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Farmer-led Innovations in Rice Farming System in the Flood-prone Ecosystem of Bangladesh

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Abstract

Farmers in the flood-prone areas of Faridpur district have innovated rice-based farming technologies to improve their farm production and household income. One of such innovations is relay cropping of modern variety (MV) rice with jute. In order to investigate the detail socioeconomic issues of this farmer-led innovation, a survey-based study was undertaken during 2003. The analysis revealed that, following Jute + rice relay cropping method, farmers could enrich their farm productivity and household income. Farmers' innovation involves lesser production costs compared to the conventional method and obtained much higher gross margin. Moreover, the new method proved to be advantageous in several ways: (i) the innovation involves about 6% less labour in MV Aman cultivation; (ii) under this technology, MV Aman rice can escape water stress in October, i.e. needs no supplemental irrigation; (iii) farmers have the scope of bearing almost 20% less input cost; and (iv) farmers can avoid the botheration of Aman seed bed preparation. Partial budget analysis further showed that, farmers could receive higher profit of Tk.4021/ha through MV rice production as relay cropping with Jute compared to that of rice production as sequential cropping.

Keywords: Farmers' innovation, jute-rice relay cropping, flood-prone, sequential cropping

1. Introduction

The flood-prone ecosystem consists of the depressed basins and low land areas, which are subject to flooding either due to monsoon rainfall or tidal inundation or both. In Bangladesh, such flood-prone ecosystem covers about 5.5 to 6.5 million hectares of cultivable land (Husain, 2004). In a different estimate it was evident that the total flood prone areas cover almost 6.88 million hectares (Zaman, 1986). About 22% of the total Transplanted Aman (T. Aman) rice is grown in the flood-prone areas (BBS, 2004). A large portion of the flood prone land is still remaining single cropped where flooding depth is above 90 cm, but in the medium high land or medium low land areas usually double cropping is practiced. In such flood-prone medium high land areas under Bhanga Upazila of Faridpur district, there are few cropping patterns commonly followed by the farmers. Among those cropping patterns, jute production followed by transplanted Aman (mainly traditional aman varieties) is an important one.

However, it has been reported by the farmers in the flood-prone areas of Bhanga upazilla, Faridpur district, that they have innovated rice-based technologies to improve their land productivity and household income as well. The innovation is relay cropping of MV rice with jute or chili. The farmers in the area sometimes grow modern variety rice, instead of a traditional variety immediately after a modern variety of boro (winter) rice. However, the potentialities as well as the socio-economic aspects of the aforesaid farmer-led innovation is not known. Documentation of such innovations could help transferring such technologies to other similar environments of the country and help researchers for bringing improvements of such technologies. The present study was, therefore, carried out in order to:

- document analytically the emerging farmers' innovations in rice production in the Bhanga area;
- determine the economic benefits derived from the innovations in farmers' practice; and
- identify the potentials for transferring the technology to other areas of the country.

2. Methodology

The study was conducted at Dharmadi village under Nurullaganj Union of Bhanga upazila in Faridpur district during Kharif (1& 2) seasons in 2003. In terms of ecology, the area falls under the flood-prone ecosystem. Data for this study were generated in two steps.

(a) Informal interview with the key informants or focal group discussion, and

(b) Formal survey using structured and pre-tested questionnaire.

At the first step, a group discussion was held with about 25 farmers (key informants) of the aforesaid village. A research team consisting of Agronomist, Economist and Extension specialist were engaged in carrying out the focal group discussion. The group discussion was mainly confined on socio-economic aspects of the farm households, physical description of production activities, access to resources, post harvest practices and common facilities and constraints to farming activities. In the process, a checklist was used to collect all the relevant information of the selected village.

At the second step, formal survey was conducted in limited scale to collect data on crop production practices, resource availability, technology adoption, input use pattern and input output prices etc. The survey was done using structured and pre-tested questionnaire made in consistence with the objectives of the study. For the formal survey a total of 40 sample households were randomly selected to collect the required data.

Mainly descriptive statistics were employed to analyze the collected information. In addition, partial budget analysis was done to determine the relative profitability of different cropping patterns.

3. Empirical Results

3.1. History of the innovation

About fifty years back farmers used to grow jute and indigenous Aman rice variety together (as mixed crop). Both jute and local variety (LV) Aman seeds were broadcasted in April-May. Jute was harvested during late August to September while the LV Aman was harvested in early to mid October.

At the initial practice, the indigenous rice varieties namely Bashiraj, Kalasail, Kajalsail etc. were broadcasted and grown as mixed crop with jute, but these varieties used to yield very low.

One local farmer named Mr. Kala Chan Sikari of Village Dharmadi started this practice about 10 years back. According to the key informants' report, Mr Kala Chan Sikari came to know the practice from the farmers of the adjacent district Jessore and he started practicing it in his plot. Subsequently other farmers at the similar ecology started adopting the method and that is how the technology became popular.

3.2. Reasons for practicing jute + paddy relay cropping

According to the statements of the farmers, the aforesaid cropping practice has three main advantages: (a) requires less labour, (b) needs less irrigation, and (c) involves less production costs. Usually the land remains fallow after harvesting jute because of unavailability of irrigation (since transplanted Aman requires supplemental irrigation some times in the month of October). Furthermore, by way of adopting this cropping pattern, farmers had been able to uplift the farm productivity that helped them raising their household income and livelihoods.

3.3. Improvement of the innovation

Farmers of Dharmadi village made a bit change to the original innovation through introducing high yielding variety (HYV) instead of growing the indigenous rice genotypes. At that time the HYV was BR11. Again, instead of broadcasting jute and rice seeds together, they started a new practice as:

(a) Jute is seeded during March and MV rice is seeded in the same field in June to early July (as a relay crop).

(b) Unsprouted rice seed is broadcasted in the jute field when the jute plants grow about 4-5 ft. tall. Farmers take rice seed in a bag and broadcast as traditional way; and Mostly MV rice seed is broadcasted in the jute field when the crop land remains at least in the light wet condition or enough soil moisture available in order to grow MV rice as relay crop with jute. Nevertheless, this jute + MV rice relay cropping technology has gained popularity and estimates suggest that, the practice covers nearly 40% cropped lands of the study area (Alam *et al.*, 2004).

3.4. Bio-physical feature

3.4.1. Land type and soil type

The topographical situation of the village is described in Table 1. The survey village is dominated by medium low lands (i.e. flooding depth of up to 180 cm) since 72% of the cropped lands of the village belong to this category. About 15% of the lands in the village fall under medium high lands where the flooding usually reaches up to only 90 cm. It was found from the survey results that, the majority of the cropped lands under Dharmadi village belong to the clay soil and nearly 65% of the land area falls under this soil category. Only 25% lands belong to the loamy soil. However, the proportion of cropped lands under sandy soil in the sample village was absolutely low (only about 3-4%).

3.4.2. Irrigation facility

Both deep tube well (DTW) and shallow tube well (STW) irrigation are available in the study village but in terms of irrigation coverage, the village is dominated by the STW irrigation facility since it covers almost 65% of the irrigated area. Since there is a canal running

Table 1. Biophysical features of the sample farms under Dharmadi village, Faridpur.

Physical factors	% area covered
Land type	
High lands (above flood level)	03
Medium high lands(up to 90 cm)	15
Medium low lands (up to 180 cm)	72
Low lands (180-300 cm)	10
Soil type	
Clay soil	65
Loamy soil	25
Silty soil	7
Sandy soil	03
Irrigation coverage by:	
DTW	22
STW	65
LLP	10
Local devices	3

through the village, there is also scanty use of Low Lift Pump (LLP) irrigation and that covers only 10% of the cropped lands in the village.

3.5. Cropping pattern and crops grown

There are several cropping patterns followed in the study village and the major patterns as reported by the sample farmers are presented in Table 2. Fallow –MV Boro-MV Aman is the dominant cropping pattern in the village and almost one fourth of the cropped area is devoted to this pattern. Since the lion's share of the cropped lands belong to medium topography, majority of the farmers devoted lands for rabi crops in the winter season which is followed by Jute and modern variety (MV) Aman in the kharif I and II seasons.

Data in Table 3 indicate that the study village is quite advance in terms of modern technology adoption. In the Boro season, the coverage of MVs is about 97%, while in the wet season 70% of Aman area is devoted to HYVs, which is higher than the national average of 58% (BBS,2005). In case of the winter crops like wheat and mustard, 100% farmers adopted the HYVs implying that the status of technology diffusion through extension services is quite good in the study village. In case of jute-Aman production practice as a relay crop, modern varieties are adopted almost in 80% of the area. However, in the low lands B.Aman is grown as sequential crop after MV Boro and 95% of such area is covered by the local varieties (LVs).

3.6. Farmers' perceptions on jute+rice relay cropping

Rice cultivation as relay cropping with jute favours improvement of soil fertility because this practice requires less tilling of lands and thus helps the crop lands from degradation. Farms having no irrigation equipments would prefer this practice.

On the contrary, those who do not follow this practice (rather follow jute-T.aman sequential cropping), might face problem in growing T. Aman since T. Aman needs irrigation some times during land preparation and also in mid to late October at the panicle initiation stage.

Table 2. Major cropping patterns under practice in the study village, Faridpur, 2003.

Cropping patterns	% area covered
Fallow – MV Boro- MV Aman	25
Pulse – Jute - MV Aman	10
Fallow-MV Boro-B.Aman (LV)	10
Wheat – Jute - MV Aman	7
Rabi crop-Jute+MV.Aman (relay)	39
Vegetable -Jute - MV Aman	6
Chili – Jute- LV Aman	3

Table 3. Crops grown and their distribution according to the coverage of genotypes.

Crop type	Coverage of crop genotypes (%)	
	MV	LV
Boro	97	3
T.Aman	75	25
B.Aman (as relay crop)	80	20
B.Aman (grown after Boro)	5	95
Jute	90	10
Wheat	100	-
Mustard	100	-

More over, farmers' preferences towards jute + rice relay cropping is from another vital stand-point, i.e. this practice involves much lesser cash investment that relieves the resource poor farmers from paying for the input costs.

3.7. Economics of the relevant cropping patterns

The costs and return structure for both the Jute + Rice relay cropping and Jute followed by T. Aman as sequential cropping pattern are furnished in Tables 5 and 6. The costs of production for jute as mixed crop (with rice) and jute as single crop production are very similar. On the other hand, per hectare production cost of B. Aman as relay crop with jute is substantially lower (Tk13104/ha) compared to that for T. Aman cultivation (Tk18403/ha). This result is in good agreement with the findings of other earlier study (Alam *et al.,* 2004). Therefore, farmers have the scope of investing less money (worthing about Tk.5300/ha) for growing MV rice as relay cropping with jute, which could be one of the important attracting factors to the farming community for adopting this technology. In fact, cash investment is thought to be a major concern to the resource poor farming community of Bangladesh. However, cultivation of MV rice with jute appeared to be more profitable. The gross margin obtained in case of MV rice as direct seeded crop in jute field is much higher since it involves much lesser production costs.

In order to estimate the relative profitability of two different cropping patterns (for making a management decision), partial budget analysis was done. In this respect, the break down of economic advantage of growing MV rice was assessed separately for jute with rice as a pattern and for B. Aman (MVs) as a replacement for T. Aman as single enterprise and the results are presented in Tables 8 and 9 respectively. The analysis shows that, MV rice as relay crop with jute appeared to be more profitable than growing MV rice as sequential crop after jute, since farmers had been able to obtain about Tk.4021.00 per hectare through relay cropping instead of the sequential cropping method (Table 8). Similarly, farmers of the same village could derive benefit of Tk 4186.00/ha more in growing MV rice as a relay crop with jute instead of growing MV rice as a mono crop T. Aman (Table 9).

Table 4. Dominant crop varieties grown in the study village; Faridpur, 2003.

Season	Varieties	Reason for growing
MV Boro	BR3, BR14, BRRIdhan 28, BRRIdhan29, IR8, BR16, Type, Hybrid	Higher yield
T.Aman	BR10, BR11, BR22, BR23, Pajam,BRRIdhan29,BRRIdhan30, BRRIdhan 31, BRRIdhan32, BRRIdhan39	Higher yield
B.Aman(MVs)	BR11, BR14, BRRIdhan29, BR26	Higher yield
B.Aman (LVs)	Bashiraj, Lakhidhiga, Kajalsail, Nizersail,Malbhog,Jhingasail,Rajfal Hijaldigha,Kartiksail,Chowraghot	Less water needed, Late planting possible, better taste, better price
Jute	Bankim, Tarabogi,Satnala,Mahamaya, Shipsankar,NEC,Maharastra, Panpata,Annapunna	Higher yield
Wheat	Kanchan, Sonali, Balaka	Higher yield
LV Boro	Kali boro, Chaita boro	Early maturing
Mustard	Maghi, Chaita	Higher yield

Table 5. Costs and return for Jute and MV Aman production as relay cropping in the study village, Kharif season (1 &2), 2003.

Items	Cost & return (Tk/ha)	
	Jute	B.Aman (MV)
Pre-harvest production costs	16304	9887
Harvesting/threshing etc	6898	3217
Total variable costs	23202	13104
Gross value of output	35266	28102
Gross margin	12034	14998
BCR on variable cost	1.50	2.13

Table 6. Costs and return structure for Jute and MV T.Aman production as sequential cropping in the study village, Kharif season (1&2), 2003.

Items	Cost & return (Tk/ha)	
	Jute	T.Aman (MV)
Pre-harvest production costs	17221	15687
Harvesting/threshing etc	6128	2716
Total variable costs	23349	18403
Gross value of output	35576	29217
Gross margin	12227	10814
BCR on variable cost	1.53	1.58

Table 7. Comparative cost and return scenario of MV Aman as relay and sequential cropping practices.

Items	Cost and return (Tk/ha)		Mean difference	P(t<=t)
	MV Aman as relay crop	MV Aman as sequential crop		
Total variable costs	13104	18403	5299	0.101
Gross value of output	28102	29217	1115	0.216
Gross margin	14998	10814	4184	0.053
Increase in gross margin over sequential cropping (%)	28.85			

Table 8. Partial budget analysis for Jute + B.Aman (MV) relay cropping VS Jute –T.Aman sequential cropping/pattern.

Items	Debit (Tk./ha)	Items	Credit (Tk/ha)
Cost of production under Jute+B.Aman pattern	36306	1. Gross return from Jute+B.Aman cropping pattern	63368
Revenue forgone for not practicing Jute- T. Aman pattern	64793	2. Cost saved for not practicing Jute-T.Aman pattern.	41752
1. Profit/Loss	+ 4021		
	======		======
	105,120		105,120

Table 9. Partial budget analysis for B.Aman (MV) as mixed/relay crop VS T. Aman as a sequential crop in the Aman season.

Items	Debit (Tk./ha)	Items	Credit (Tk/ha)
1. Cost of production for B.Aamn as relay crop with Jute	13104	1. Return from B.Aman as relay crop	28102
2.Revenue forgone for not growing T.Aman as a sequential crop	29217	2. Cost saved for not growing T. Aman as sequential crop.	18403
3.Profit/Loss	+ 4184		
	======		======
	46,505		46,505

Appenix 1: Pre-harvest cost structure for Jute and MV Aman production as relay cropping in the study village, Karif season, 2003

Items	Pre-harvest production cost (Tk/ha)	
	Jute	B. Aman (MVs)
Seed cost	783	1125
Land preparation cost	2923	
Irrigation cost	1077	
Fertilizer cost	1999	1651
Weeding cost	9522	6401
Pesticide cost		710
Total	16304	9887

Appendix 2: Pre-harvest cost structure for Jute and MV T. Aman production as sequential cropping in the study village, Karif season, 2003

Items	Pre-harvest production cost (Tk/ha)	
	Jute	B. Aman (MVs)
Seed cost	705	974
Seedbed cost		304
Land preparation cost	2997	2515
Uprooting cost		691
Transplanting cost		1957
Irrigation cost	823	1420
Fertilizer cost	2206	3582
Weeding cost	10490	3776
Pesticide cost		468
Total	17221	15687

4. Conclusions and Recommendations

The farmers of the sample village under the flood-prone areas of Bhanga upazila, Faridpur used to grow indigenous Aman rice varieties along with jute as mixed cropping where seeds of both jute and Aman rice were broadcasted together. Under this practice the yield of Aman was quite low. Farmers themselves made improvement of the technology by introducing modern rice varieties in the cropping/practice. By growing broadcast MV Aman in the grown-up jute field farmers obtained higher productivity of MV Aman. Eventually, the new practice gained popularity and the practice has been getting momentum since it renders several distinct advantages; (i) the technology requires less labour which is very costly now a days, (ii) needs less irrigation, (iii) because of early broadcasting, MV Aman can escape water stress during panicle initiation stage resulting in better plant growth and yield, and (iv) it involves much lesser cash investment in crop production. More over, jute + rice relay cropping saves soil from continuous degradation because this practice involves less tilling in growing crops.

The gross return from Jute +rice relay cropping was much higher compared to that of jute – rice sequential cropping. Partial budget analysis revealed that, farmers could derive benefit (profit) of Tk. 4021.00/ha through MV rice production as relay cropping with jute instead of following Jute-T .Aman production as sequential cropping.

Attempt may be taken by extension services to disseminate the jute + rice relay cropping in the similar other environments. This will help to enhance the productivity and income of the rural households.

References

Alam, M. S, M. Z. Abedin and M. Hossain. 2004. Farmer Innovations in Rice Production in Flood-prone Areas in Bangladesh. Paper presented at the Workshop on Validation and Delivery of New Technologies for Increasing the Productivity of Flood-prone Rice Lands of South and South East Asia, Cantho University, Vietnam, 5-7 February.

Bangladesh Bureau of Statistics (BBS). 2004. Statistical Year Book of Bangladesh, Statistics Division, Ministry of Planning, Government of the People's Republic of Bangladesh, Dhaka.

Husain, M. 2004. Validation and Delivery of New Technologies for Increasing the Productivity of Flood-prone Rice Lands of South and South East Asia, IFAD/IRRI/BRRI Project Report presented at the Final Review Meeting held at Cantho University, Vietnam, 5-7 February.

Naseem, S. B, A. H. Khan, M. S. Alam, S. M. R. Karim and N.E.Elahi.1996. "Beel Dakatia- Transition from Tragedy to Prosperity". Project Research Report, Investigation of Flood Plain Production Systems in Bangladesh, Land Water Interface Production System, Overseas Development Administration, Dhaka.

Islam, M. S, M. A. Majid, M. S. Alam, N. Ferdous and K. A. Bhuiyan.2003. Bio-physical and Socio-economic Scenario of the High Barind Farms: A Study on Farmers' Perceptions with Emphasis on Rice, Journal of Agriculture and Rural Development.Vol.1(1).

Samina, Z, S.Ahmed, D. Majumder and M. Rahman. 1996. Characteristics of the Production System at Constraining Site: The Case of Hamidpur Baor. Research Report, Investigation of Flood Plain Production Systems, Natural Resources Systems Program, LWI Production System, ODA, Dhaka

Zaman, S. M. H. 1986. Current Status and Prospects for Rainfed Foodgrain Production in Bangladesh, BRRI Publication No 75, Bangladesh Rice Research Institute, Gazipur-1701.