

Short duration rice varieties for the High Barind Tract of Bangladesh: the Initial impact of varieties from client oriented breeding and selection in Nepal

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EXECUTIVE SUMMARY

This paper describes the huge potential impact that products of client-oriented breeding (COB) in Nepal can have on improving rice production in Bangladesh. Studies in Bangladesh found that short duration rice (SDR) varieties bred by COB in Nepal out-performed all other varieties.

Participatory research on transplanted main season (*t. aman*) rice was conducted in 2003 in the HBT of Bangladesh to identify farmer-preferred rice varieties that gave high returns, fitted with local cropping patterns and that could enhance productivity and crop diversity. In 2003, over 190 farmers participated in the trials and in seed production.

Eleven rice varieties were introduced from Nepal. The first five varieties had previously been identified using participatory method by the NGO Local Initiatives for Biodiversity Research and Development (LI-BIRD) and CAZS, University of Wales, Bangor. The remaining six varieties were bred using client-oriented breeding by a LI-BIRD–CAZS–NARC collaboration.

Participatory varietal selection (PVS) was used to test the varieties in mother and baby trials. In these trials farmers tested the varieties in their fields using farmers' levels of inputs. The rice varieties were evaluated using focus group discussion, preference ranking, household level questionnaires and in depth interviews.

Grain and straw yields of the SDRs from Nepal were similar to, or exceeded, the check varieties that were the farmers' customary varieties and the recent, recommended varieties from BRRI. The highest yielding, Judi 567, out-yielded the most productive check variety, Swarna, by 34%. All the SDRs from Nepal were significantly earlier than the check varieties and as much as three to four weeks earlier than the most widely grown variety Swarna.

Most of the new varieties were preferred to the check varieties in all locations because of their early maturity, high yield potential, good grain quality, market price, input responsiveness, lodging-resistance and ease of threshing.

The majority of collaborating farmers intended to grow the test entries in the either or both of the main (*aman*) or *boro* (winter) seasons. The demand for the seeds of new varieties is increasing in all the project villages. Farmer-to-farmer seed spread was found.

Spillover effect in the boro season

Farmers decided to grow the SDRs during the *boro* season because they had appreciated their performance in the previous season. They said that the SDRs:

- Overall out-yielded all the existing *boro* rice varieties by over 30%.
- Were considered '*khara sahinsh*', meaning drought-tolerant, by the participating farmers. There was a saving of 2-3 irrigations with SDRs as they matured earlier and were more drought-tolerant.
- Required less fertilizer and were more responsive to the applied inputs.
- Did not lodge.

- Have better grain quality, required less cooking time and taste better.
- Fetched a similar price in the market to that of the best selling *boro* varieties, such as Minikit.

Monitoring showed that 410 kg of seed of various SDRs was distributed to 67 farmers by 11 farmers in the villages (a six-fold increase in farmer number, and averaging over 6 kg of seed per farmer).

The project has greatly increased farmer access to a choice of new, short duration, farmer-preferred rice varieties in the rural HBT of Bangladesh using a simple, rapid, and cost-effective approach to identifying and disseminating new rice varieties.

INTRODUCTION

Rice systems in Bangladesh

Rice, the staple food crop of Bangladesh, is grown on over 10 million ha and it is historically associated with culture, rites and rituals of Bangladeshi people. The millennium development goal of the elimination of extreme poverty and hunger can only be met in Bangladesh by increasing rice productivity as it accounts for 95% of food grain production. Over 90% people depend on rice for their daily diets and it engages over 65% of the total agricultural labour force. Among the rice growing countries of the world, Bangladesh ranks third in area and fourth in production (Huke and Huke, 1990).

The rice-growing ecosystems in Bangladesh are diverse and modern varieties cover almost 56% of the total rice area (Das *et al.*, 2001). The various types of rice grown in Bangladesh are summarised in Table 1. BRRI-developed rice varieties are suitable for favourable rice growing ecosystems but there has been lower adoption of these varieties in less favourable conditions.

Table 1. Types of rice culture and their relative importance in Bangladesh.

Rice type	Normal growing period	Area (million ha)	Area (%)
Broadcast <i>aman</i> (includes deep water rice)	Jun-Dec	0.8	7
Transplanted <i>aman</i>	Jun-Dec	4.9	46
<i>Boro</i> (winter, irrigated)	Dec-Apr	3.7	34
<i>Aus</i> (mainly broadcast)	Apr-Aug	1.4	13
Total		10.7	

Source: Bhuiyan (2004); data are for 2000.

More than 3 million ha of rice is affected by drought during both the dry and wet seasons (Das *et al.*, 2001). A considerable area of *boro* rice in the High Barind Tract (HBT) is grown under partially irrigated conditions, especially in recent seasons, due to declining water tables and decreasing supply of electricity for deep tube wells. As a result, farmers in all the study villages of the study strongly desired to have drought-tolerant *boro* rice varieties.

The human development scenario

Nearly 30% of the population live below \$1 a day and nearly 80% are below \$2 a day. About 35% of people are under nourished and nearly 48% of children below 5 years of age are under weight and 45% show stunted growth. While the per capita income was one of the lowest in the world, the density of population was among the highest (UNDP, 2003).

The population of Bangladesh is increasing at 1.8% per annum and annual food deficit is 1.8 million tons (Uddin, 2001). The demand for rice is rapidly increasing with the increase in population and this demand is the highest in Bangladesh among the least developed countries (Virmani *et al.*, 1997). Contrary to this, the increase in

the productivity of rice is hardly keeping pace with the population growth rate. In the last decade rice yields have failed to increase (Islam et al., 2001).

Background to the study

The HBT of Bangladesh is situated in the north-west of Bangladesh with an area of 1600 km² (160,000 ha). The predominant soil type is silty loam to silty clay loam with very low organic matter content, high bulk density, and low pH. The rainfall in the area is erratic and low (average 1300 mm per annum) and is concentrated between June and September. The only traditional crop grown during the rainy season is *t. aman* rice, provided that the rain arrives in time. Lands remain fallow in the winter (*rabi* season) after the harvest of *t. aman* rice. In recent years, farmers have started to grow *rabi* season crops on residual soil moisture (e.g. chickpea, linseed, barley, mustard) with chickpea, in particular, being successful and promoted by PROVA (Peoples Resource Oriented Voluntary Association) in collaboration with CAZS.

In order to ensure the timely sowing of *rabi* crops in November in the HBT there is a need to identify *t. aman* rice genotypes of considerably shorter duration than the commonly cultivated Swarna, but with comparable yields and grain quality. Some BRRI-released rice varieties with shorter durations than Swarna are available, namely BRRIdhan 32, 33 and 39, but these varieties have various shortcomings and have not been readily adopted by farmers in the HBT.

In the 2002 rainy season, seven short duration rice varieties were supplied to PROVA by LI-BIRD through the CAZS research coordinator based in Kathmandu. LI-BIRD and CAZS have been jointly working in Nepal to develop rice varieties using client-oriented breeding (COB) approaches (also called participatory plant breeding, PPB) for a range of agroecological conditions.

Participatory varietal selection (PVS) procedures are increasingly being used to involve farmers in the varietal selection process, and thereby increase the likelihood of farmer adoption of superior varieties (Witcombe *et al.*, 1996; IPGRI, 1996; Weltzein *et al.*, 2000; Witcombe *et al.*, 2002). This study used the PVS procedures recommended by Witcombe *et al.* (2002).

METHODS

‘Mother’ and ‘Baby’ trials were used in this study. Mother trials are analogous to on-station research trials in that they generate statistical data on yield per unit area. Baby trials are designed to give data on farmers’ perceptions and acceptance of varieties. The Mother trials comprised a multi-entry, single replicate trial, replicated across several farmers whilst the Baby trials involve paired comparison of new varieties with the farmer’s existing variety under the farmer’s own management conditions.

Mother trials

Two sets of Mother trials were conducted during the 2003 season. Mother trial ‘A’ involved rice varieties previously evaluated during the 2002 season, while Mother trial ‘B’ had a new set of entries that were bred using COB approaches (Tables 2 and

Table 3). Mother trials ‘A’ and ‘B’ were conducted across one *Upozilla* (sub-district), each consisting of three districts and with three participants in each¹.

Baby trials

Five varieties were included in the Baby trials across three districts (Table 4) involving 155 farmers (However, data were collected from 78 farmers). Grain yield data were available from 42 farmers; 14 for Pant Dhan 10, 10 farmers for Judi 582, 7 farmers each for Sugandha 1 and Ekhattar and only four farmers for PNR 381. Post-harvest evaluation data were available for 78 farmers (Table 4).

Table 2. Summary of mother trials and seed production using short duration rice varieties (SDRs) from Nepal, 2003.

Activity	SDR variety	Number of participating farmers (replication) by sub district		
		Godagai	Porsha	Nachole
Mother Trial ‘A’	PNR 381, Pant Dhan 10, Ekhattar, Sugandha 1, Judi582, BG 1442 Swarna, BRRIdhan 32, BRRIdhan 39	3	3	3
Mother Trial ‘B’	Barkhe 2001, Judi 565, Judi 566, Judi 567, Swarna, BRRIdhan 32, BRRIdhan 39	3	2	3
Seed production	Pant Dhan 10, Sugandha 1, Judi 582, BG 1442, BRRIdhan 32, Judi 565, Sarwati, BRRIdhan 39, Barkhe 2001, Judi 566, Judi 567	20	-	-

Evaluation

The Mother and Baby trials were evaluated by measuring quantitative traits, farm walks, focus group discussion (FGD) and farmers’ preference ranking. Household-level questionnaires (HLQ) were done only in the case of Baby trials.

Statistical analysis

Analysis of variance was done for grain and straw yield data for the Mother trials using Genstat (version Genwin32). A paired t test was done for Baby trial data for four varieties; PNR 381 was excluded from this analysis there were too few replicates. Farmers’ perceptions from both Mother and Baby trials were analysed using SPSS 11.

¹One of the Mother ‘B’ trials could not be planted at Naogaon as the seedlings were stolen and so there were only 8 participants for this trial set.

Table 3. Details of the short duration rice varieties which were identified by PVS or bred by COB in Nepal and used in participatory trials and seed production, 2003.

Name of rice variety	Year of introduction	
	by PROVA	Origin
Barkhe 2001	2003	COB, Nepal
BG 1442	2002	PVS, Nepal
Ekahattar	2002	IRRI
Judi 565	2003	COB, Nepal
Judi 566	2003	COB, Nepal
Judi 567	2003	COB, Nepal
Judi 582	2002	COB, Nepal
Pant Dhan 10	2002	PVS, Nepal
PNR-381	2002	PVS, Nepal
Sarwati	2002	PVS, Nepal
Sugandha 1	2002	COB, Nepal

Table 4. Distribution of baby trials using short duration rice varieties (SDRs) from Nepal in various villages in High Barind Tract, Bangladesh, 2003

District, <i>Upozilla</i> (Sub- district)	Village	Number [†] of baby trials by varieties					Total
		Pant Dhan 10	Sugandha 1	PNR 381	Judi 582	Ekhattar	
Rajshahi, Godagari	Chaubisnagar	5	1	2	2	2	12
	Kakanhat	-	2	1	1	1	5
	Digram	1	1	1	1	-	4
	Amoti	-	1	1	2	-	4
	Hatatpara						
	Kazipara	1	2	-	1	-	4
Naogaon, Porsha	Amtoli	-	-	-	-	1	1
	Shoharanda	4	2	1	3	-	10
	Uporsisha	1	1	1	1	-	4
	Jofarpur	1	1	1	1		4
Nawabganj, Nachole	Ghatnagar	3	-	-	2	1	6
	Baypur	4	4	-	2	-	10
	Borandha	1	1	-	2	-	4
	Pukriyapara	1	1	1	-	2	5
	Nizampur	-	2	-	2	1	5
	Total	22	19	9	20	8	78

[†] - indicates no baby trial was given

RESULTS AND DISCUSSION

Results from 2002 season

Promising results were obtained for five of the new varieties, showing yields greater than or equal to the check cultivars BRRIdhan 32 and Swarna and having durations 3-4 weeks shorter than the checks. Judi 582, which is a product of COB, had the highest grain yield and was three weeks earlier to mature than Swarna, the latest variety in the trial (Table 5).

Table 5. Varietal performance (in two farmers fields) of short duration rice varieties from Nepal under rainfed conditions in Rajshahi, Bangladesh and differences in maturity between varieties grown in Bangladesh and Nepal, 2002 (Rajshahi data are based on two observations).

Rice variety	Days to maturity in:		Yield (t ha ⁻¹)	
	Rajshahi	Chitwan Nepal	Grain	Straw
Judi 582	118	120-125	4.0	5.2
Ekahattar	109	120-125	3.9	4.3
Ekahattar	109	120-125	3.9	4.3
PNR-381	119	110-115	3.8	5.5
Sugandha 1	107	120-125	3.8	5.1
Pant Dhan 10	104	115-119	3.8	3.7
Swarna	139	160-165	3.3	4.5
BG 1442	102	110-115	3.3	3.1
BRRIdhan 32	136	NA	3.7	5.7
Sarwati	113	120-125	3.1	5.5
Mean	116	122-127	3.7	4.7

NA = not applicable

Results from 2003

Mother trials

Mother trial 'A'

The grain and straw yields of the short duration rice (SDR) varieties were comparable to, or better than, those of the three check varieties, Swarna, BRRIdhan 32 and BRRIdhan 39. Judi 582 produced the highest grain yield, followed by Pant Dhan 10 and BRRIdhan 39 (Table 6). Similarly, Judi 582 produced the greatest straw yield (Table 6).

Differences in crop maturity were highly significant ($P < 0.001$). The SDRs from Nepal and the 'check' varieties fell into four distinct maturity classes: BG 1442, Pant Dhan 10 and Ekhattar were the earliest group; PNR 381, Sugandha 1 and Judi 582 the medium maturity group; whilst the 'check' varieties BRRIdhan 32, BRRIdhan 39 and Swarna were the latest (Table 6).

Table 6. Grain and straw yield and crop duration of the short duration rice varieties from Nepal and the three 'check' varieties (i.e. Swarna, BRRIdhan 39 and BRRIdhan 32) grown under farmers management across the High Barind Tract of Bangladesh, 2003 (Mother trial 'A'). Means of three districts (Rajshahi, Naogaon and Nawabganji).

Rice variety	Grain yield (t ha ⁻¹)	Straw yield (t ha ⁻¹)	Crop duration (days)
Judi 582	2.8	3.9	111
Pant Dhan 10	2.4	3.4	100
BRRIdhan 39	2.2	3.7	117
PNR 381	2.1	3.1	112
Swarna	2.0	3.7	128
Ekhattar	2.0	3.6	101
Sugandha 1	1.9	3.3	109
BG 1442	1.9	2.9	99
BRRIdhan 32	1.8	3.3	116
Mean	2.1ns	3.4ns	110***
SE	±0.34	±0.44	±1.9

In addition to measured yield, several focus group discussions (FGDs) were organized to obtain the preference rankings of test entries by the farmers at different locations (Table 7). Judi 582 was consistently and significantly ranked the best by farmers in all the three regions, followed by Pant Dhan 10. The check varieties Swarna, BRRIdhan 32 and 39 were significantly the least preferred even though Swarna and BRRIdhan 32 were not the lowest yielding. The reasons for preference of Swarna over BRRIdhan 39 are several; BRRIdhan 39 is susceptible to gall midge, has coarser grains so it fetches a lower price in the market and it also takes more time to cook and does not taste as good.

Table 7. Summary of overall mean preference ranks[§] for short duration rice varieties from Nepal across three districts of High Barind Tract of Bangladesh, 2003 (Mother trial 'A')

Variety	Rajshahi				Naogaon				Nawabganj				Overall mean preference rank
	1 n = 7	2 n = 7	3 n = 10	Site mean rank	1 n = 8	2 n = 5	3 n = 9	Site mean rank	1 n = 8	2 n = 5	3 n = 9	Site mean rank	
Judi 582	3	1	2	2	1	1	1	1	1	2	1	1	1
Pant Dhan 10	1	4	2	2	2	2	2	2	2	0	0	1	2
PNR 381	5	2	1	3	4	3	5	4	6	1	2	3	3
Sugandha 1	2	5	2	3	6	5	3	5	5	4	3	4	4
BG 1442	3	6	5	5	5	8	5	6	4	0	0	1	4
Ekhattar	6	2	6	5	8	7	6	7	3	7	7	6	6
Swarna	7	7	7	7	6	4	4	5	7	3	5	5	6
BRRIdhan 32	8	8	8	8	9	0	8	6	8	5	6	6	8
BRRIdhan 39	9	9	7	8	7	6	7	7	9	6	4	6	8
Mean													4.6***
S.e.d.													0.7

[§] 1 = best, 9 = worst; n = number of farmers participated in the ranking

Mother trial 'B'

There was significant difference among test varieties for grain yield. Judi 567 was the highest yielding variety followed by Barkhe 2001 and Judi 566 (Table 8). Judi 567 yielded 34% more than Swarna, the highest yielding among the check varieties. Judi 567 also had the highest straw yield, followed by both Swarna and BRRIdhan 39 (Table 8).

There was no effect of location on the grain yield indicating that the rice varieties would perform similarly across a range of environments close to those used in the trials.

There were significant differences in crop duration ($P < 0.001$) with the new SDRs from Nepal as much as 3 to 4 weeks earlier than the check variety Swarna (Table 8).

Table 8. Grain and straw yield and crop duration of short duration rice varieties from Nepal and the three 'check' varieties (i.e. Swarna, BRRIdhan 39 and BRRIdhan 32) grown under farmers management across the High Barind Tract of Bangladesh, 2003 (Mother trial 'B'). Mean of three districts (Rajshahi, Naogaon and Nawabganj).

Rice variety	Grain yield (t ha ⁻¹)	Straw yield (t ha ⁻¹)	Crop duration (days)
Judi 567	3.5	4.7	102
Judi 566	2.7	3.7	99
Judi 565	2.6	3.6	99
Swarna	2.5	4.1	128
Barkhe 2001	2.5	3.9	115
BRRIdhan 39	2.5	4.1	116
BRRIdhan 32	2.1	3.7	115
Mean	2.7**	4.0**	111***
S.e.d.	0.32	0.3	2.2

Several FGDs were organized for the Mother 'B' trials. Preference ranking for the short duration rice (SDR) varieties relative to the check varieties revealed that Judi 567 was consistently and significantly the most preferred variety followed by Barkhe 2001 (Table 9). The farmers overall preference ranks for SDR varieties agreed perfectly with the grain yield of the varieties.

Table 9. Summary of overall mean preference ranks[§] for short duration rice varieties from Nepal across three districts of the High Barind Tract of Bangladesh, 2003 (Mother trial 'B')

Variety	Rajshahi				Naogaon			Nawabganj				Overall mean preference rank
	1 n = 7	2 n = 7	3 n = 10	Site mean rank	1 n = 8	2 n = 5	Site mean rank	1 n = 8	2 n = 5	3 n = 9	Site mean rank	
Judi 567	1	1	1	1	1	1	1	1	1	1	1	1
Barkhe 2001	2	1	2	2	2	2	2	2	2	3	2	2
Judi 566	4	4	3	4	3	3	3	3	6	2	4	3
Judi 565	3	3	4	3	6	4	5	4	4	5	4	4
Swarna	5	6	5	5	5	6	6	4	3	3	3	5
BRRIdhan 39	7	7	6	7	4	4	4	7	4	6	6	5
BRRIdhan 32	6	5	6	6	7	6	7	6	6	7	6	7
Mean												3.9***
S.e.d.												0.5

[§]1 = best, 7 = worst; n = number of farmers participated in the ranking

Baby trials

In the Baby trials the test varieties did not significantly differ from the check varieties except for Pant Dhan 10 (Fig. 1)². Pant Dhan 10 gave almost a 14% yield advantage over all the check varieties. However, the test varieties were significantly earlier maturing than the check varieties (Fig. 2). Early maturity is an important trait across the HBT of Bangladesh as late maturing varieties such as Swarna or the BRRI lines are susceptible to yield losses caused by end-of-season drought. Another very important implication of early maturity is that the succeeding winter crops planted after a late variety (e.g. Swarna) are subjected to greater of drought stress and hence poor stand establishment at the time of late planting.

Post harvest evaluation of the SDR varieties from Nepal revealed that 100% of farmers considered them to be earlier maturing than the check varieties (Table 10). Farmers were also overwhelmingly of the opinion that grain quality of all the SDRs was superior. In the case of grain yield, however, the response was more variable with the majority of farmers considering only Judi 582 and Pant Dhan 10 to be higher yielding than the check varieties (Table 10).

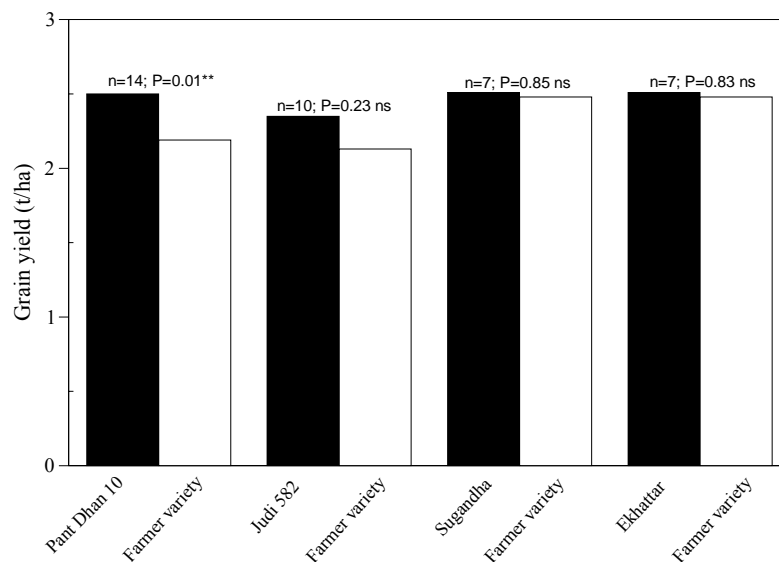


Figure 1. Comparison of grain yield of short duration rice varieties from Nepal and farmers' varieties under farmers' management in the High Barind Tract of Bangladesh, 2003 (Baby trial), where *n* is the number of participating farmers and *P* the level of significance for the comparison.

² This is not unexpected as the number of trials for the non-significant cases is never above 10.

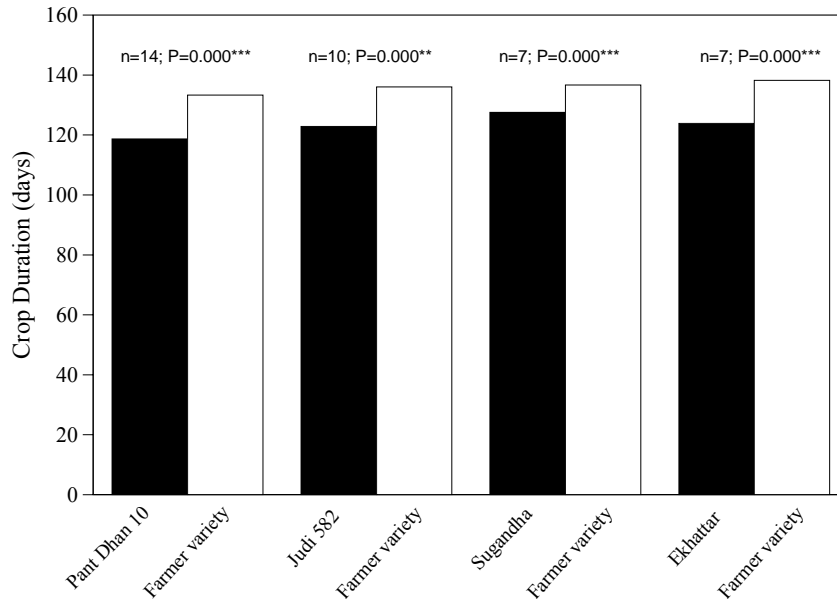


Figure 2. Comparison of crop duration of short duration rice varieties from Nepal and farmers' varieties under farmers' management in the High Barind Tract of Bangladesh, 2003 Baby trials, where n is the number of participating farmers and P the level of significance for the comparison.

For market price, 100% farmers said that PNR 381 would fetch a higher price than existing check varieties, and over 70 said this for the rest of the varieties except Ekhattar. The most interesting and important message from the household level evaluation is that the majority of the farmers were in favour of growing the SDRs next year. The most preferred were Judi 582, Pant Dhan 10 and PNR 381 (Table 10).

These exercises really show the power of participatory approaches. Farmers' decisions to continue growing SDRs next year are not only based on the level of grain yield alone. Several other criteria were also important in influencing farmers' adoption decisions.

Table 10. Farmers' perceptions of short duration rice varieties from Nepal across three districts of the High Barind Tract of Bangladesh relative to check varieties.

	Number of Farmers			Percentage of farmers preferring the SDR from Nepal	Probability ¹
	SDR from Nepal preferred	SDR and check variety equally preferred	Check variety preferred		
Judi 582					
Earliness	13	0	0	100	<0.001
Grain yield	10	2	1	77	Ns
Grain quality	11	2	0	85	<0.05
Market price	10	2	0	83	Ns
Growing next year	12	0	1	92	<0.01
Pant Dhan 10					
Earliness	21	0	0	100	<0.001
Grain yield	15	2	4	71	<0.05
Grain quality	20	1	0	95	<0.001
Market price	15	6	0	71	<0.001
Growing next year	20	0	1	95	<0.001
Suhgandha 1					
Earliness	24	0	0	100	<0.001
Grain yield	9	4	10	39	Ns
Grain quality	21	2	1	88	<0.001
Market price	20	4	0	83	<0.001
Growing next year	17	0	7	71	Ns
PNR 381					
Earliness	9	0	0	100	<0.01
Grain yield	4	2	3	44	Ns
Grain quality	8	1	0	89	<0.05
Market price	9	0	0	100	<0.01
Growing next year	9	0	0	100	<0.01
Ekhattar					
Earliness	8	0	0	100	<0.05
Grain yield	1	1	6	13	Ns
Grain quality	6	2	0	75	<0.05
Market price	0	8	0	0	<0.05
Growing next year	6	0	2	75	Ns

¹from χ^2 test

Quality and disease attributes of rice varieties included in Mother and Baby trials

A few important quality traits and disease scores of rice varieties developed through COB have been summarised (Table 11). In COB it is essential that all entries are tested in a disease screening nursery.

Table 11. Summary of the quality and other traits of COB lines.

Rice variety	Milling %	Eating quality	Disease score		Ease of threshing
			Blast	BLB [†]	
Judi 565	65	Selected by the test panel	0	5	Easy
Judi 566	69	Selected by the test panel	1	5	Easy
Judi 567	69	Selected by the test panel	3	5	Easy
Judi 582	68	Moderately preferred	NA	NA	Hard
Sugandha 1	68	Selected by the test panel	1	7	Easy

[†] BLB = Bacterial leaf blight

Source: LI-BIRD unpublished data

Community based seed production programme

Considering the popularity of the rice varieties in the Mother and Baby trials, PROVA initiated community based seed production in different parts of the project villages. In total over 2.3 t of rice seed (see Annex 2) was procured from the farmers, and a quantity of the seed of each variety was left behind with the participating farmers for their own use and also to encourage farmer-to-farmer seed dissemination. The collected seed was used in composing Mother and Baby trials, seed multiplication and also used as Informal Research and Development (IRD) kits in order to disseminate the farmer-preferred varieties much more widely. Some of the seed of these varieties were also shared with the network of the Wheat Research Centre (WRC) and BIRRI Regional Station, Rajshahi.

Spillover effect on boro rice in 2003 – 2004

The project did not plan any activities for the *boro* rice season (i.e. winter season under irrigation). Later the project staff discovered that farmers in most of the project villages assessed most of the varieties that were in Mother and Baby trials during the *t. aman* season for their suitability as *boro* rice. Farmers have been growing a number of the varieties promoted through the informal system e.g. Minikit, Pariza, Noinmony and a few cases of BRRIdhan 28, which is an officially recommended *boro* rice variety. A crop cut survey in the *boro* season revealed that new rice lines introduced as *t. aman* varieties performed much better than BRRIdhan 28 (Fig. 3).

The overall yield advantage for the new varieties from crop cut data over all the existing *boro* varieties was 20% while the yield advantage of all the new varieties over BRRIdhan 28 was 31%. These data very much agree with the information from the in-depth interviews with selected farmers and strengthens our previous findings that farmers' perceptions are as reliable as quantitative data.

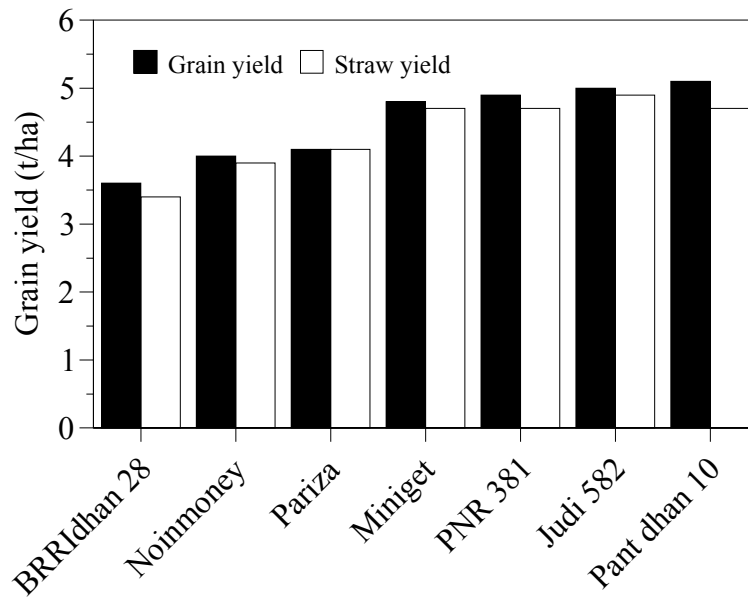


Figure 3. Comparative performance (assessed by crop cuts) of short duration main season rice varieties from Nepal grown as *boro* rice under farmers' management in High Barind Tract of Bangladesh, 2004.

Findings from in depth interviews with selected boro rice farmers

A short visit was organized in a few villages of the HBT of Bangladesh in May 2004 to monitor farmer uptake of the SDR varieties from Nepal as *boro* rice. Although these introduced varieties were mainly targeting *t. aman*, some farmers grew a few of these rice varieties in the *boro* season as well. The source of seed for these farmers was their own retained seed or from the seed obtained from farmer-to-farmer seed spread. The Judi rice lines were developed for the *Chaite* season rice planted during the month of February-March and harvested in June-July. In Nepal so they have some seedling-stage cold tolerance as well as drought tolerance.

The team visited a few households in various villages in Rajshahi district. Although the *boro* rice crop was already harvested the farmers were busy with threshing and other post-harvest operations. The main findings from the visit are summarised in Table 12 and individual in depth case studies are described separately below.

Table 12. Summary of farmers' uptake of short duration main season rice varieties from Nepal for *boro* planting in the High Barind Tract of Bangladesh, 2004

Farmer	District	Village	Variety Grown		Area SDR m ²	Yield (t/ha)		Seed sold:		Willingness to grow <i>t. aman</i>	Remarks
			Local	SDR		Farmer's variety	SDR	kg	no of farmers		
1. Nazurul Islam	Rajshahi	Chaubisnagar	BRRIdhan 28	Pant Dhan 10	998	3.6	4.1	100	20	✓	Seed sold also included that of Judi 582 & BG1442, intends to grow during <i>boro</i> also
2. Rojab Ali (A)	Rajshahi	Chaubisnagar	Parija, Nain Muni	Pant Dhan 10	1330	3.6	4.9	-	-	✓	He will find out more in <i>t. aman</i> & then decide whether to go for <i>boro</i>
3. Rossal	Rajshahi	Godagari		BG 1442	96	-	7.8			✓	Intends to grow in <i>aus</i> also
4. Rojab Ali (B)	Rajshahi	Chaubisnagar	BRRIdhan 28	Judi 582	333	4.5	5.6	100	20	✓	Seeds of Pant Dhan 10 sold but not Judi 582
5. Soyjuddin	Rajshahi	Godagari	Nain Muni	Pant Dhan 10	133	4.2	5.1	90	8	✓	
6. Rabi Tudu & Srimati Tudu	Rajshahi	Chaubisnagar	Parija, BRRIdhan 28	Pant Dhan 10	998	3.3	4.9	10	1	✓	
7. Lutfar Rahman		Nabogram	BRRIdhan 28	Judi 582	1995	1.8	3.0	-	-	✓	The variety was grown under harsh conditions
8. Arman Ali	Rajshahi	Parmanandpur	BRRIdhan 28	Sugandha 1	333	3.9	4.2	4	2	✓	
9. Kurban Ali	Rajshahi	Parmonandpur	BRRIdhan 28	Judi582	865	4.5	6.0	20		✓	Seed demand from the neighbours
10. Nazurul Islam	Rajshahi	Parmonandpur	Minikit	PNR 381	1663	4.2	6.0	75	15		Kurban Ali's father
11. Abdullahaziz		Digram	BRRIdhan 28	Judi 582	1663	4.2	6.0	15	1	✓	
Total					10407			414	67		

SDR= short duration rice; yield data are based on farmers' observations.

Nazzurul Islam, Chaubisnagar owns about 15 *bigha*³ of land.

- He grew Pant Dhan 10 during the *boro* season and produced 405 kg from 3/4 of a *bigha* compared with a yield of 390 kg from the same area during the *t. aman* season. He knew that the lower yield in *t. aman* season was due to late planting. His neighbours who planted in time got better yields.
- He now knows a lot more about the quality traits of this variety, e.g. it has very good cooking and eating qualities, grains are medium fine.
- It also has drought tolerance hence requires less irrigation while BRRI varieties need 2-3 irrigations more than Pant Dhan 10. Irrigating one *bigha* land requires about Tk 90 (\$ 1.6) per irrigation and this is also a saving in the case of short duration rice varieties. During the *boro* season there is generally a lack of diesel and electricity, this further complicates efforts to avoid subjecting longer-duration varieties to moisture stress. Pant Dhan 10 is safer as it is earlier.
- He mentioned that early maturity is also desirable as rice can escape potential damage from the storms and also pre-monsoon rain that may affect yield or quality of the produce or both.
- He also reckoned that Pant Dhan 10 requires nearly 50% less fertilizer compared to BRRI varieties with a saving of about Tk 120/*bigha* (\$ 2.1/*bigha*).
- Pant Dhan 10 is also easier to thresh and saves on threshing time even using the pedal thresher.
- He mentioned that during the *boro* season BRRI varieties tended to lodge heavily as they were taller causing considerable yield loss. Pant Dhan 10 with stiff straw did not lodge.
- 20 farmers already approached him for the seed. Of these, 12 took Pant Dhan 10, while 8 farmers took either Judi 582 or BG 1442.
- The grain expands on cooking

- It takes about 10-15 minutes less time than Swarna for cooking with important savings on fuel that is scarce.
- He put more emphasis on the early maturity of Pant Dhan 10 as it needs 100-110 days in the field (nearly 45 days in the nursery) during the *boro* season compared to 145 days for BRRI dhan 28 and 155 days for BRRI dhan 29.



Nazzurul Islam with a sample of Pant Dhan 10 rice

Nazzurul said "I sold or exchanged over 100 kg of rice seed this year".

He intends to expand the area under new short duration rice varieties including Pant Dhan 10.

³ *Bigha* is a local unit of measuring land in Bangladesh. 1 *bigha* = 1,330 m², 20 *kattha* = 1 *bigha* and 1 *kattha* = 66.5 m².

Md Rajob Ali (A), Chaubishanagar owns 15 *bigha* of land.

- He planted Pant Dhan 10 in 1 *bigha* land and harvested 16.5-*maund/bigha* rice, though he expected to have 20 *maund/bigha*. He thought that the weight of Pant Dhan 10 was less than Swarna which might explain the lower yield. From the same field last year, he harvested about 16 *maund/bigha* from Parija and 14 *maund/bigha* from BRRIdhan 28.
- He recalls that there was less rainfall, less cloudy sky and less insect attack. But yield levels were not very high and with this management BRRIdhan 28 may have given only 12-13 *maund/bigha*.
- His observation on the nutrient responsiveness of Pant Dhan 10 was that given the same amount of fertilizer as Parija and Nain muni, Pant Dhan 10 responded more.
- Since Pant Dhan 10 did not lodge, it was easier to harvest, as plants were standing erect. His experience had been that it is really cumbersome to harvest a lodged crop of rice.

- He was constantly keeping an eye on the market prices for various rice varieties and found that Minikit⁴ variety was selling at Tk 310/*maund* (\$5.4 per 40 kg), Pant Dhan 10 at Tk 300/*maund* (\$5.3 per 40 kg) and BRRIdhan 28 at TK 270/*maund*.
- His strategy, as he shared with the team, was that he wished to sell Pant Dhan 10 and consume a relatively coarser variety.
- He intended to grow Pant Dhan 10 during *t. aman* and find out more about the variety then he would decide on whether to grow this variety next year in the *boro* season.



Rajob Ali (A) with a sack of Judi 582

Arman Ali, Parmonandpur, Godagari cultivated 11 *bigha* of land of which he owned just 1 *bigha*, the rest was rented in.

- During *t. aman* he got 1 kg of Sugandha 1 seed from the project and planted in 5 *kattha* harvesting 2.25 *maunds*. He used some of the seeds for *boro* from the *t. aman* harvest and planted in 10 *kattha* and harvested 7 *maunds*.
- He was impressed with the grain and straw yields and the grain quality of this variety. The milling recovery of the rice was 60%.
- He found that the Pulao was a bit more sticky and hard but the steamed rice had very good flavour. He thought that this rice required much delicious curries to go with it and to him it seemed like a rich man's rice.



Arman Ali

- When this rice was cooked together with the chickpeas, it gives nicer taste. He gave 2 kg seeds each to two farmers during *t. aman* season.
- He intended to plant 5 kg seeds in 15 *kattha* of land all for his home consumption.

⁴ Minikit is an unidentified variety from India, initially included in the Minikit programme and subsequently known by the same name as it lost its original identity.

Rossal, Godagari owns 18-bigha land

- He tried BG 1442 in a small patch of land (96 m²) and harvested 75 kg rice.
- The variety was non-lodging
- He planned to grow 10 kg seed in *t. aus*, harvest the crop and use the same variety for *t. aman*. Following *t. aman* he would then grow chickpea. Hence he was planning to grow three crops of BG 1442 to exploit its early maturity.



Rossal - a farmer

Rojab Ali (B), Chuabishanagar owns 17 bigha of land.

- He grew Judi 582 in 5 *kattha* of land. He got 1 kg seed from PROVA during last *t. aman* season and harvested 75 kg and the same seed was used for planting during the *boro* season.
- It appeared that he was pretty satisfied with the performance of the variety and put it as "*sundar Dhan*" meaning beautiful rice in vernacular language. He made the following observations for this variety:
- There was no seedling mortality in the nursery under the foggy conditions as the variety was cold tolerant in the seedling stage. Under similar conditions, the seedling mortality for BRRIdhan 28 was quite high.
- "*Khara shahisnu Dhan*" means drought tolerant in vernacular language
- High yield: seeding was late, in spite of that the yield was quite high. Had other varieties been planted so late no reasonable harvest could be expected.
- It has more attractive grains and less chaffs compared to other *boro* varieties.
- Judi 582 is heavier in weight, an important criterion for the farmers.
- One of the unique observations by the farmer was that Judi 582 has an erect flag leaf and it extends quite close to the neck of panicle, i.e. neck of the panicle is short. He reckoned that this type of variety gives more yield compared to a variety having droopy flag leaves. BRRIdhan 28 seems to have drooping leaves with long neck of the panicle.
- Is early maturing
- It did not lodge even under adverse conditions (survived stormy winds) while BRRIdhan 28 did.



Rojab Ali (B) with his rice thresher.

Planted Judi 582 in a relatively less fertile land compared to BRRIdhan 28 and applied same amount of fertilizer but his observation was that it did well even under moderate fertility unlike BRRIdhan 28.

- Very uniform crop including synchronous flowering.
- Required less cooking time compared to BRRIdhan 28
- Better quality of *bhat* than BRRIdhan 28.
- Even *basi bhat* (stale rice, i.e. eaten considerable time after cooking!) is reasonably good while *basi bhat* of Minikit does not taste as good. Market price TK 300/*maund* similar to Parija
- No one had asked for seed of this variety yet.
- For Pant Dhan 10, more than 20 farmers came for seed and he bartered or sold about 100 kg when told the selling price was Tk 400/*maund* (\$ 7.0 per 40 kg).
- His plan for the coming season was to reduce area under BRRi varieties and increase area for new SDR varieties. He clearly mentioned that he wanted to diversify varieties to spread the risk

Soyjuddin, Godagari owns 15 *bigha* of land.

- He got 1 kg seed of Pant Dhan 10 as a Baby trial from the project last year *t. aman*, harvested 50 kg and used part of that harvest to grow in 2 *bigha* of land in *boro* season.
- He planted the crop late during *boro* season. Looking at the crop he expected 18-20 *maund/bigha* but he actually harvested 17 *maund/bigha*.
- The yield from Nain muni variety was only 12-13 *maund/bigha* while Minikit variety gave a yield of 14 *maund/bigha*.
- He mentioned that the flowering stage of Pant Dhan 10 met with a storm resulting in severe dropping of the flowers and ultimately a reduction in yield.
- The variety did not lodge and there was no yield loss from lodging
- Price of Pant Dhan 10 was same as Minikit or Parija.

- He intended to grow Pant Dhan 10 again in 2-*bigha* land during *t. aman*.
- 7-8 farmers have already taken the seed (about 10-15 kg per farmer). He felt that in a few years time most of the Godagari area would come under Pant Dhan 10.



Lutfar Rahman, Nabogram cultivated 12 *bigha* of land, of which 2 *bigha* belonged to him while he rented 10 *bigha*.

- He planted Judi 582 in 1.5 *bigha* and harvested 10 *maunds*. The crop was totally rainfed and experienced drought; even then it gave reasonable yield.
- He reckoned that other varieties would have just given 5-6 *maunds* under such harsh conditions, however, Judi 582 was better.
- He also planted BRRIdhan 28 and Parija which gave a yield of 6 *maunds* each *bigha*.
- He saw the difference within the Judi 582 crop stand; particularly in the patches where there was more moisture he found better performance.
- He intended to grow this variety in 4 *bigha* in *t. aman* season. It was learnt that the seedlings were raised at Parmanandpur, Godagari and carried about 20 km? to Nabogram for transplanting.



Lutfar Rahman

- He has yet to test the post harvest qualities, e.g., milling recovery and taste of *bhat*, etc, but without going for those he was pretty convinced and he intended to grow it in the coming season

Rabi Tudu and Srimati Tudu (Husband and wife), Chaubishnagar, Chaighati are landless farmers from a tribal ethnic group of Bangladesh, but cultivate about 3 *bigha* of land on a contract agreement at 3 *maund/bigha*.

- They planted Pant Dhan 10 in 15 *kattha* and harvested 12.5 *maund* (16.5 *maund/bigha*), which was more than both BRRIdhan 28 and Parija that gave about 12-13 *maunds bigha*.
- They reckoned that Pant Dhan 10 yields higher with the same amount of fertilizer and less water. Rabi also remarked that the variety had "*khara Sahishnu*" trait, i.e. drought tolerance.
- They did not come across any insect or disease problems on Pant Dhan 10. They were planning to grow Pant Dhan 10 in their entire contracted field in t. *aman* season.
- Another interesting point which Rabi Tudu shared with the team was that they kept Pant Dhan 10 for seed and home consumption while gave Parija to the owner and this was because they very much preferred the quality of this variety.
- Another remark made by them was that all the *boro* rice varieties that were in the village lodged but this did not lodge.
- Until now, two farmers have approached them for seed, one has already taken 10 kg while another asked for 20 kg but has not yet bought it.
- Another farmer (Rup Lal) who was listening to the discussion was pretty convinced and placed an order for seed with Rabi.



Rabi Tudu



Srimati Tudu

Kurban Ali, Parmanandpur owns 9-bigha land.

- He got 1 kg seed of Judi 582 in *t. aman*, season from the project and used the harvest from *t. aman* to plant in 13 *kattha* of *boro* crop harvesting 13 *maund*, about 20 *maund/bigha*. Whereas Minikit gave only 15 *maund/bigha*. In the coming season he wished to grow Judi 582 in 5 *bigha*.
- He found this new variety similar to Minikit in most traits, e.g. fertilizer requirement, tolerance to insect pests and diseases while Judi 582 was nearly 20 days earlier than Minikit variety and much higher yielding. He also knew about the quality traits of Judi 582, e.g. finer grains than BRRIdhan 28, good milling recovery with no or less breakage and moreover the quality of *bhat* was good. It also required less cooking time than BRRIdhan 28.



Kurban Ali with his wife busy in post harvest operations

- Kurban Ali also planted PNR 381 in 25 *kattha* and harvested 23 *maunds*. This was also given the similar management as for Judi 582 and Minikit variety.

Kurban's observations on Judi 582:

- It has better seedling vigour
- Medium height with stiffer plants and hence does not lodge
- It has better cold tolerance at seedling stage than BRRIdhan 28, as the mortality of the latter was quite high in the nursery.
- There was already 20 kg seed demand from the neighbours although not yet purchased.

Kurban's observations on PNR 381:

- It appeared that PNR 381 may require less fertilizer than other varieties. It gave good yield even under partially irrigated condition.
- Was later than Judi 582 but same as Minikit
- Got good yield with moderate care and maintenance
- He sold a total of 75 kg PNR 381 seed to 15 farmers.

Abdullahaziz, Digram owns 50 *bigha* of land. He got 1 kg of Judi 582 in a Baby trial from the project, harvested 50 kg and from that harvest, he planted this variety in 25 *Kattha* in *boro*.

- Although transplantation of the crop was late due to the shortage of electricity, he harvested a reasonable yield, i.e. 16.5 *maund/ bigha*, while other varieties gave 14 *maund* from a similar area.
- He clearly noticed that this variety had '*Khara Sahisnu*' trait i.e. drought tolerant.
- Its fertilizer requirement may be the same, but because of late planting it attracted more insect pests. He also noticed that other varieties lodged but this did not.
- The market price of Judi 582 was Tk300/*maund* (\$ 5.3 per 40 kg) compared Tk280/*maund* (\$ 4.9 per 40 kg) for most of the varieties and Tk 305/*maund* (\$ 5.4 per 40 kg) for Minikit.
- He was willing to grow this variety during the coming *t.aman* season. Somebody came and purchased 15 kg seeds of this variety from him. This he considered as a sign of success of this variety.

The team also came across an interesting case while discussing with Abdullahaziz, another farmer Abdul Kalam Azad, in the same village had developed a crop museum (i.e. collection of varieties) with 11 *boro* rice varieties in which Judi 582 was also included. It was learnt that;

- The crop museum was actually planted on rented land (rented 2.5 *bigha*).
- Of the 11 varieties, the highest yield of 4 t ha⁻¹ was obtained from Judi 582.
- A ranking exercise by the farmers was also done and Judi 582 followed by Minikit was the most preferred varieties.
- He intended to grow Judi 582 on about 10 *kattha* of land during the coming *t. aman*.

Conclusions from in depth studies

In spite of the very limited time spent in the community our discussions with the farmers revealed some very interesting information which is summarised below.

- Overall, SDRs out-yielded all the existing *boro* rice varieties by 32%.
- The yield advantage with Judi 582 was 37% and with Pant Dhan 10 over 29%.
- SDRs were considered '*khara sahinshu*', i.e. drought tolerant by the participating farmers. There was a saving of 2-3 irrigations with SDRs as they mature earlier and had more drought tolerance.
- Judi 582 was also considered to have cold tolerance and better seedling vigour.
- SDR varieties did not lodge.
- SDRs were considered to require less fertilizer and were more responsive to the applied inputs.
- SDRs have better grain quality, required less cooking time and taste better.
- SDRs fetch a comparable price in the market with that of the best selling *boro* variety, e.g. Minikit.
- All the farmers intended to grow them in the coming *t.aman* season. There was evidence of seed sale and exchange taking place in the community. These are the indicators of uptake and adoption of SDRs in HBT area.

WAY FORWARD

- The significant findings of this study should be shared with government organizations (GOs), non-government organizations (NGOs), community based organizations (CBOs), Consultative Group on International Agricultural Research (CGIAR) systems and donor communities working on rice research and development in Bangladesh. This wider collaboration will aid the scaling up of farmer-preferred technologies in order to promote more widely the benefits of the most promising rice varieties.
- As part of this process a workshop has been organized in October 2004.
- This study suggests that the SDR varieties are suitable for both the *t. aman* and *boro* seasons and quite likely beyond the HBT as well. There is a need to have

systematic evaluation of these varieties across domains in different seasons and outside the HBT area.

- It is proposed that efforts are made to initiate policy dialogue with the GO sector in Bangladesh to explore the possibility of institutionalizing the process and outputs of this initiative into the formal sector.

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ANNEX 1: General climatic conditions and rice planting operations in 2003

Rainfall pattern during the rainy season of 2003 in different parts of HBT, Bangladesh was variable and unreliable. There were also cases of unusually high rainfall in October when it was not so important for crops (Fig. A). Severe drought occurred from the last week of July through the whole of the August in Godagari. Similarly little rain fell in Porsha during August.

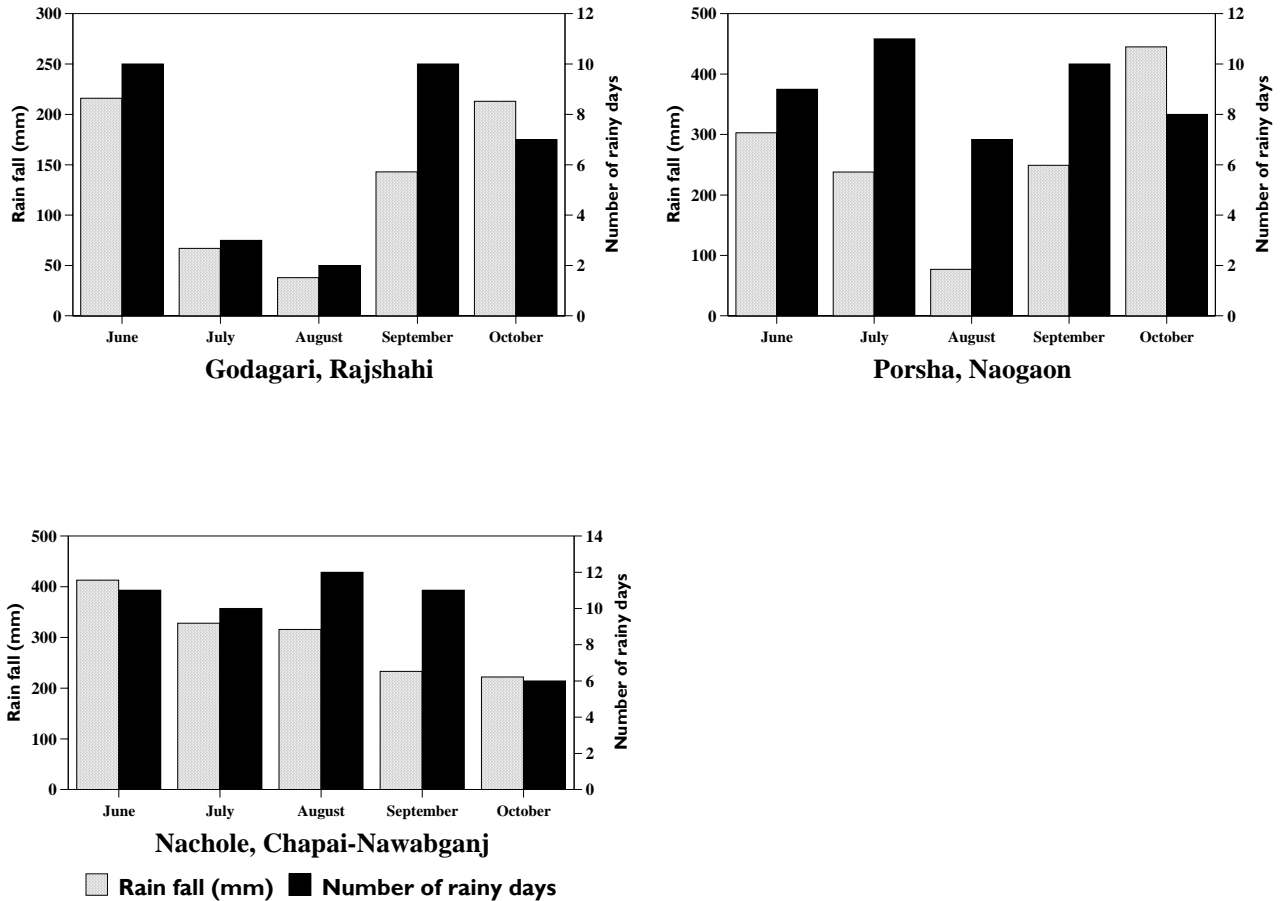


Figure A. Amount and distribution of rainfall at three upozilla of High Barind Tract of Bangladesh, 2003

Rice transplanting in HBT area started from the third week of July and continued until the middle of August (Fig. B). There was considerable difference in the timing of seeding and planting rice so that the age of seedlings differed quite markedly between Porsha, Godagari and Nachole. In the latter two upozilla, rice seeding and planting generally started much earlier than at Porsha.

The rice crop in general in the HBT area suffered from moisture stress both in the nursery bed and in the field. Because of severe drought much of the land in the Porsha area also remained fallow.

Seeding and planting time for rice in High Barind Tract (HBT), Bangladesh, September 03

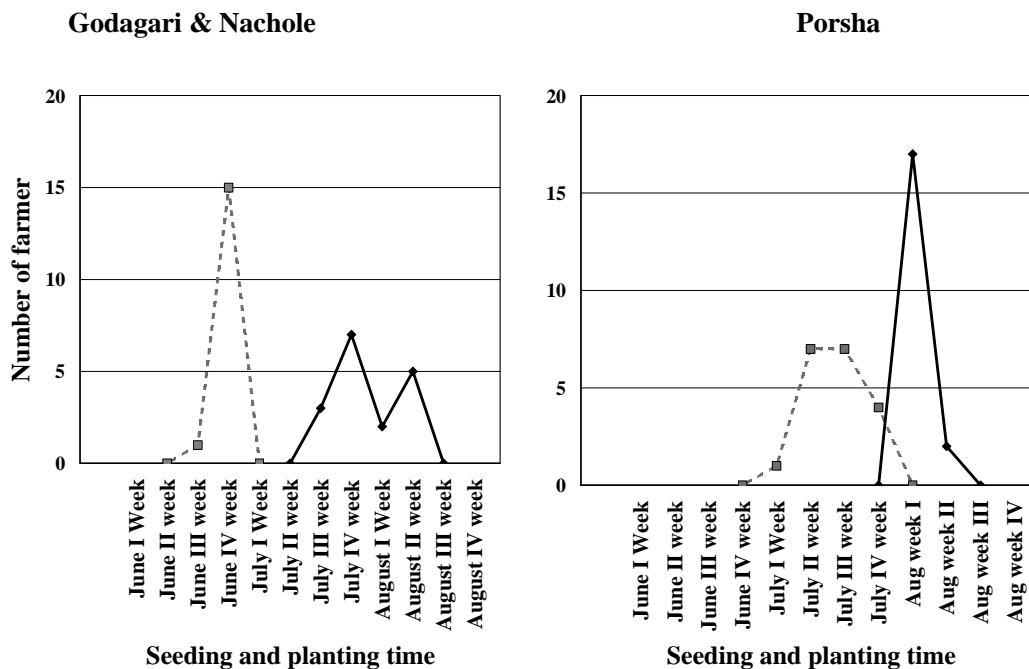


Figure B. Date of seeding (dotted lines) and transplanting (solid lines) of rice in the High Barind Tract (HBT) of Bangladesh, 2003.

ANNEX 2: *Community-based seed production*

Table A. Summary of community based seed production by PROVA in the High Barind Tract of Bangladesh, 2003

<i>Rice variety</i>	<i>Quantity of Seed (kg)</i>
Pant Dhan 10	1223
PNR 381	44
Ekhattar	27
Sugandha 1	189
Judi 582	323
Judi 565	22
Judi 566	23
Judi 567	28
Barkhe 2001	135
Sarwati	60
BG 1442	133
Swarna	40
BRRIdhan 32	32
BRRIdhan 39	45
BRRIdhan 40	20

