540, Tk. 52330 and Tk. 50450, respectively. Among the crop establishment methods under study the net income was the highest (Tk. 13524.94) in direct seeded thick row sown method and the lowest (Tk. 4013.62) was in transplanted method. The net income from each taka of investment was also the highest (0.35) in direct seeded thick row method and the lowest (0.10) was in transplanting method. This might be due to higher grain and straw yield in direct seeded thick row method and lower yield and higher labour requirement in transplanted method. These results are in conformity with the findings of those who stated that direct seeded rice provide an additional income of Tk. 8787 ha⁻¹ (Husain *et al.*, 2006) in boro season, Tk. 6116 ha⁻¹ (BRRI, 2005b) in aman season. Among the three crop establishment methods, direct seeded thick row would be more profitable and promising for providing higher net profit than those of others.

Human labour (man-day 8 hours) @ Tk. 70, animal labour (animal-day 8 hours of a pair of bullock) @ Tk. 125, mechanical labour (tractor-day of 8 hours) @ Tk. 1640, rice seed per kg @ Tk. 20, urea kg⁻¹ @ Tk. 6, TSP kg⁻¹ @ Tk. 16, MOP kg⁻¹ @ Tk. 15, gypsum kg⁻¹ @ Tk. 6, zinc sulphate kg⁻¹ @ Tk. 40, irrigation (one irrigation per hectare) @ Tk. 650, herbicide (Rifit) per 100 ml @ Tk. 80, insecticide (Basudin 5 G kg⁻¹) @ Tk. 95, value of land (one hectare) @ Tk. 200000 and interest on inputs and value of land per year 12.25% and the selling price of rice grain and straw were @ Tk. 10 and Tk. 1,

respectively. The cost of production (Tk. ton⁻¹) of per unit of product was comparatively higher in transplanting method (Tk. 8978.72) than those of direct seeded thick row (Tk. 7059.80) and direct seeded thin row method (Tk. 7262.94). This might be due to higher cost involvement associated with higher labour requirement in transplanting than those of direct seeding.

Table 3. Operation-wise break-up of the labour requirement ha⁻¹ for production of boro rice under different methods of crop establishment

Production operations	Transplanting		Direct seeded rice			
	Cost (Tk. ha ⁻¹)	% of IC*	Thick row		Thin row	
			Cost (Tk. ha ⁻¹)	% of IC	Cost (Tk. ha ⁻¹)	% of IC
A. Non-material input cost						
1. Land preparation	3545	14.18	3685	15.58	3685	15.85
2. Fertilizer application	420	1.68	420	1.78	420	1.80
3. Seed soaking, water removing and sprouted seed sowing	-	-	560	2.37	560	2.41
4. Seedling raising and transplanting	2770	11.08	-	-	-	-
5. Guard against birds	-	-	350	1.48	350	1.51
6. Weeding (herbicide application)	350	1.40	350	1.48	350	1.51
7. Irrigation water application	700	2.80	700	2.96	700	3.01
8. Harvesting	1960	7.84	1960	8.29	1960	8.43
9. Carrying the harvest	350	1.40	350	1.48	350	1.51
10. Threshing by pedal thresher	490	1.96	490	2.07	490	2.11
11. Cleaning, drying, winnowing, weighing and bagging of grains	350	1.40	350	1.48	350	1.51
12. Straw drying and heaping	350	1.40	350	1.48	350	1.51
Total non-material cost	11285	45.13	9565	40.45	9565	41.15
B. Material input cost						
Seed	400	1.60	760	3.21	360	1.55
Fertilizer						
Urea	1620	6.48	1620	6.85	1620	6.97
TSP	2080	8.32	2080	8.80	2080	4.95
MOP	1800	7.20	1800	7.61	1800	7.74
Gypsum	420	1.68	420	1.78	420	1.80
Zinc sulphate	400	1.60	400	1.70	400	1.72
Herbicide	800	3.20	800	3.38	800	3.44
Irrigation water	5200	20.80	5200	22.00	5200	22.37
Insecticide	1000	4.00	1000	4.23	1000	4.30
Total input cost	25005	54.87	25005	59.55	25005	58.85

*IC, Total input cost

Table 4. Analysis of cost and return per hectare of boro rice (BRRI dhan29) grown at the Agronomy Field Laboratory, Bangladesh Agricultural University, Mymensingh during 2005-2006

Total production	Transplanting	Direct seeded thick row	Direct seeded thin row
Total cost of production (Tk ha ⁻¹)	40526.38	38805.06	38360.06
2. Output (yield):			
a) Product (grain) (t ha ⁻¹)	3.93	4.60	4.45
b) By-product (straw) (t ha ⁻¹)	5.24	6.33	6.04
3. Cost of production (taka) ton ⁻¹ of product	8978.72	7059.80	7262.94
4. Gross income (taka ha ⁻¹)	44540	52330	50540
a) Product	39300	46000	44500
b) By-product	5240	6330	6040
5. Net income (+) or less (-) (taka ha ⁻¹)	4013.62	13524.94	12179.96
6. Net income (+) or less (-) taka ⁻¹ invested (taka)	+0.10	+0.35	+0.32

Summary and Conclusion

Transplanted rice required more investment (Tk. 1721.32 and Tk. 2166.32 more) than direct seeded thick and thin row, respectively. The

non-material input cost was considerably higher in transplanted method (Tk. 11285) than those of direct seeded thick and direct-seeded thin row method (Tk. 9565). Material cost for all the

methods of crop establishment were similar except seed cost. The higher cost involvement in transplanting method was due to extra labour required in seedling raising, uprooting and transplanting, accounting 8.40% of input cost. Direct seeding required an extra cost for guard against birds (Tk. 350) and for very smooth land preparation for direct seeding (Tk. 140). The gross and net income obtained from transplanting, direct seeded thick row and thin row sowing method were Tk. 44540, Tk. 52330, Tk. 50450 and Tk. 4013.62, Tk. 12179.96, Tk. 13524.94, respectively. The net income from each taka of investment was the highest (0.35) in direct seeded thick row method and the lowest (0.10) was in transplanting method, due to higher grain and straw yield in direct seeded thick row method and lower yield and higher labour requirement in transplanted method. Although transplanted method required more investment than direct seeded rice but return was more in direct wet seeded method, consequently direct seeded thick and thin row methods produced an additional profit of Tk. 9511.32 and Tk. 8166.34 over transplanting.

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