

Performance of Six Rice Hybrids Under Bangladesh Conditions

2003-04 Boro Season

Sub-project: Farmer's participatory field trial on rice hybrids
(SP # 1500)

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Md.Harun-Ar-Rashid

PI, Farmer’s participatory field trial on rice hybrids

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Glossary

AAS	=	Agricultural Advisory Society
AC	=	Area Coordinator
AID	=	Action in Development
AJ	=	Atmobiswas Jheneda
AKK	=	Aso Kaj Kari
AURD	=	Association for Urban and Rural Development
BADC	=	Bangladesh Agricultural Development Corporation
BARC	=	Bangladesh Agricultural Research Council
BASA	=	Bangladesh Association For Social Advancement
BBS	=	Bhai Bhai Sangstha
BD.	=	Bangladesh
BDSC	=	Beel Chalan Development Service Centre
Boro	=	Winter crop season
BRAC	=	Bangladesh Rural Advancement Committee
BRDB	=	Bangladesh Rural Development Board
BRRI	=	Bangladesh Rice Research Institute
CBOs	=	Community Based Organizations
CMS	=	Cytoplasmic Male Sterility
Co.	=	Company
CPS	=	Crop Production Specialist
DA	=	Dipshikha Anirban
DAE	=	Department of Agricultural Extension
DAP	=	Diammonium Phosphate
DD	=	Deputy Director
ED	=	Executive Director
FC	=	Field Coordinator
gm	=	Gram
ha	=	Hectare
IPM	=	Integrated Pest Management
JSKS	=	Jamuna Samaj Kalyan Sangstha
Kg	=	Kilogram
Ltd.	=	Limited
Mac-Bangladesh	=	Manifold Assistance Centre for Bangladesh
MBNMS	=	Madhabpur Bhahumukhi Nari Mukti Sangstha
min	=	Minute
MKS	=	Manab Kalyan Sangstha
MP	=	Muriate of Potash
MVs	=	Modern Varieties
NEDA	=	Natore Economic Development Association
NGOs	=	Non Government Organization
NKSS	=	Nishchitapur Krishak Samabai Samity
NSB	=	National Seed Board
PETRRRA	=	Poverty Elimination Through Rice Research Assistance
PI	=	Principal Investigator
POs	=	Partner Organizations
PPS	=	Plant Protection Specialist
RPA	=	Rice Provisioning Ability
RPFs	=	Resource Poor Farmer Groups
RPFs	=	Resource Poor Farmers
SB	=	Sabuj Bangla
SFF	=	Sirajganj Flood Forum
SSUK	=	Suchana Samaj Unnayan Kendro
TSP	=	Triple Super Phosphate
UAO	=	Upazila Agriculture Officer
UVUBSS	=	Uttar Varaura Udayan Bahumukhi Samabai Samity
WDP	=	Women Development Project

Executive summary

Rice hybrids are having a positive impact on the country. With one exception, most cultivars under current consideration in Bangladesh are from China. These and our sole national rice hybrid for Boro Season are all reporting yields, which are in excess of our expectation. Nevertheless, the yield capacity of rice hybrids needs to be systematically investigated through a process of participatory field trials at the farmer level. The purpose of the farmer's participatory hybrid rice field trials was to identify location specific adaptable rice hybrid(s) which are suitable for inclusion in a rice yield maximization package for the small plots of the resource poor farmers (RPFs).

Six hybrid rice varieties were selected for the field trial. Five imported varieties (Sonarbangla1, Jagoran1, Hira, Aftab LP50 and Richer101) were selected along with BRRI hybrid dhan1, which has been developed by BRRI, as check cultivars.

In order to implement the sub-project 75 villages of 18 upazilas of 10 districts in Northeast, Northwest and Southwest regions of Bangladesh were selected. Out of 75 villages 29, 24 and 22 villages were from Northeast, Northwest and Southwest regions respectively.

At the preliminary stage of the sub-project awareness cum motivation meetings were conducted at the 75 villages, 75 RPFs were formed and a total of 144 farmers were selected to conduct the field trial with 6 cultivars of hybrid rice. Each selected farmer received training and 3 kg of hybrid rice seeds of 6 six cultivars. Finally 130 trial plots were established. (during the crop season 21 plots were damaged due to flash flood and hailstorm). Thus, the farmers harvested 109 trial plots.

Among the 6 rice hybrids tested in three regions, Hira was found to be the highest average grain yield producing variety with 7.94 ton/ha followed in order by Sonarbangla1 (7.88 ton/ha), Aftab LP50 (7.85 ton/ha), Richer101 (7.83 ton/ha), Jagoran1 (7.49 ton/ha) and BRRI hybrid dhan1 (6.97 ton/ha) during 2003-2004 Boro season. Out of the three study regions, the yield potentiality was highest in Northwest region followed in order by Southwest and Northeast regions. However, the yield potentiality of 3 varieties, Sonarbangla1, Hira and BRRI hybrid dhan1 in Northeast region, exceeded 9 ton/ha. On the other hand the yield potentiality of all 6 varieties in Northwest and Southwest regions exceeded 9 ton/ha. Moreover, in Northwest region, the highest yield of all 6 varieties exceeded 10 ton/ha.

The average field duration was highest with about 113 days in BRRI hybrid dhan1 and for the rest 5 varieties; the average field duration was found more or less same (about 104 days).

In BRRI hybrid dhan1, average maximum tillers per hill (20.34) and average panicles per hill (14.40) were the highest but the average effective tiller production percentage (71.61%) was the lowest. However, in Hira, average maximum tillers per hill (17.39) and average panicles per hill (13.30) were the least but the average effective tiller production percentage (77%) was the highest.

The average number of filled grains per panicle was highest with about 110 in Hira followed in order by Sonarbangla1 (106.58), Richer (105.68), Aftab LP50 (104.37), Jagoran1 (103.26) and BRRI hybrid dhan1 (96.82). But the average number of unfilled grains per panicle was highest with about 41 in BRRI hybrid dhan1 followed in order by Aftab (31.58), Jagoran (31.44), Hira (29.98), Richer (25.55) and Sonarbangla (23.78). The highest percentage of average unfilled grain was about 30% in BRRI hybrid dhan1 followed in order by Jagoran (23.97%), Aftab (23.95%), Hira (21.22%), Richer (20.39%) and Sonarbangla1 (18.73%).

The average highest oven dry weight of thousand grains was with 27.32 gm in Sonarbangla1 followed in order by Richer (26.54 gm), Aftab LP50 (26.18 gm), Jagoran1 (26.03 gm), Hira (25.34 gm) and BRRRI hybrid dhan1 (24.68 gm).

The average milling outturn was the highest with 72.33% in Hira followed in order by BRRRI hybrid dhan1 (71.63%), Jagoran1 (71.33%), Aftab LP50 (71.00%), Richer101 (70.00%) and Sonarbangla1 (68.33%). The milling outturn was found more or less same with six tested rice hybrid cultivars. It is very much similar to our popular commercial modern varieties of rice. Thus six rice hybrids tested can be considered on a par with other commercial varieties for rice millers in the country. The appearance of 6 hybrid rice cultivars tested in 3 regions was found good. The grain of Jagoran and Hira were medium-bold (MB) and the rest four varieties were long bold (LB). The average amylose content was the lowest with 24.30% in Aftab LP50 followed in order by Hira (24.33%), BRRRI hybrid dhan1 (24.67%), Richer101 (24.70%), Sonarbangla1 (24.77%) and Jagoran1 (24.80%). The finding is further confirmed that tested six hybrid cultivars are not sticky rice. The protein content was highest with 6.26% in both Hira and Aftab followed in order by Jagoran1 (5.99%), BRRRI hybrid dhan1 (5.87%), Sonarbangla1 (5.65%), and Richer101 (5.42%). The required cooking time was the lowest with Aftab LP50 at 21.00 min., followed in order by Hira at 21.56 min., BRRRI hybrid dhan1 at 22.22 min., Jagoran1 at 22.50 min., Sonarbangla1 at 22.67 min. and Richer101 at 22.83 minutes.

The average highest insect infestation was measured in BRRRI hybrid dhan1 using the insect infestation scale ranging from 1 to 9 and the average lowest insect infestation was measured in Richer101 using the same scale. Stem borer was the most common and considerable insect for infestation in 3 study regions. The other 4 varieties had almost same but lower insect infestation than that of BRRRI hybrid dhan1. The highest disease infection was observed with BRRRI hybrid dhan1 and the rest 5 varieties had almost the same level of disease infection, which was lower than that of BRRRI hybrid dhan1. However, low disease infection of Bacterial Leaf Streak (BLS) and Bacterial leaf blight (BLB) were observed in 3 regions as well as low infestation of Bakanae was observed in Northeast region.

Lodging was slightly higher in 3 regions with BRRRI hybrid dhan1 than the other five rice hybrids. On the other hand crop damage due to flash flood, storm and hailstorm was also observed during the crop season 2003-2004. In northeast region, crop damage due to flash flood and hailstorm was extreme.

The average cost of production for 6 rice hybrid cultivars were the same in as much as the management (fertilizer, labor, irrigation, weeding, etc.) of the 6 varieties was more or less the same for each individual farmer/plot cultivator. The per hectare net-return on full cost basis was highest with Hira (Tk.24,853) followed in order by Sonarbangla1 (Tk.24,379), Aftab LP50 (Tk.24,142), Richer101 (Tk.23,984), Jagoran1 (Tk.21,298) and BRRRI hybrid dhan1 (Tk.17,190). Similarly, the per hectare net-return on cash cost basis was highest with Hira (Tk.45,730) followed in order by Sonarbangla1 (Tk.45,265), Aftab LP50 (Tk.45,019), Richer101 (Tk.44,861), Jagoran1 (Tk.42,175) and BRRRI hybrid dhan1 (Tk.38,067). The benefit-cost-ratio on full cost basis was highest with 1.66 in Hira followed in order by Sonarbangla1 (1.65), Aftab LP50 (1.64), Richer101 (1.63), Jagoran1 (1.56) and BRRRI hybrid dhan1 (1.45). Likewise, the benefit-cost-ratio on cash cost basis was highest with 3.69 in Hira followed in order by Sonarbangla1 (3.66), Aftab LP50 (3.65), Richer101 (3.64), Jagoran1 (3.48) and BRRRI hybrid dhan1 (3.24). So that the net-return on both full cost basis and cash cost basis is found economically encouraging for all the 6 rice hybrids. Moreover, the net-return on cash cost basis is found more profitable than that of full cost basis.

However, during farmers' participatory evaluation workshop in 3 regions, the most accepted rice hybrids was found Sonarbangla1 (about 36%) followed in order by Hira (about 31%), Jagoran1 (about 11%), Richer (about 10%), Aftab LP50 (about 8%) and BRRRI hybrid dhan1 (about 4%).

The overall performance of 5 imported Chinese varieties was found better over the control variety BRR1 hybrid dhan1. So the above mentioned 5 Chinese hybrid rice varieties, should be adopted in Boro season within and outside of the project areas. BRR1 hybrid dhan1 should be adopted in Northwest region as well as Southwest region. But in Northeast region where early flood is a problem, BRR1 hybrid dhan1 is not well suited due to its longer duration.

The most important concerns are seed quality and seed availability. Farmers' acceptance is vital and the easiest way of gaining it is through the improvement of seed quality and availability. These are the top most consideration for farmers. High demand, location specific seed of accepted rice hybrids must be supplied in time to the farmers. During sowing season farmers are frustrated because at peak demand, supplies tend to be tight and, as one would expect, seed prices become artificially high. The concerned seed companies should take necessary steps to ensure that seed prices do not exceed their fixed, maximum retail prices (MRP). Rice hybrid is a new technology in our country and farmers are not yet fully familiar with it. It is obvious that without the necessary and prerequisite training, rice hybrid cultivation will be advance more slowly than necessary. Real emphasis should be given on practical training and transfer of rice hybrid technology for its large-scale dissemination and sustainability.

Chapter 1: Introduction

1.1 Background

Our challenge is to maintain or enhance the production of rice in order to keep pace with the population growth. The introduction of improved rice production technologies has eased the situation and led to the multifold increase in overall rice production. However, the limitation of existing technologies to further enhance rice production growth at a desirable rate have led to the large scale introduction of hybrid rice technology. The use of hybrid varieties now dominate the rice sectors of major rice growing countries, notably in China, Vietnam, and India. Other countries have also been trying to take up the effort. Thus, we are witness to the introduction of hybrid rice in Bangladesh.

In the early days, hybrid rice technology seemed to be excessively complicated and also expensive. Recent advancements, however, suggest that it is not so difficult as originally thought and modern scientific approaches have gone a long way to minimize both the complications and the expense. Breeding procedures used for developing hybrid rice are strikingly different from those used for breeding inbred rice varieties.

The term “hybrid rice” refers to the first-generation (F_1) offspring of a cross of two genetically diverse parents that yields (performs) better than both parents due to manifestation of a biological phenomenon known as hybrid vigor or heterosis. Farmers can enjoy substantial benefit from hybrids if the F_1 (hybrid) seeds are used for commercial cultivation. Sadly, the grains produced on the commercial hybrid crop are unusable as seed for the next crop because, in the subsequent generations, the yield advantage expressed in the first generation offspring of a hybrid is significantly reduced due to inbreeding depression or the dramatic fall in heterosis.

China first developed and demonstrated the use of hybrid rice technology to increase rice production. In China, research on hybrid rice begun in 1964. The first set of commercial rice hybrids was released in 1976 (after 12 years of research). The use of hybrid rice technology is by now a well-proven success story in China. Hybrid rice production occupies about 16 million-hectare or about 50 percent of the total cultivated rice area. Hybrid rice production in China contributes about 18 million tones of extra food grain annually for China and gives about 20% higher grain yield in comparison with the most popular, highest yielding non-hybrid varieties.

Thus, the dream of high yielding rice hybrids is a reality in China. Hybrid rice varieties have been widely adapted since 1976. The success of hybrid rice in China triggered an interest to initiate research at IRRI in the late 1970s as well as in other Asian countries since the late 1980s. By the early 1990s IRRI had developed several CMS lines, which could be used as parents for developing hybrid rice varieties suitable for local agro-ecological conditions in several countries.

Hybrid rice research in the Bangladesh context was first initiated at the Bangladesh Rice Research Institute (BRRI) in 1993. Systematic efforts were begun only in 1996 with financial support from BARC. The government of Bangladesh authorized field-testing of four hybrid rice varieties (Alok, Loknath, Amarsiri1 and Sonarbangla1) during the 1998-99 Boro season. In response to the recommendation of the NSB, four private seed companies were granted licenses to import 2200 metric tons of hybrid rice seed for the purpose of carrying out field-testing in farmer's fields. Among the four rice hybrids three were from India and one from

China (Sonarbangla1). Since the first tests were carried out, the government of Bangladesh has subsequently allowed the import of three more hybrids from China. The import and marketing of rice hybrids of foreign origin in Bangladesh was undertaken by the NSB on condition that the concerned companies and organizations will develop the necessary infrastructure for production of hybrid rice seed within a stipulated period under a memorandum of joint collaboration with the hybridizing authorities in India or China. Besides the seven foreign rice hybrids, the NSB has released a BIRRI developed rice hybrid in the name of **BIRRI hybrid dhan1** in Jessore and Barisal regions for cultivation in that agro-ecological zone.

Similarly, the experience of hybrid rice in Bangladesh has become largely contrasting. Success as well failure is now a debated issue. Researchers, extensionists and policy makers are divided over the performance of hybrid rice in the country. Although, at the initial stage, there was lot of misunderstanding, partly because of the limitation of actual information flow on rice hybrid technology to the farmers, reports are now growing that in many parts of the county farmers are making remarkable progress with hybrid rice. Farmers, particularly in the low-lying high fertile soils where mostly Boro is cultivated as single crop, have made tremendous achievement, and there are huge demands for hybrid seeds.

Considering several advantages including yield and income of rice hybrids as compared with non-hybrids, it is very obvious to note that the farmers' gradual shifting from non-hybrids to hybrids in the country. As a result the area under hybrids continues to increase in high and moderate fertile soils with single to double crops based on farmer's year of experiences with the rice hybrids. However, in 2002-03 Boro was the real beginnings of hybrids with farmers planting in a sizeable area across the country, which was around 70,000 acres. Such area in 2003-04 Boro was about 1,30,000 acres with seed scarcity during sowing period. Currently there are five Chinese varieties widely grown across the country based on the availability of seeds of the varieties with limited varietal information. Along with the Chinese varieties, large-scale trials have been going on with another variety release by Bangladesh Rice Research Institute.

Presently rice hybrid has **positive acceptance** in the country with most cultivars from china and a national rice hybrid only for Boro season. The yield performance of these rice hybrids has been published in the country's print media (English/Bangla dailies). So far, reported yields have exceeded expectations. The yield capacity of rice hybrids deserves to be systematically validated through a process of participatory field trial at the farmer level.

1.2 Purpose

The purpose of the farmer's participatory hybrid rice field trials were to identify location specific adaptable rice hybrid(s) which were suitable for rice yield maximization on the small plots of the resource poor farmers (RPFs).

Chapter 2: Study sites, Partners and Methodology

2.1 Study sites and Partners

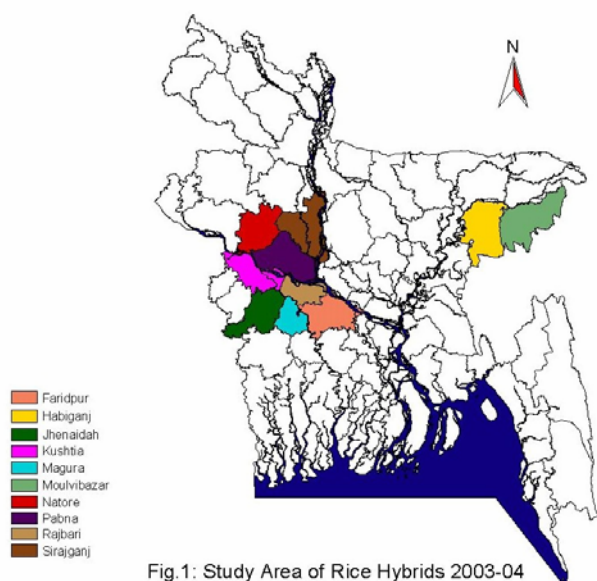


Fig.1: Study Area of Rice Hybrids 2003-04

Accordingly, the farmers participatory field trial on rice hybrids sub-project was implemented in 75 villages of 18 upazilas under 10 districts in Northwest, Northeast and Southwest regions of Bangladesh. Out of 10 districts, 2, 3 and 5 districts were from Northeast, Northwest and Southwest region respectively. Out of 18 upazilas, 5, 6 and 7 upazilas were from Northeast, Northwest and Southwest region respectively. The rice hybrid sub-project was implemented at 75 villages, of which 29, 24 and 22 villages were in Northeast, Northwest and Southwest region respectively. The Project locations are shown in the map (Fig.1). Region wise districts, upazilas and number of villages are provided in the following Table 1:

Table 1. Sub-project locations in 3 regions

Region	District		Upazila		Village	
	Name	Total (Nr.)	Name	Total (Nr.)	District wise (Nr.)	Region wise (Nr.)
Northeast	Habiganj	2	Sadar, Madhabpur, Baniachang	5	13	29
	Moulvibazar		Sadar, Srimangal		16	
Northwest	Pabna	3	Chatmohar	6	3	24
	Sirajganj		Tarash, Ullahpara,		8	
	Natore		Gurudaspur, Singra, Baraigram		13	
Southwest	Jhenaidah	5	Jhenaidah Sadar	7	12	22
	Magura		Sadar, Shalikha, Mohammadpur		7	
	Kushtia		EB Shekh para		1	
	Rajbari		Rajbari Sadar		1	
	Faridpur		Faridpur Sadar		1	
Total		10		18	75	75

A total of 23 members of the AAS partnership network were involved in implementing the sub-project activities in three working regions, of which 7, 9 and 7 partners were from the Northeast, Northwest and Southwest region respectively. A region wise list of POs is given in Table 2. The list of POs' details is provided in Annex-VI.

Table 2: Region wise list of involved Partner Organizations (POs)

Region	Partner Organizations	Number
Northeast	AURD, MKS, BASA, MBNMS, Mac-Bangladesh, NKSS, UVUBSS	7
Northwest	WDP, SFF, SB, SSUK, BBS, BDSC, AKK, KPKSS, NEDA	9
Southwest	KALYANI, AJ, DA, Chetona, Kalpotaru, JSKS, ADD	7
Total		23

2.2 Methodology

Farmer's participatory field trial on rice hybrids was conducted during 2003-04 Boro season. Six hybrid rice varieties were selected for the field trial. Five imported varieties (Sonarbangla1, Jagoran1 (GB4), Hira (99-5), Aftab LP50 and Richer101) were selected along with BRRI hybrid dhan1, which has been developed by BRRI as a check cultivar. All 5 foreign varieties were imported from China by four seed companies and a NGO (BRAC). The variety origin, seed supply source and germination status of the supplied seed of the 6-rice hybrid cultivars of this field trial are provided in the following Table 3:

Table 3. Variety origin, seed source and germination status of selected 6 cultivars

Variety	Variety origin	Seed source	% Germination
BRRI hybrid dhan1	BRRI-Bangladesh	BADC	71
Sonarbangla1	China	Mollika Seed Co.	80
Jagoran1 (GB 4)	China	BRAC	85
Hira (99-5)	China	Supreme Seed Co.	64
Aftab LP50	China	Aftab Bohumukhi Farm Ltd.	65
Richer101	China	Chens Crop-Science BD. Ltd.	91

Germination test of seed of six cultivars of rice hybrid were done by AAS after procurement and before distribution among the trained farmer researchers. To study the comparison among the varieties of hybrid rice, 75 villages were selected in three regions of Bangladesh. The awareness cum motivational meetings was conducted at 75 selected villages in ten districts of three regions. During such meetings, 75 Resource Poor Farmer Groups (RPFGs) were formed for field trial on rice hybrids in three regions. A total of 144 farmers were selected to conduct the field trial with 6 cultivars of hybrid rice. Staffs of partner NGOs and AAS were trained on rice hybrid technology. A total of 3 farmers' participatory training on rice hybrid technology was conducted in three regions by AAS with the cooperation of POs. Each selected farmer received a total of 3 kg hybrid rice seeds of 6 cultivars i.e., 0.5 Kg seed for each variety.

A total of 144 farmers received the seeds of six cultivars of rice hybrids, from which 135 seedbeds were established as per the agreed layout. Post sowing, seedbed management practices were provided by the involved farmers. Finally a total of 130 trial plots were established by 130 farmer researchers (Annex-V) with six cultivars of hybrid rice as per agreed layout for field trial plot and recommended practices. A total of 21 trial plots were damaged mainly due to flash flood and hailstorm in Northeast region during reproductive stage of the crop. Region wise number of established field trial plots and reported plots are provided in the following Table 4:

Table 4. Number of established field trial plots and reported plots

Region	Farmers received seed (Nr)	Seedbed established (Nr)	Trial plots established (Nr)	Trial plots damaged (Nr)	Reported plots (Nr)
Northeast	44	42	42	21	21
Northwest	50	43	41	-	41
Southwest	50	50	47	-	47
Total	144	135	130	21	109

Plot size for each variety was five decimals and thus total plot size for each farmer was 30 decimals for the six cultivars of hybrid rice. The layout of a field trial plot with six cultivars is provided in the following Fig.2.

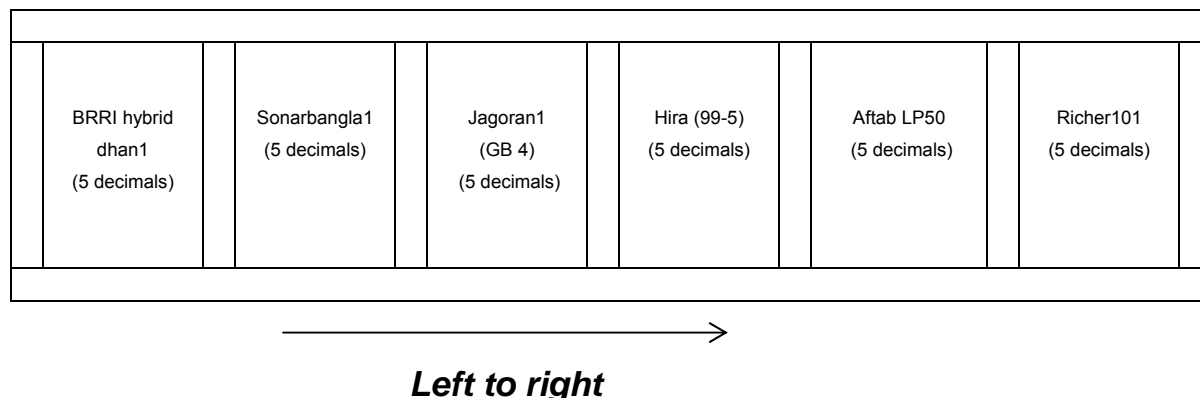


Fig.2: Layout of transplanted trial plot with 6 cultivars of hybrid rice

Seedlings were transplanted between 21 December 2003 to 17 February 2004 with 35-45 days old seedlings for 6 cultivars. One seedling per hill for all 6 varieties was transplanted. The spacing between rows and within hills was maintained at 20 cm each.

Recommended doses of fertilizers were supplied to the farmers by AAS staffs. The plots were fertilized with urea, DAP/TSP, MP, Gypsum and Zinc Sulphate at the rate of 270, 130, 120, 70 and 10 Kg per hectare, respectively. Post transplanting managements i.e., irrigation and drainage, fertilizer, weed, pest and disease management were done by the farmers with advice from crop production specialists.

Tiller production and yield component data were collected from 16 hills at 4 spots (4 hills/spot) for each variety of the established field trial plots. The tiller count was done at 15 days interval for six cultivars of 130 established field trial plots. The panicles per hill were calculated from the same 16 hills for six cultivars before harvesting the crop of the 109 field trial plots. Three representative (average) hills were harvested for six cultivars for yield component data collection of the each selected trial plots. Later, panicles were detached from three representative hills for each cultivar separately. After drying the detached panicles, filled and unfilled grains were threshed and counted manually by AAS staffs as well as at BRRI, Gazipur. Thereafter, 1000-grains weight after oven drying of the 6 cultivars were measured at BRRI by using sophisticated electronic scale.

Whole plot for each variety of a field trial plot was harvested separately by keeping one row border crop. Thus, the crop of 109 field trial plots was harvested at 80% maturity stage. After harvesting the crop, carrying, threshing, drying and cleaning were done for each variety separately. Thereafter, the assigned field staff for each variety took paddy weight separately with the electronic scale and measured moisture content of the paddy samples with moisture meters. Later paddy weights were adjusted at 14% moisture content for six cultivars of 109 trial plots and calculated the grain yield (unhusked paddy) in ton per hectare.

Insect infestation, disease infection and crop lodging were estimated using 1-9 scales during crop growing period of the rice hybrid trial plots and the crop damage mainly due to storm and hailstorm was estimated in percent by the help of relevant farmers and respective staffs.

Grain samples (unhusked paddy) of six cultivars of hybrid rice were sent to BRRI, Gazipur from three regions for physicochemical properties analysis of the farmer's produced paddy

from F₁ hybrid rice seed. The laboratory analysis was conducted at Grain Quality and Nutrition Division of Bangladesh Rice Research Institute, BRRI.

Grain yield (unhusked paddy), field duration, tiller production, yield contributing characters, physicochemical properties, insect infestation, disease infection, crop lodging and crop damage were systematically recorded for six hybrid rice cultivars of 109 plots.

Assigned field staffs and area coordinators of AAS collected primary data of cost and return of 6 cultivars from Northeast, Northwest and Southwest regions.

One signboard was placed at each field trial plot with relevant information of six cultivars of hybrid rice. Besides this, six small signboards were also placed for six cultivars separately at each field trial plot.

Total of 1965 farmers including 138 female farmers attended in 42 field days at 40 villages during ripening stage of rice hybrids of the trial plots in three regions. Field days were organized for the surrounding farmers of the involved villages in three project regions to demonstrate the standing crop conditions for their understanding and assessment on six tested cultivars.

Three farmer's participatory workshops on rice hybrid assessment were conducted in three regions in collaboration with DAE, relevant public sector departments and AAS-Partner organizations (NGOs/CBOs). The research farmers voted for the best performing variety of the 6 tested rice hybrids. The participating farmers assessed and selected only one variety as the best among the tested 6 hybrid rice varieties depending on their own acquired knowledge and experience specially during 2003-04 Boro season. Farmer's assessment was done through casting vote. For this, each farmer cast one vote for his/her best-selected variety among the tested six hybrid rice cultivars. Thereafter, the average percentage of farmers' opinion of 3 regions against each variety and final ranking among the 6 varieties were done.

Chapter 3: Capacity Building

3.1 Training, Workshop and Field days

Training: Three regional participatory trainings on rice hybrid technology were conducted for the farmers, staffs and chief executives of the Partner Organizations. The information relating to training courses such as date, course title, number of participants by the type and sex, duration is provided in the following Table 5.

Table 5. Training details of farmer, staff and chief executive

Date	Title of the course	Venue (Institution)	Number of participants by type and sex						Total		Duration (days)
			Farmers		Researcher/ Extensionist*		Field staff**		M	F	
			M	F	M	F	M	F			
11.11.03	Participatory training on rice hybrid technology	AAS zonal office, Srimangal, Moulvibazar	16	-	1	-	8	-	25	-	full day
11.12.03	Participatory training on rice hybrid technology	BRDB HALL Room, Baraigram, Natore	41	-	2	-	9	6	52	6	full day
25.12.03	Participatory training on rice hybrid technology	Upazila Hall Room, Jhenaidah	60	-	3	-	9	-	72	-	full day
Total			117	-	6	-	26	6	149	6	

Workshop: Similarly, three regional participatory evaluation workshops were conducted on rice hybrid assessment. The information relating to participatory evaluation workshop such as date, workshop title, number of participants by the type and sex, total number of participants and duration is provided in the following Table 6.

Table 6. Details of participatory evaluation workshop participants

Date	Title of the course	Venue (Institution)	Number of participants by type and sex						Total		Duration (days)
			Farmers		Researcher/ Extensionist*		Field staff**		M	F	
			M	F	M	F	M	F			
16.06.04	Participatory evaluation workshop on rice hybrid assessment	BRDB Hall Rom, Baraigram, Natore	34	3	4	1	8	4	46	8	full day
22.06.04	Participatory evaluation workshop on rice hybrid assessment	AID complex, Jhenaidah	57	-	6	-	6	1	69	1	full day
25.06.04	Participatory evaluation workshop on rice hybrid assessment	TTDC Hall Room, Srimangal, Moulvibazar	35	1	7	2	10	-	52	3	full day
Total			126	4	17	3	24	5	167	12	

* Researcher/Extensionist includes sub-project PI, Agronomist, Agri. Eng., Chief executive of NGOs, DD, CPS, PPS, UAO of DAE, Scientist

** Field staff includes field staff of AAS and Partner Organizations

Field days: Total of 1827 male and 138 female farmers attended 42 Field days at 40 villages during ripening stage of rice hybrids of the trial plots conducted in three regions. Field days were organized for the surrounding farmers of the involved villages in three project regions to demonstrate the standing crop conditions for their understanding and assessment on six tested cultivars. Out of 42 Field days 14,16 and 12 Field days were conducted in Northeast, Northwest and Southwest region respectively. Region wise Field days, Participants and Village number are given in the following Table 7.

Table 7. Number of Field days, Participating farmers and Villages of 3 regions

Region	Field days (Nr.)	Participants (Nr.)		Village (Nr.)
		Male	Female	
Northeast (Moulvibazar, Habiganj)	14	507	136	14
Northwest (Pabna, Sirajganj, Natore)	16	679	-	16
Southwest (Magura, Jhenaidah)	12	641	2	10
Total	42	1827	138	40

The information relating to Field days, such as Field day site, conducting date, number of participants by the type and sex, demonstrating village, upazila, and district of Northeast, Northwest and Southwest regions, are provided in Annex-VII(i),VII(ii) and VII(iii) respectively.

Chapter 4: Results

4.1 Physical Characteristics

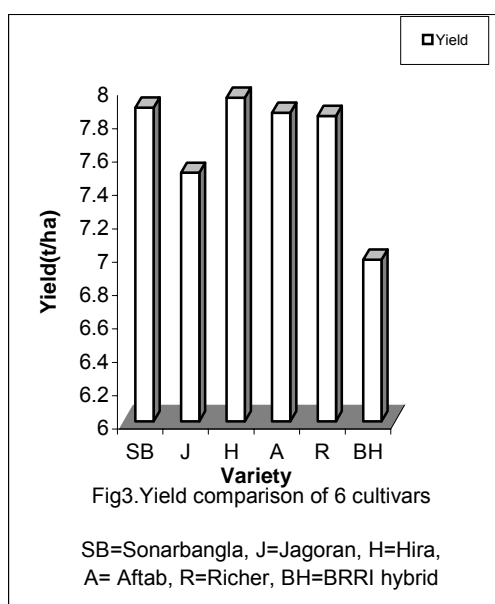
Grain yield and yield potentiality

Grain yield: The Grain yield (unhusked paddy) of 6 rice hybrid cultivars from 109 trial plots were calculated at 14% moisture content. It was found that the average grain yield of 3 regions was highest with 7.94 t/ha in Hira followed in order by Sonarbangla1, Aftab LP50, Richer101, Jagoran1 and BRRI hybrid dhan1 (control variety). It was revealed that the average grain yield of the control variety was the lowest with 6.97 t/ha (Table 8 & Fig.3). The yield advantage of Sonarbangla1, Jagoran1, Hira (99-5), Aftab LP50 and Richer101 was higher by 13.05%, 7.46%, 13.91%, 12.63% and 12.34% respectively over that of control variety BRRI hybrid dhan1. Except the control variety, on an average the 5 rice hybrid cultivars (imported from China) produced more or less same yield in respect to the study regions. The average grain yield of 6 cultivars tested in 3 regions is provided in the following Table 8.

Table 8. Comparison of means of paddy yield of 6 cultivars tested in 3 regions

Variety	Paddy Yield (ton/ha)							
	Northeast		Northwest		Southwest		Average	
	Mean	CV (%)	Mean	CV (%)	Mean	CV (%)	Mean	CV (%)
Sonarbangla1	7.11	18.08	8.35	13.93	8.18	12.61	7.88	8.50
Jagoran1	6.75	17.36	8.12	14.53	7.61	12.90	7.49	9.21
Hira (99-5)	7.59	15.75	8.32	11.30	7.90	12.00	7.94	4.66
Aftab LP50	7.08	15.24	8.46	15.80	8.00	12.76	7.85	8.92
Richer101	7.11	15.43	8.38	15.31	7.99	14.12	7.83	8.30
BRRI hybrid dhan1	6.61	28.41	7.65	16.08	6.64	17.30	6.97	8.46

In Northeast region the average grain yield was highest with 7.59 t/ha in Hira (99-5) and the lowest was with 6.61 t/ha in BRRI hybrid dhan1 (Annex-I(i)). The average grain yield of Sonarbangla1, Jagoran1, Hira, Aftab LP50 and Richer101 was higher than that of BRRI hybrid dhan1 by 7.56%, 2.11%, 14.83%, 7.11% and 7.56% respectively.



In Northwest region, the average grain yield was highest with 8.46 t/ha in Aftab LP50 and the lowest was with 7.65 t/ha in BRRI hybrid dhan1 (Annex-I(ii)). The average grain yield of Sonarbangla1, Jagoran1, Hira, Aftab LP50 and Richer101 was higher than that of BRRI hybrid dhan1 by 9.15%, 6.14%, 8.76%, 10.59% and 9.54% respectively.

In Southwest region the average grain yield was the highest with 8.18 t/ha in Sonarbangla1 and the lowest was with 6.64 t/ha in BRRI hybrid dhan1 (Annex-I(iii)). The average grain yield of Sonarbangla1, Jagoran1, Hira, Aftab LP50 and Richer101 was higher than that of BRRI hybrid dhan1 by 23.09%, 14.61%, 18.98%, 20.48% and 20.33% respectively.

Yield potentiality: Grains yield potentiality of 6 rice hybrids was assessed on the basis of achieved maximum yield, 9 ton per hectare and above, and 10 ton per hectare and above, separately.

Among the three regions, the highest yield potentiality (9 ton/ha) was found in Northwest region followed in order by Southwest and Northeast region. Out of 654 sub-plots (109x6) of 109 farmers, the yield of 99 sub-plots were 9 and above 9 ton/ha. Out of 99 out yielded sub-plots, highest numbers of sub-plots were found in Northwest region (59 plots) followed in order by Southwest region (35 plots) and Northeast region (5 plots). Region wise yield potentiality (9 ton/ha and above) is provided in the following Table 9.

Table 9. Yield potentiality of 6 cultivars tested in 3 regions (9 ton/ha and above)

Variety	Northeast region			Northwest region			Southwest region		
	Plot(s) with yield above 9 t/ha	Highest yield (t/ha)	Average yield above 9 t/ha	Plots with yield above 9 t/ha	Highest yield (t/ha)	Average yield above 9 ton/ha	Plots with yield above 9 t/ha	Highest yield (t/ha)	Average yield above 9 t/ha
Sonarbangla1	2	9.64	9.38	11	10.50	9.73	10	9.78	9.35
Jagoran1	-	8.66	-	7	11.29	9.92	3	9.36	9.17
Hira (99-5)	2	9.58	9.58	10	10.18	9.51	4	9.37	9.25
Aftab LP50	-	8.62	-	13	10.70	9.89	6	9.78	9.33
Richer101	-	8.87	-	12	11.60	9.81	10	9.63	9.31
BRR1 hybrid dhan1	1	9.58	9.58	6	10.64	9.80	2	9.13	9.11

In Northeast and Southwest regions, no variety reached 10 ton/ha. But in Northwest region, out of 246 sub-plots (41 x 6) of 41 farmers', the yields of 14 sub-plots were 10 or above 10 ton/ha. Aftab LP50 out yielded in five plots, but Sonarbangla1 and Richer101 out yielded in three plots each, whereas Jagoran1, Hira and BRR1 hybrid dhan1 out yielded in one plot. Richer101 produced recorded highest paddy yield (11.60 ton/ha) in Northwest region. Region wise yield potentiality (10 ton /ha and above) is provided in the following Table 10.

Table 10. Yield potentiality of 6 cultivars tested in 3 regions (10 ton/ha and above)

Variety	Northwest region			Northeast region	Southwest region
	Plot(s) with yield above 10 t/ha	Highest yield (t/ha)	Average yield above 10 t/ha	NA ¹	NA ¹
Sonarbangla1	3	10.50	10.37	-	-
Jagoran1	1	11.29	11.29	-	-
Hira (99-5)	1	10.18	10.18	-	-
Aftab LP50	5	10.70	10.34	-	-
Richer101	3	11.60	11.18	-	-
BRR1 hybrid dhan1	1	10.64	10.64	-	-

¹NA= It is not applicable because there was no plot with yield above 10 ton/ha both for Northeast and Southwest regions.

Field duration

The average field duration was highest with BRRI hybrid dhan1 (112.88 days) and lowest with Sonarbangla1 (103.40 days). But the average field duration was found more or less similar among the five tested cultivars of Chinese hybrid rice during 2003-04 Boro season. Jagoran1, Hira, Aftab LP50 and Richer101 required field duration ranging from 104.04-104.91 days. Comparison of average field duration of 6 cultivars was provided in the following Table 11.

Table 11. Comparison of average field duration of 6 cultivars

Variety	Field duration (days)	
	Mean	CV (%)
Sonarbangla1	103.40	2.55
Jagoran1	104.04	2.33
Hira (99-5)	104.38	2.09
Aftab LP50	104.58	2.18
Richer101	104.91	2.43
BRRI hybrid dhan1	112.88	2.50

In Northeast region, average field duration of BRRI hybrid dhan1 was about 114 days, which was the longest among the 3 regions. The average field duration of five cultivars of Chinese hybrid rice was 6-8 days shorter ranging from 106-108 days than BRRI hybrid dhan1. In Northwest region average field duration of BRRI hybrid dhan1 was about 112 days and for the rest five cultivars that was 9-10 days shorter ranging from 102-103 days. Similarly, in Southwest region average field duration of BRRI hybrid dhan1 was about 113 days and the required average field duration of the rest five cultivars was ranging from 103-107 days (Annex-I(i), I(ii) and I(iii)).

Tiller and Panicle production

The average maximum tillers and panicles production per hill and percent effective tiller of 6 hybrid rice cultivars tested in 3 regions are shown in the following Table 12.

Table 12. Maximum tillers and panicles production per hill and % effective tiller production of 6 cultivars of hybrid rice

Variety	Max. Tillers/hill (Nr.)		Panicles/hill (Nr.)		% Effective tiller	
	Mean	CV (%)	Mean	CV (%)	Mean	CV (%)
Sonarbangla1	18.30	14.10	13.55	14.20	74.66	9.22
Jagoran1	17.93	12.77	13.39	12.70	75.43	7.19
Hira (99-5)	17.39	7.53	13.30	10.83	77.00	6.86
Aftab LP-50	18.06	14.62	13.57	13.26	75.47	7.09
Richer101	18.06	14.95	13.54	12.04	75.55	7.93
BRRI hybrid dhan1	20.34	15.83	14.40	16.25	71.61	13.95

Tiller: Among the 6 rice hybrid cultivars tested in 3 regions, the average maximum numbers of tillers per hill was the highest with 20.34 tillers in BRRI hybrid dhan1 and the lowest was with 17.39 tillers per hill in Hira. The rest four cultivars' number of tiller production was ranging from 17.93-18.06 tillers per hill (Table 12). The maximum tiller production per hill of Sonarbangla1, Jagoran1, Hira, Aftab LP50 and Richer101 were lower than that of control variety BRRI hybrid dhan1 by 10.02%, 11.84%, 14.50%, 11.2% and 11.2% respectively (Table 12).

In Northeast region, the average maximum numbers of tillers per hill was the highest with 23.92 tillers in BRRi hybrid dhan1 and the lowest was with 18.90 tillers per hill in Hira. The maximum tiller production per hill of Sonarbangla1, Jagoran1, Hira, Aftab LP50 and Richer101 were lower by 11.04%, 14.01%, 20.98%, 11.79% and 11.58% respectively than that of control variety BRRi hybrid dhan1 (Annex-I(i)).

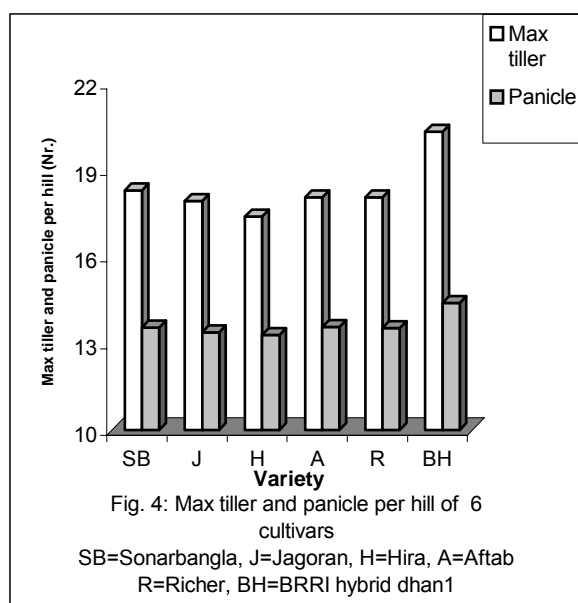
In Northwest region, the average maximum numbers of tillers per hill was the highest with 17.69 tillers in BRRi hybrid dhan1 and the lowest was with 16.67 tillers per hill in Hira. The maximum tiller production per hill of Sonarbangla1, Jagoran1, Hira, Aftab LP50 and Richer101 were lower than that of control variety BRRi hybrid dhan1 by 5.0%, 5.03%, 5.6%, 5.76% and 4.86% respectively (Annex-I(ii)).

Similarly, in Southwest region, the average maximum numbers of tillers per hill was the highest with 19.41 tillers in BRRi hybrid dhan1 and the lowest was with 16.41 tillers per hill in Aftab LP50. The maximum tiller production per hill of Sonarbangla1, Jagoran1, Hira, Aftab LP50 and Richer101 were lower by 13%, 15.35%, 14.63%, 15.46% and 16.59% respectively than that of control variety BRRi hybrid dhan1 (Annex-I(iii)).

Panicle: The average numbers of panicles per hill was the highest with 14.4 panicles in BRRi hybrid dhan1 and the lowest was with 13.3 panicles per hill in Hira. The average panicles production of the rest four cultivars of hybrid rice (Sonarbangla1, Jagoran1, Aftab LP50 and Richer101) was estimated around 13 per hill. The panicle production per hill of Sonarbangla1, Jagoran1, Hira, Aftab LP50 and Richer101 was lower by 5.9%, 7.01%, 7.64%, 5.76%, and 5.97% respectively than that of control variety BRRi hybrid dhan1 (Table 12).

In Northeast region, the average numbers of panicles per hill was the highest with 16.68 panicles in BRRi hybrid dhan1 and the lowest was with 14.52 panicles per hill in Hira. The average panicle production per hill of Sonarbangla1, Jagoran1, Hira, Aftab LP50 and Richer101 was lower by 7.97%, 10.31%, 12.95%, 5.51% and 9.89% respectively than that of control variety BRRi hybrid dhan1 (Annex I(i)).

In Northwest region, the average numbers of panicles per hill was the highest with 14.53 panicles in BRRi hybrid dhan1 but the lowest was with 13.62 panicles per hill in Jagoran1. The average panicle production of the rest four cultivars of hybrid rice (Sonarbangla1, Hira, Aftab LP50 and Richer101) was estimated around 13 per hill. The panicle production per hill of Sonarbangla1, Jagoran1, Hira, Aftab LP50 and Richer101 were lower by 5.37%, 6.26%, 5.9%, 6.19% and 5.09% respectively than that of control variety BRRi hybrid dhan1 (Annex-I(ii)).



In Southwest region, the average numbers of panicles per hill was the highest with 12 panicles in BRRi hybrid dhan1 and the lowest was with 11.56 panicles per hill in Sonarbangla1. The average panicle production of the rest four hybrid cultivars (Jagoran1, Hira, Aftab LP50 and Richer101) was estimated around 12 per hill. The panicle production per hill of Sonarbangla1, Jagoran1, Hira, Aftab LP50 and Richer101 was lower by 3.67%, 3.50%, 2.33%, 2.08% and 1.67% respectively than that of control variety BRRi hybrid dhan1 (Annex-I(iii)).

Percent effective tiller: Average effective tiller production percentage was the highest with 77% in Hira and the lowest was with 71.61% in BRR1 hybrid dhan1. Though the control variety, BRR1 hybrid dhan1, had the highest numbers of maximum tillers per hill, the effective tiller percentage of the control variety was calculated as the lowest. Moreover, the percentage of effective tiller of Sonarbangla1, Jagoran1, Hira, Aftab LP50 and Richer101 were 3.05%, 3.82%, 5.39%, 3.86% and 3.94% higher than that of BRR1 hybrid dhan1. The estimated percentage of effective tillering of five cultivars of hybrid rice was more or less same during 2003-04 Boro season (Table 12). The comparison between maximum tiller per hill and panicle per hill of 6 cultivars is shown in above Fig 4.

In Northeast region, the average effective tiller production percentage was the highest with 76.83% in Hira and the lowest was with 69.72% in BRR1 hybrid dhan1. The percentage effective tiller of Sonarbangla1, Jagoran1, Hira, Aftab LP50 and Richer101 were higher than that of BRR1 hybrid dhan1 by 2.41%, 3.01%, 7.11%, 2.98% and 1.34% respectively (Annex-I(i)).

But in Northwest region, the average effective tiller production percentage of 6 rice hybrid cultivars was more or less same (about 82%). Among the three regions, the effective tiller productivity of all six rice hybrid cultivars was highest in Northwest region (Annex-I(ii)).

On the other hand, in Southwest region, the average effective tiller production percentage was the highest with 73.23% in Richer101 and the lowest was with 62.7% in BRR1 hybrid dhan1. The percent effective tiller of Sonarbangla1, Jagoran1, Hira, Aftab LP50 and Richer101 were higher than that of BRR1 hybrid dhan1 by 6.7%, 9.18%, 9.1%, 9.37% and 10.53% respectively (Annex-I(iii)).

Grain production

Average filled grains per panicle, unfilled grains per panicle and percent-unfilled grains of 6 rice hybrids tested in 3 regions are provided in the following Table 13.

Table 13. Grain production per panicle of 6 rice hybrids

Variety	Filled grains/panicle		Unfilled grains/panicle		% Unfilled grains	
	Mean	CV (%)	Mean	CV (%)	Mean	CV (%)
Sonarbangla1	106.58	28.50	23.78	33.81	18.73	34.22
Jagoran1	103.26	26.89	31.44	29.70	23.97	31.71
Hira (99-5)	110.07	21.80	29.98	40.76	21.22	34.07
Aftab LP50	104.37	28.65	31.58	28.09	23.95	33.57
Richer101	105.68	29.07	25.55	29.51	20.39	34.97
BRR1 hybrid dhan1	96.82	24.61	41.07	23.11	29.99	25.94

Filled grain per panicle: The average number of filled grains per panicle was highest with 110.07 in Hira and the lowest with 96.82 in BRR1 hybrid dhan1. The filled grain formation of Sonarbangla1, Jagoran1, Hira, Aftab LP50 and Richer101 was higher than that of BRR1 hybrid dhan1 by 10.08%, 6.65%, 13.68%, 7.80% and 9.15% respectively (Table 13).

In Northeast region, the average number of filled grains per panicle was highest with 82.73 in Hira and the lowest with 69.67 in BRR1 hybrid dhan1. The filled grain formation per panicle of Sonarbangla1, Jagoran1, Hira, Aftab LP50 and Richer101 was higher than that of BRR1 hybrid dhan1 by 5.89%, 2.28%, 13.06%, 3.54% and 2.42% respectively (Annex-I(i)).

Similarly, in Northwest region, the average number of filled grains per panicle was highest with 119.82 in Hira and the lowest with 106.49 in BRR1 hybrid dhan1 (Annex-I(ii)). The filled grain formation per panicle of Sonarbangla1, Jagoran1, Hira, Aftab LP50 and Richer101 was higher than that of BRR1 hybrid dhan1 by 1.42%, 6.39%, 13.33%, 0.59% and 6.12% respectively.

But in Southwest region, the average number of filled grains per panicle was highest with 136.27 in Sonarbangla1 and the lowest with 114.31 in BRR1 hybrid dhan1 (Annex-I(iii)). The filled grain formation of Sonarbangla1, Jagoran1, Hira, Aftab LP50 and Richer101 was higher by 21.96%, 10.63%, 13.35%, 18.52% and 18.04% respectively than that of BRR1 hybrid dhan1.

Unfilled grain per panicle: The average highest unfilled grains per panicle was 41.07 in BRR1 hybrid dhan1 and the lowest was 23.78 in Sonarbangla1 among the 6 cultivars tested in the 3 study regions. The unfilled grains of Sonarbangla1, Jagoran1, Hira, Aftab LP50 and Richer101 was lower by 42.09%, 23.44%, 27%, 23% and 37.78% respectively than that of BRR1 hybrid dhan1 (Table 13).

In Northeast region, average highest unfilled grains numbers per panicle was with 42.29 in BRR1 hybrid dhan1 and the lowest numbers was with 20.93 in Sonarbangla1. The unfilled grains of Sonarbangla1, Jagoran1, Hira, Aftab LP50 and Richer101 was lower by 50.51%, 26.67%, 33.29%, 25.47% and 40.12% respectively than that of BRR1 hybrid dhan1 (Annex-I(i)).

Similarly in Northwest region, average highest unfilled grain numbers per panicle was 49.89 in BRR1 hybrid dhan1 but the lowest was 32.2 in Richer101 (Annex-I(ii)). The unfilled grains of Sonarbangla1, Jagoran1, Hira, Aftab LP50 and Richer101 were lower than that of BRR1 hybrid dhan1 by 34.16%, 17.86%, 13.85%, 18.88% and 33.45% respectively.

In Southwest region it was also found that the average highest unfilled grain numbers per panicle was 31.03 in BRR1 hybrid dhan1 and the lowest was 17.55 in Sonarbangla1 (Annex-I(iii)). The unfilled grains of Sonarbangla1, Jagoran1, Hira (99-5), Aftab LP50 and Richer101 was lower than that of BRR1 hybrid dhan1 by 43.44%, 28.07%, 39.61%, 26.72% and 41.60% respectively.

Percent unfilled grain: The highest percentage of average unfilled grains of 6 cultivars was 29.99% in BRR1 hybrid dhan1 and the lowest percentage of that were 18.73% in Sonarbangla1. Jagoran1 and Aftab LP50 had almost the same percentage of unfilled grains (about 23.97%). On the other hand, Hira and Richer101 had 21.22% and 20.39% unfilled grains respectively (Table 13).

In Northeast region, the highest percentage of average unfilled grains of 6 cultivars was with 36.44% in BRR1 hybrid dhan1 and the lowest percentage of that was with 21.43% in Sonarbangla1. The percentages of unfilled grains of Sonarbangla1, Jagoran1, Hira, Aftab LP50 and Richer101 were lower than that of BRR1 hybrid dhan1 by 15%, 6.9%, 11.7%, 7.71% and 10.82% respectively (Annex-I(i)).

In Northwest region, the highest percentage of average unfilled grains of 6 cultivars was with 32.17% in BRR1 hybrid dhan1 but the lowest percentage of that was with 23.29% in Richer101. The percentages of unfilled grains of Sonarbangla1, Jagoran1, Hira, Aftab LP50 and Richer101 were lower than that of BRR1 hybrid dhan1 by 8.68%, 5.11%, 6.15%, 3.72% and 8.88% respectively (Annex-I(ii)).

In Southwest region, the highest percentage of average unfilled grains of 6 cultivars was with 21.35% in BRRi hybrid dhan1 and the lowest percentage of that was with 11.46% in Sonarbangla1. The percentages of unfilled grains of Sonarbangla1, Jagoran1, Hira, Aftab LP50 and Richer101 were lower than that of BRRi hybrid dhan1 by 9.89%, 6.03%, 8.45%, 6.68% and 9.08% respectively (Annex-I(iii)).

The percentages of unfilled grains in Sonarbangla1, were 41.19%, 26.98%, and 46.32% lower than that of BRRi hybrid dhan1 in Northeast, Northwest and southwest respectively. The filled grain formation in Sonarbangla1 was found more stable than other tested rice hybrids cultivars.

It was also found that the unfilled grains percentages of all 6 cultivars in Southwest region were very lower than that of other two regions. Except the control BRRi hybrid dhan1, it was almost half of that percentage. Except BRRi hybrid dhan1, the unfilled grain percentage of the rest 5 cultivars in Southwest region was almost half of the percentages in Northwest and Northeast regions.

Thousand grains weight (oven dry)

The average thousand-grains (unhusked paddy) oven dry weight of 6 rice hybrid cultivars is given in the following Table 14.

Table 14. 1000 grains weight of 6 cultivars of rice hybrids

Variety	Oven dry 1000 grains weight (gm)	
	Mean	CV (%)
Sonarbangla1	27.32	2.67
Jagoran1	26.03	1.42
Hira (99-5)	25.34	1.34
Aftab LP50	26.18	5.04
Richer101	26.54	6.59
BRRi hybrid dhan1	24.68	1.62

The average highest oven dry weight of thousand grains was with 27.32 gm in Sonarbangla1 and the lowest was with 24.68 gm in BRRi hybrid dhan1. The thousand grains weights of Sonarbangla1, Jagoran1, Hira, Aftab LP50 and Richer101 were higher than that of BRRi hybrid dhan1 by 10.69%, 5.5%, 2.67%, 6.08% and 7.54% respectively (Table 14).

In Northeast region, the average highest oven dry weight of thousand grains was with 28.14 gm in Sonarbangla1 and the lowest was with 24.96 gm in BRRi hybrid dhan1. The thousand grains weights of Sonarbangla1, Jagoran1, Hira, Aftab LP50 and Richer101 were higher than that of control variety BRRi hybrid dhan1 by 12.74%, 5.65%, 3.04%, 9.25% and 11.38% respectively (Annex-I(i)).

In Northwest region, the average highest oven dry weight of thousand grains was with 27.08 gm in Sonarbangla1 but the lowest was with 24.55 gm in Richer101. The thousand grains weights of Sonarbangla1, Jagoran1 and Hira were higher by 8.93%, 3.09%, and 1.49% respectively than that of BRRi hybrid dhan1 (control). Oven dry 1000-grain weight of Aftab and Richer were lower than that of BRRi hybrid dhan1 by 0.64% and 1.25% respectively (Annex-I(ii)).

On the other hand, in Southwest region, the average highest oven dry weight of thousand grains was with 27.28 gm in Richer and the lowest was with 24.22 gm in BRRi hybrid dhan1. The thousand grains weights of Sonarbangla1, Jagoran1, Hira, Aftab LP50 and Richer101 were higher than that of BRRi hybrid dhan1 by 10.49%, 7.76%, 3.47%, 9.70% and 11.63% respectively (Annex-I(iii)).

4.2 Physicochemical properties

Physicochemical properties of six rice hybrids grown under field trial in Northeast, Northwest and Southwest Bangladesh (2003-2004 Boro season) were analyzed in BRRI, Gazipur. Among the properties, Milling outturn, Head rice yield, Chalkiness, Appearance, Length, Breadth, Length-Breadth ratio, Size and shape, Amylose percentage, Protein percentage, Cooking time, Elongation Ratio, Imbibition Ratio were measured. Region wise physicochemical properties are given in Annex-II. The average Milling outturn, Appearance, Size and Shape, Amylose percentage, Protein percentage and Cooking time of 6 rice hybrids grown in 3 regions are shown in the following Table 15.

Table 15. Physicochemical properties of 6 rice hybrids grown in 3 regions

Variety	Milling outturn (%)	Appearance	Size and Shape	Amylose (%)	Protein (%)	Cooking time (min)
BRRI hybrid dhan1	71.63	Good	LB	24.67	5.87	22.00
Sonarbangla1	68.33	Good	LB	24.77	5.65	22.67
Jagoran1	71.33	Good	MB	24.80	5.99	22.50
Hira (99-5)	72.33	Good	MB	24.33	6.26	21.56
Aftab LP50	71.00	Good	LB	24.30	6.26	21.00
Richer101	70.00	Good	LB	24.70	5.42	22.83

Milling outturn: The average milling outturn was the highest with 72.33% in Hira followed in order by BRRI hybrid dhan1 (71.63%), Jagoran1 (71.33%), Aftab LP50 (71.00%), Richer101 (70.00%) and Sonarbangla1 (68.33%). The percentage of milling outturn was found more or less same with six tested rice hybrid cultivars. It is very much similar to our popular commercial modern varieties of rice. Thus tested six rice hybrid can be considered as commercial varieties for rice millers in the country.

Appearance: The appearances of 6 hybrid rice cultivars tested in 3 regions were found good.

Size and Shape: Out of 6 hybrids, Jagoran and Hira were medium-bold (MB) and the rest four varieties were long bold (LB).

Amylose content: The average amylose content was the lowest with 24.30% in Aftab LP50 followed in order by Hira (24.33%), BRRI hybrid dhan1 (24.67%), Richer101 (24.70%), Sonarbangla1 (24.77%) and Jagoran1 (24.80%). The finding is further confirmed that tested six hybrid cultivars are not sticky rice.

Protein content: The protein content was the highest with 6.26% in both Hira and Aftab followed in order by Jagoran1 (5.99%), BRRI hybrid dhan1 (5.87%), Sonarbangla1 (5.65%), and Richer101 (5.42%).

Cooking time: Among the 6 rice hybrids, the required cooking time was the lowest with Aftab LP50 at 21.00 min., followed in order by Hira at 21.56 min., BRRI hybrid dhan1 at 22.22 min., Jagoran1 at 22.50 min., Sonarbangla1 at 22.67 min. and Richer101 at 22.83 minutes.

4.3 Insect infestation and disease infection

Both of Insect infestation and disease infection was common problems at very low level for cultivated 6 rice hybrids in 3 study regions. The average insect infestation and disease infection level of 6 cultivars of hybrid rice tested in 3 regions are given in the following Table-16.

Table 16. Comparison of insect infestations and disease infections of 6 cultivars tested in 3 regions

Variety	Insect infestation (1-9 scale)		Disease infection (1-9 scale)	
	Mean	CV (%)	Mean	CV (%)
BRRi hybrid dhan1	3.20	18.75	1.88	31.38
Sonarbangla1	2.40	10.42	1.29	24.80
Jagoran1	2.25	28.44	1.27	12.60
Hira (99-5)	2.24	26.33	1.33	6.01
Aftab LP50	2.16	29.17	1.25	8.80
Richer101	2.15	17.21	1.14	6.14

Insect infestation: The average highest insect infestation was measured in BRRi hybrid dhan1 using the insect infestation scale ranging from 1 to 9 and the average lowest insect infestation was measured in Richer101 using the same scale. Stem borer was the most common and considerable insect for infestation in 3 study regions. The rest 4 varieties had almost same but lower insect infestation than that of BRRi hybrid dhan1 (Table 16). Region wise insect infestation scales of 6 rice hybrids are provided in Annex-III(i), III(ii) and III(iii).

Disease infection: The highest disease infection was observed with BRRi hybrid dhan1 and the rest 5 varieties had almost the same level of disease infection, which was lower than that of BRRi hybrid dhan1 (Table 16). However, low disease infection of Bacterial Leaf Streak (BLS) and Bacterial leaf blight (BLB) were observed in 3 regions as well as low infestation of Bakanae was observed in Northeast region (Annex-III(i), III(ii) and III(iii)).

4.4 Lodging, storm, hailstorm and flash flood damage

Lodging was slightly higher in 3 regions with BRRi hybrid dhan1 than the rest five rice hybrids. On the other hand crop damage due to flash flood, storm and hailstorm was also observed during the 2003-2004 Boro season. In northeast region, the crop damage due to flash flood and hailstorm was severe (Annex-III(i)). Average lodging and crop damage due to storm, hailstorm and flash flood for 3 regions are presented in the following Table 17.

Table 17. Lodging and crop damage due to storm, hailstorm and flash flood of 6 cultivars tested in 3 regions

Variety	Lodging (1-9 scale)		Crop damage due to storm, hailstorm and flash flood (%)
	Mean	CV (%)	Mean
BRRi hybrid dhan1	3.01	6.97	5.71
Sonarbangla1	1.19	9.24	7.08
Jagoran1	1.23	15.38	7.38
Hira (99-5)	1.10	4.55	6.61
Aftab LP50	1.13	4.42	7.21
Richer101	1.07	2.80	5.93

Lodging: The average highest lodging was observed as 3.01 in BRRI hybrid dhan1 and the average lowest lodging was observed as 1.07 in Richer using a lodging measuring scale ranging from 1 to 9. Except BRRI hybrid dhan1, the rest 5 cultivars had very low-level lodging. Lodging was extensive with BRRI hybrid dhan1 in 3 regions due to their higher height than that of the rest 5 varieties (Annex-III(i), III(ii) and III(iii)).

Storm, hailstorm and flash flood damage: The average highest percentage of crop damage, due to flash flood, storm and hailstorm for 6 rice hybrids, was observed in Jagoran1 and the average lowest that percentage was observed in BRRI hybrid dhan1. It was notable that the natural calamity, storm and hailstorm were experienced by the 5 varieties at their flowering stage except BRRI hybrid dhan1. However, the differences among the average varietal crop damage percentages were very close. But the crop damage percentages of Northwest and Southwest regions that afforded no more extensive damage during 2003-2004 Boro season were considerably lower than that of Northeast region (Annex-III(i), III(ii) and III(iii)).

4.5 Cost and Return

Cost and return varied from region to region. Region wise cost and return of the main product and by-product of 6 rice hybrids are shown in Annex –IV(i), IV(ii) and IV(iii).

Separate cost and return analysis for individual hybrid variety was calculated, as there was variation among the varietal yield contribution. Average gross return, full cost and cash cost basis total production cost, net-return and benefit-cost-ratio of the 6 cultivars of hybrid field trial in 3 regions for 2003-04 Boro season, is provided in the following Table 18.

Table 18. Cost and return of the 6 cultivars tested in 3 regions for 2003-04 Boro season

Item	Sonarbangla1	Jagoran1	Hira	Aftab LP50	Richer 101	BRRI Hybrid dhan1
Gross-return (Tk/ha)	62,252	59,171	62,726	62,015	61,857	55,063
Total cost (Tk/ha):						
<i>(i) Full cost basis</i>	37,873	37,873	37,873	37,873	37,873	37,873
<i>(ii) Cash cost basis</i>	16,996	16,996	16,996	16,996	16,996	16,996
Net-return (Tk/ha):						
<i>(i) Full cost basis</i>	24,379	21,298	24,853	24,142	23,984	17,190
<i>(ii) Cash cost basis</i>	45,256	42,175	45,730	45,019	44,861	38,067
Benefit-cost-ratio:						
<i>(i) Full cost basis</i>	1.65	1.56	1.66	1.64	1.63	1.45
<i>(ii) Cash cost basis</i>	3.66	3.48	3.69	3.65	3.64	3.24
Net-return in terms of gross value of the product (%):						
<i>(i) Full cost basis</i>	39.16	35.99	39.62	38.93	38.77	31.22
<i>(ii) Cash cost basis</i>	72.70	71.28	72.90	72.59	72.52	69.13

The average cost of production for 6 hybrid cultivars were same as the management of 6 varieties was same for the trial plot of individual farmer.

The per hectare net-return on full cost basis was highest with Hira (Tk.24,853) followed in order by Sonarbangla1 (Tk.24,379), Aftab LP50 (Tk.24142), Richer101 (Tk.23,984), Jagoran1 (Tk.21,298) and BRRI hybrid dhan1 (Tk.17,190).

Similarly, the per hectare net-return on cash cost basis was highest with Hira (Tk.45,730) followed in order by Sonarbangla1 (Tk.45,265), Aftab LP50 (Tk.45,019), Richer101 (Tk.44,861), Jagoran1 (Tk.42,175) and BRRI hybrid dhan1 (Tk.38,067).

The benefit-cost-ratio on full cost basis was highest with 1.66 in Hira followed in order by Sonarbangla1 (1.65), Aftab LP50 (1.64), Richer101 (1.63), Jagoran1 (1.56) and BRRI hybrid dhan1 (1.45).

Likewise, the benefit-cost-ratio on cash cost basis was highest with 3.69 in Hira followed in order by Sonarbangla1 (3.66), Aftab LP50 (3.65), Richer101 (3.64), Jagoran1 (3.48) and BRRI hybrid dhan1 (3.24).

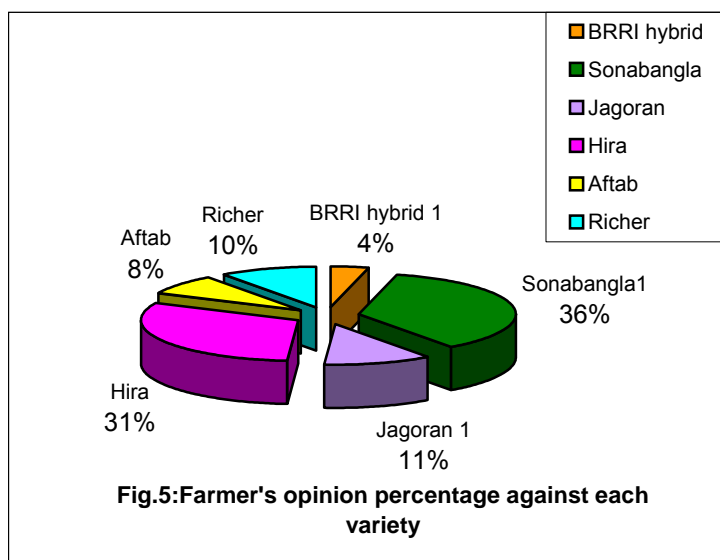
On full cost basis, the net-return in term of gross value of the product was the highest with 39.62% in Hira followed in order by Sonarbangla1 (39.16%), Aftab LP50 (38.93%), Richer101 (38.77%), Jagoran1 (35.99%) and BRRI hybrid dhan1 (31.22%).

In the same way, on cash cost basis the net-return in terms of gross value of the product was highest with 72.90% in Hira followed in order by Sonarbangla1 (72.70%), Aftab LP50 (72.59%), Richer101 (72.52%), Jagoran1 (71.28%) and BRRI hybrid dhan1 (69.13%).

The net-return on both full cost basis and cash cost basis was found economically encouraging for the 6 rice hybrids tested in 3 regions. Moreover, cash cost basis net return was more profitable than full cost basis net return.

Similarly, from the benefit-cost-ratio and net-return in terms of gross value of the product (%), it was clear that the cash cost basis was not only encouraging but also more profitable than full cost basis.

4.6 Acceptability of rice hybrids



During the farmers' participatory evaluation workshops in three regions, the participating farmers, who had established trial plots, assessed and selected only one variety as the best among the tested 6 hybrid rice varieties depending on their own acquired knowledge and experience specially during 2003-04 Boro season. Farmer's assessment was done through casting vote. For this, each farmer cast one vote for his/her most favored variety among the tested six hybrid rice cultivars. Thereafter, the average percentage of farmers' opinion of 3 regions

against each variety and final ranking among the 6 varieties were done. The most accepted rice hybrid was found Sonarbangla1 (about 36%) followed in order by Hira (about 31%), Jagoran1 (about 11%), Richer (about 10%), Aftab LP50 (about 8%) and BRRI hybrid dhan1 (about 4%)(Fig.5). Region wise number of participating farmer's opinion and average

percentage of farmer's opinion against each variety and desired rank are provided in the following Table 19.

Table 19. Varietal assessment of 6 hybrid cultivars tested in 3 regions

Variety	Participating farmer's opinion against each variety (Nr.)				Farmer's opinion against each variety (%)	Rank
	Northeast	Northwest	Southwest	Total		
BRR1 hybrid dhan1	02	01	00	03	3.41	6
Sonarbangla1	11	00	21	32	36.36	1
Jagoran1	03	06	01	10	11.36	3
Hira	11	09	07	27	30.68	2
Aftab LP50	00	05	02	07	7.96	5
Richer101	02	05	02	09	10.23	4
Total	29	26	33	88	100	

4.7 Lesson Learned

The establishment of trial plots with the 6 cultivars of rice hybrids have given participating farmer researchers an opportunity to observe the comparative field performance of the tested rice hybrids during the 2003-04 Boro season. They have learned a lot from the sub-project of farmer's participatory field trials on rice hybrids. The following lessons-learned are part of the evidence the farmer researchers gave as the basis for their cumulative knowledge and experience.

- ✓ Hybrid rice gives more yield than modern varieties (i.e., BRR1 dhan28 and BRR1 dhan29). In high fertile land (i.e., *Chalan beel*) rice hybrids perform better. Moreover, in medium fertile land, hybrid rice varieties give higher yield than modern rice varieties.
- ✓ Hybrid rice requires less seed and seedling per unit area. For transplanting 1-acre (100 decimals) land, about 5 Kg hybrid rice seed is enough whereas at least 15-20 Kg seed of modern varieties is required. It requires only one seedling per hill for transplanting. But if the seedling is weak, 2 transplanted seedlings will be better. The spacing, line to line 8 inch (20 cm) and hill to hill also 8 inch (20 cm), is the best and always square spacing for seedling transplanting is satisfactory & more effective. Younger seedling is good for hybrid rice cultivation. At the time of seedling uprooting more care is necessary to prevent root damage.
- ✓ Unfilled grain percentage of hybrid varieties are less than modern varieties (BRR1 dhan29 and BRR1 dhan28). In high fertile land more unfilled grain is being produced by the modern varieties than hybrid varieties.
- ✓ Out of the 6 tested hybrid varieties, mixture was found notably in Jagoran1 commonly in 3 regions. More or less similar percentages of mixture were observed all over the regions with Jagoran1. On an average 3 % mixture, that means, heterogeneous rice plant was found commonly in every plots with Jagoran1, which were taller than normal rice plant and experienced early flowering and maturity with less filled grains.
- ✓ Hybrid rice seedling can tolerate foggy and cold weather; even after transplanting it can tolerate cold temperature than the popular modern varieties of rice (i.e., BRR1 dhan28 and BRR1 dhan29) during Boro season.

- ✓ Recommended dose of fertilizer for BRR1 dhan29 is best suited for the rice hybrid varieties. Urea topdressing for BRR1 hybrid dhan1 needs to be done carefully. Less unfilled grain can be produced with BRR1 hybrid dhan1 if optimal rate of urea is carefully applied at the time of top dressing especially during last top dressing just before panicle initiation stage of the crop.
- ✓ In early flood-prone areas, BRR1 hybrid should not be used. But 5 tested Chinese rice hybrid cultivars are suitable for these areas due to their reputations for short duration.
- ✓ Milling outturn of hybrid rice is higher than that of BRR1 dhan29 and BRR1 dhan28. Per mound (40 kg) of hybrid rice is sold with at least Tk. 20 higher than that of modern varieties. Good quality of *Chira* (beaten rice) can be made from BRR1 hybrid dhan1 but *Muri* and *Khai* (puffed rice) cannot be made from hybrid rice. Hybrid rice is not so good for making different types of traditional *Pitha* (rice cake). Cooked rice of all 6 cultivars tasted very well, especially Hira is very sweet to eat. Hybrid *Khichuri* (hotchpotch) is very much tasty. Aftab LP50 and BRR1 hybrid dhan1 are slightly aromatic rice.

Chapter 5: Conclusion and Recommendations

5.1 Conclusion

Among the 6 rice hybrids tested in three regions, Hira was found to be highest average grain yield producing variety followed in order by Sonarbangla1, Aftab LP50, Richer101, Jagoran1 and BRR1 hybrid dhan1 during the Boro season 2003-2004. Out of the three study regions, the yield potentiality was highest in Northwest region followed in order by Southwest and Northeast regions. However, the yield potentiality of 3 varieties, Sonarbangla1, Hira and BRR1 hybrid dhan1 in Northeast region, exceeded 9 ton/ha. On the other hand the yield potentiality of all 6 varieties in Northwest and Southwest regions exceeded 9 ton/ha. Moreover, in Northwest region, the highest yield exceeded 10 ton/ha for all 6 cultivars (maximum individual grain yield).

The average field duration was highest with about 113 days in BRR1 hybrid dhan1 and for the rest 5 varieties; the average field duration was found more or less same (about 104 days).

In BRR1 hybrid dhan1, average maximum tillers per hill and average panicles per hill were the highest but the average effective tiller production percentage was the lowest. However, in Hira, average maximum tillers per hill and average maximum panicles per hill were the least but the average effective tiller production percentage was the highest.

The average number of filled grains per panicle was highest with about 110 in Hira followed in order by Sonarbangla1, Richer, Aftab LP50, Jagoran1 and BRR1 hybrid dhan1 and the average number of unfilled grains per panicle was highest with about 41 in BRR1 hybrid dhan1 followed in order by Aftab, Jagoran, Richer, Sonarbangla and Hira. The highest percentage of average unfilled grain was about 30% in BRR1 hybrid dhan1 followed in order by Jagoran, Aftab, Hira, Richer and Sonarbangla1.

The average highest oven dry weight of thousand grains (un husked paddy) was with 27.32 gm in Sonarbangla1 followed in order by Richer, Aftab LP50, Jagoran1, Hira and BRR1 hybrid dhan1.

Among the tested physicochemical properties, milling outturn was found more or less same with six tested rice hybrid cultivars. It is very much similar to our popular commercial MVs of rice. Thus tested six rice hybrid can be considered as commercial varieties for rice millers in the country. The appearances of 6 hybrid rice cultivars tested in 3 regions were found good. Jagoran and Hira were medium-bold (MB) and the rest four varieties were long bold (LB). It is found that the tested six hybrid cultivars are not sticky rice because the amylose content varied from 24.3%-24.8%. The protein content of the 6 cultivars varied from 6.26% to 5.42%. It was also observed that the required cooking time of the hybrid cultivars was more or less the same and varied from 22.83 -21.00 min. Thus hybrid rice cooking time is comparable to our popular Mvs of rice.

The average highest insect infestation and disease infection were observed in BRR1 dhan 1. The rest 5 varieties had the same but lower insect infestations as well as disease infections.

Lodging was slightly higher in 3 regions with BRR1 hybrid dhan1 than the rest five rice hybrids. On the other hand, crop damage due to flash flood, storm and hailstorm was also observed during the crop season 2003-2004. In northeast region, the crop damage due to

flash flood and hailstorm was extreme. Short duration hybrid varieties had an advantage in avoiding damage from the seasonal onset of early flooding.

Hybrid rice Net-returns on both full cost and cash cost basis was found economically advantageous and calculations done on cash cost basis was found more profitable than that of full cost basis.

During farmers' participatory evaluation workshop in 3 regions, the most widely accepted variety was Sonarbangla1 followed in order by Hira, Jagoran, Richer, Aftab and BRR1 hybrid dhan1.

5.2 Recommendations

Six rice hybrids, Sonarbangla1, Jagoran1, Hira (99-5), Aftab LP50, Richer101 and BRR1 hybrid dhan1, were tested successfully in Northeast, Northwest and Southwest regions during 2003-04 Boro season. The overall performances of five imported Chinese varieties were found better over the control variety BRR1 hybrid dhan1. So the above mentioned 5 Chinese hybrid rice varieties, should be adopted in Boro season within and outside of the project areas. BRR1 hybrid dhan1 should be adopted in Northwest region as well as Southwest region. But in Northeast region where early flood is a problem, BRR1 hybrid dhan1 should not be introduced/produced due to its longer duration.

The quality of seed is an integral part of improved production package for achieving higher yield of rice. Hybrid rice seed is costly, so its quality should be ensured without any doubt. As there has been reported of impurity during flowering and low percentage of seed germination of some particular varieties, the respective companies must identify the real causes of the problems. Especially for the locally produced seed, more emphasis should be given to keeping its purity intact; maintaining its hybrid integrity. The seed of high demand location specific rice hybrids should be supplied in time to the farmers. During sowing season farmers are often frustrated because of short supplies during peak demand as well as unjustified price hikes due to artificial shortages of hybrid seed. The concerned seed companies should take necessary steps so that the seed price does not exceed the advertised maximum retail price (MRP).

Rice hybrid is a technology innovation in our country and farmers are not yet fully familiar with it. It has different management practices for cultivation. Technology of modern rice cultivation has not been satisfactorily disseminated among the farmers. Moreover, rice hybrid technology has some additional differences with the production practices of modern varieties (MVs). It is obvious that without the necessary and prerequisite training, rice hybrid uptake will be slower than its high potential would indicate. Real emphasis should be given on practical training of rice hybrid technology for its large-scale dissemination and sustainability.

Annex-I(i): Comparison of means of different characters of Sonarbangla1, Jagoran1, Hira, Aftab LP50, Richer101 and BRR1 hybrid dhan1 in 2003-04 Boro season of Northeast region

Characteristics/ Parameters	Sonarbangla1			Jagoran1			Hira			Aftab LP50			Richer101			BRR1 hybrid dhan1		
	Mean	CV (%)	SE	Mean	CV (%)	SE	Mean	CV (%)	SE	Mean	CV (%)	SE	Mean	CV (%)	SE	Mean	CV (%)	SE
Paddy yield (t/ha)	7.11	18.08	0.28	6.75	17.36	0.26	7.59	15.75	0.26	7.08	15.24	0.24	7.11	15.43	0.25	6.61	28.41	0.41
Field duration (days)	106.43	7.23	1.70	106.67	6.84	1.59	106.90	8.60	2.00	107.19	8.89	2.07	107.85	8.61	2.03	114.04	8.09	1.98
Tiller and panicles productions:																		
a) Max. Tillers /hill (Nr)	21.28	17.20	0.76	20.57	19.69	0.84	18.90	30.63	1.21	21.10	21.43	0.94	21.15	20.76	0.94	23.92	23.70	1.18
b) Panicles/hill (Nr)	15.35	33.75	1.04	14.96	35.89	1.05	14.52	33.40	1.00	15.34	31.16	0.94	15.03	31.60	0.93	16.68	33.75	1.10
c) % Effective tiller	72.13	24.56	3.41	72.73	23.06	3.23	76.83	20.33	2.81	72.70	22.33	3.16	71.06	31.10	4.45	69.72	25.39	3.51
Grain production:																		
a) Filled grains/Panicle	75.56	37.65	7.34	71.95	31.17	5.79	82.73	32.81	7.00	73.21	29.56	5.59	72.09	34.91	6.50	69.67	35.45	6.38
b) Unfilled grains/panicle	20.93	72.34	3.91	31.01	42.55	3.41	28.21	55.97	4.08	31.52	47.46	3.86	25.32	53.67	3.51	42.29	48.52	5.30
c) %Unfilled grains	21.43	51.56	2.85	29.54	27.42	2.09	24.74	0.41	2.60	28.73	20.57	1.53	25.62	43.95	2.91	36.44	28.81	2.71
d) 1000-grains wt. (gm), oven dry	28.14	5.50	0.39	26.37	3.15	0.21	25.72	4.50	0.30	27.27	5.50	0.39	27.80	6.63	0.48	24.96	4.71	0.30

Annex-I(ii): Comparison of means of different characters of Sonarbangla1, Jagoran1, Hira, Aftab LP50, Richer101 and BRR1 hybrid dhan1 in 2003-04 Boro season of Northwest region

Characteristics/ Parameters	Sonarbangla1			Jagoran1			Hira			Aftab LP50			Richer101			BRR1 hybrid dhan1		
	Mean	CV (%)	SE	Mean	CV (%)	SE	Mean	CV (%)	SE	Mean	CV (%)	SE	Mean	CV (%)	SE	Mean	CV (%)	SE
Paddy yield (t/ha)	8.35	13.93	0.18	8.12	14.53	0.18	8.32	11.30	0.15	8.46	15.80	0.21	8.38	15.31	0.20	7.65	16.08	0.19
Field duration (days)	102.13	6.11	0.91	102.23	6.06	0.90	102.89	5.85	0.88	102.95	5.88	0.88	103.21	5.58	0.84	111.59	3.96	0.62
Tiller and panicles productions:																		
a) Max. Tillers /hill (Nr)	16.79	18.40	0.48	16.80	21.49	0.56	16.70	19.82	0.51	16.67	20.28	0.52	16.83	19.85	0.51	17.69	19.67	0.54
b) Panicles/hill (Nr)	13.75	14.84	0.31	13.62	18.06	0.38	13.67	17.12	0.36	13.63	20.61	0.44	13.79	17.69	0.38	14.53	18.65	0.42
c) % Effective tiller	82.44	6.02	0.77	81.67	6.63	0.84	82.36	5.46	0.70	81.63	5.74	0.72	82.35	5.85	0.74	82.41	4.35	0.55
Grain production:																		
a) Filled grains/Panicle	107.91	19.37	4.67	112.88	31.10	7.85	119.82	20.22	5.41	107.08	33.99	8.14	112.61	26.92	6.78	106.49	23.93	5.70
b) Unfilled grains/panicle	32.85	33.19	2.44	40.98	28.97	2.65	42.98	36.46	3.50	40.47	32.91	2.98	33.20	24.33	1.80	49.89	30.13	3.36
c) %Unfilled grains	23.49	30.91	1.62	27.06	23.36	1.41	26.02	30.71	1.79	28.45	31.18	1.98	23.29	22.28	1.16	32.17	20.61	1.48
d) 1000-grains wt. (gm), oven dry	27.08	3.49	0.21	25.63	4.99	0.29	25.23	3.96	0.22	24.70	4.90	0.27	24.55	4.45	0.24	24.86	4.02	0.22

Annex-I(iii): Comparison of means of different characters of Sonarbangla1, Jagoran1, Hira, Aftab LP50, Richer101 and BRR1 hybrid dhan1 in 2003-04 Boro season of Southwest region

Characteristics/ Parameters	Sonarbangla1			Jagoran1			Hira			Aftab LP50			Richer101			BRR1 hybrid dhan1		
	Mean	CV (%)	SE	Mean	CV (%)	SE	Mean	CV (%)	SE	Mean	CV (%)	SE	Mean	CV (%)	SE	Mean	CV (%)	SE
Paddy yield (t/ha)	8.18	12.61	0.15	7.61	12.90	0.14	7.90	12.00	0.14	8.00	12.76	0.15	7.99	14.12	0.16	6.64	17.30	0.17
Field duration (days)	106.63	5.95	0.88	103.23	5.30	0.79	103.60	5.52	0.83	103.60	5.45	0.82	103.68	5.38	0.81	113.02	3.17	0.58
Tiller and panicles productions:																		
a) Max. Tillers /hill (Nr)	16.82	13.50	0.33	16.43	16.42	0.39	16.57	17.44	0.42	16.41	15.23	0.36	16.19	12.54	0.30	19.41	18.91	0.53
b) Panicles/hill (Nr)	11.56	17.56	0.25	11.58	14.85	0.25	11.72	16.81	0.29	11.75	17.62	0.30	11.80	16.19	0.28	12.00	21.17	0.37
c) % Effective tiller	69.40	17.25	1.75	71.88	18.17	1.91	71.80	15.88	1.66	72.07	14.13	1.48	73.23	13.05	1.39	62.70	17.02	1.56
Grain production:																		
a) Filled grains/Panicle	136.27	11.60	4.77	124.94	16.20	6.11	127.66	15.09	5.81	132.83	8.51	3.41	132.35	16.86	6.73	114.31	9.35	3.22
b) Unfilled grains/panicle	17.55	27.46	1.45	22.32	18.10	1.22	18.74	19.32	1.09	22.74	14.2	3.23	18.12	24.50	1.34	31.03	14.21	1.33
c) %Unfilled grains	11.46	8.55	0.98	15.32	17.75	0.82	12.90	18.53	0.72	14.67	15.81	0.70	12.27	26.57	0.98	21.35	13.55	0.88
d) 1000-grains wt. (gm), oven dry	26.76	5.98	0.48	26.10	6.28	0.49	25.06	3.15	0.24	26.57	4.63	0.37	27.28	8.45	0.28	24.22	4.29	0.31

Annex-II: Physicochemical properties of six rice hybrids grown in Northeast, Northwest and Southwest Bangladesh (2003-04 Boro)

Variety	Milling outturn (%)	Head rice yield (%)	Chalkiness	Appearance	Length (L) mm	Breadth (B) mm	L/B ratio	Size and shape	Amylose (%)	Protein (%)	Cooking time (min)	ER	IR
Northeast:													
BRR1 hybrid dha1	73	44	Wb5	Good	6.62	2.14	3.09	LS	25.3	5.67	23.5	1.3	4.3
Sonarbangla1	70	74	Tr	Good	6.65	2.29	2.90	LB	24.5	5.47	23.0	1.4	4.1
Jagoran1	74	82	Wb1	Good	5.95	2.38	2.50	MB	24.2	5.73	22.0	1.5	4.1
Hira	73	49	Wb5	Good	5.97	2.43	2.46	MB	24.9	5.73	21.0	1.4	4.0
Aftab LP50	73	42	Tr	Good	6.55	2.31	2.84	LB	24.2	5.61	20.5	1.4	3.9
Richer 101	73	57	Tr	Good	6.68	2.30	2.90	LB	24.2	4.72	22.5	1.4	3.9
Northwest													
BRR1 hybrid dhan1	71	27	Wb5	Good	6.48	2.20	2.95	LB	24.2	5.89	21.0	1.4	4.0
Sonarbangla1	67	29	Wb5	Good	6.50	2.24	2.90	LB	24.9	5.68	23.5	1.4	4.3
Jagoran1	70	42	Wb5	Good	5.85	2.45	2.39	MB	25.3	6.21	24.0	1.5	4.3
Hira	73	62	Tr	Good	5.88	2.38	2.47	MB	24.2	6.90	21.0	1.5	3.7
Aftab LP50	70	45	Tr	Good	6.43	2.27	2.83	LB	24.2	7.20	20.5	1.4	4.0
Richer 101	71	49	Tr	Good	6.39	2.35	2.72	LB	24.2	6.11	22.0	1.3	4.0
Southwest													
BRR1 hybrid dhan1	71	29	Wb5	Good	6.42	2.19	2.93	LB	24.5	6.06	21.5	1.3	3.9
Sonarbangla1	68	30	Wb5	Good	6.62	2.20	3.00	LB	24.9	5.80	21.5	1.3	3.9
Jagoran1	70	26	Wb5	Good	5.90	2.44	2.42	MB	24.9	6.05	21.5	1.4	3.7
Hira	71	36	Tr	Good	5.79	2.41	2.40	MB	24.9	6.16	22.5	1.4	4.1
Aftab LP50	70	33	Tr	Good	6.72	2.26	2.97	LB	24.5	5.97	22.0	1.3	4.1
Richer 101	66	24	Wb1	Good	6.43	2.25	2.86	LB	25.7	5.42	24.0	1.3	4.1

Wb = white belly, Tr = Translucent, L = Long, S = Slender, B = Bold, M = Medium, ER = Elongation Ratio, IR = Imbibition Ratio

Annex-III(i): Comparison of insect infestation, disease infection and storm damage of 6 cultivars of hybrid rice in Northeast region

Characteristics/ Parameters	BRR1 hybrid1			Sonarbangla1			Jagoran1			Hira			Aftab LP50			Richer101		
	Mean	CV (%)	SE	Mean	CV (%)	SE	Mean	CV (%)	SE	Mean	CV (%)	SE	Mean	CV (%)	SE	Mean	CV (%)	SE
Insect infestation (1-9 scale)	2.57	51.36	0.36	2.35	53.19	0.35	1.65	48.48	0.22	1.69	50.29	0.24	1.54	42.85	0.18	1.77	48.58	0.24
Disease infection (1-9 scale)	1.56	42.95	0.24	1.63	26.99	0.16	1.18	77.97	0.33	1.38	57.24	0.28	1.38	50.0	0.25	1.06	47.16	0.18
Lodging (1-9 scale)	3.25	33.23	0.44	1.08	18.51	0.08	1.21	8.26	0.04	1.04	9.61	0.04	1.07	9.34	0.04	1.06	11.32	0.05
Crop damage due to storm or hailstorm (%)	11.67	64.43	3.07	17.50	50.28	3.59	18.33	44.52	3.33	15.83	67.47	10.68	17.83	57.20	4.17	14.16	75.91	4.39

Annex-III(ii): Comparison of insect infestation, disease infection and storm damage of 6 cultivars of hybrid rice in Northwest region

Characteristics/ Parameters	BRR1 hybrid1			Sonarbangla1			Jagoran1			Hira			Aftab LP50			Richer101		
	Mean	CV (%)	SE	Mean	CV (%)	SE	Mean	CV (%)	SE	Mean	CV (%)	SE	Mean	CV (%)	SE	Mean	CV (%)	SE
Insect infestation (1-9 scale)	3.76	27.65	0.16	2.17	27.18	0.09	2.17	27.18	0.09	2.17	27.18	0.09	2.14	26.63	0.09	2.17	27.19	0.09
Disease infection (1-9 scale)	2.53	40.71	0.16	1.24	56.45	0.11	1.17	32.48	0.60	1.24	39.52	0.08	1.21	34.71	0.07	1.17	42.73	0.08
Lodging (1-9 scale)	2.93	30.00	0.14	1.20	38.33	0.07	1.17	32.48	0.06	1.14	31.58	0.06	1.17	32.48	0.06	1.05	36.53	0.06
Crop damage due to storm or hailstorm (%)	3.64	29.67	0.17	2.10	29.52	0.10	2.07	24.64	0.08	2.12	27.83	0.09	2.12	27.83	0.09	2.14	28.04	0.09

Annex-III(iii): Comparison of insect infestation, disease infection and storm damage of 6 cultivars of hybrid rice in Southwest region

Characteristics/ Parameters	BRRI hybrid1			Sonarbangla1			Jagoran1			Hira			Aftab LP50			Richer101		
	Mean	CV (%)	SE	Mean	CV (%)	SE	Mean	CV (%)	SE	Mean	CV (%)	SE	Mean	CV (%)	SE	Mean	CV (%)	SE
Insect infestation (1-9 scale)	3.29	41.94	0.37	2.67	48.69	0.35	2.92	47.27	0.37	2.86	52.79	0.40	2.79	42.8	0.31	2.50	43.60	0.29
Disease infection (1-9 scale)	1.55	34.00	0.16	1.00	63.0	0.63	1.45	56.55	0.25	1.36	67.65	0.28	1.18	63.55	0.23	1.18	63.55	0.23
Lodging (1-9 scale)	2.85	24.21	0.26	1.29	30.23	0.15	1.32	31.82	0.16	1.11	18.01	0.07	1.14	17.54	0.08	1.11	18.01	0.08
Crop damage due to storm or hailstorm (%)	1.82	47.80	0.26	1.64	46.95	0.23	1.73	51	0.26	1.59	42.30	0.20	1.68	53.57	0.27	1.50	44.67	0.20

Annex-IV (i): Cost and return of the six cultivars for 2003-04 Boro season under rice hybrid trials in Northeast

Items	Variety					
	Sonarbangla1	Jagoran1 (GB4)	Hira	Aftab LP50	Richer101	BRRi hybrid dhan1
Paddy Yield (Kg/ha)	7710	6750	7590	7080	7110	6610
Price of Paddy (Tk/kg)	7.5	7.5	7.5	7.5	7.5	7.5
Straw yield (kg/ha)	7110	6750	7590	7080	7110	6610
Price of straw (Tk/kg)	0.40	0.40	0.40	0.40	0.40	0.40
Gross return (Tk/ha)	56,169	53325	59961	55932	56169	52219
Total Cost (Tk/ha)						
(i) Full cost basis*	34491	34491	34491	34491	31491	34491
(ii) Cash cost basis**	13538	13538	13538	13538	13538	13538
Net return (Tk/ha)						
(i) Full cost basis	21678	18834	25470	21441	21678	17728
(ii) Cash cost	42631	39787	46423	42394	42631	38681
Benefit-cost ratio						
(i) Full cost basis	1.63	1.55	1.74	1.62	1.63	1.51
(ii) Cash cost basis	4.15	3.94	4.43	4.13	4.14	3.85
Net return in terms of gross value of the product (%)						
(i) Full cost basis	38.59	35.32	42.48	38.33	38.59	33.95
(ii) Cash cost basis	75.90	74.61	77.42	75.90	75.90	75.07

* Full cost basis includes human labour, bullock power, seeds, fertilizers, insecticides, irrigation, interest on working capital and land rent.

** Cash-cost includes seeds, fertilizers, insecticides, irrigation and interest of the outflow cash.

* Grain and straw is considered at 1:1 for this cost analysis.

Annex-IV(ii). Cost and return of the six cultivars for 2003-04 Boro season under rice hybrid trials in Northwest

Items	Variety					
	Sonarbangla1	Jagoran1 (GB4)	Hira	Aftab LP50	Richer101	BRR1 hybrid dhan1
Paddy Yield (Kg/ha)	8350	8120	8320	8460	8380	7650
Price of Paddy (Tk/kg)	7.50	7.50	7.50	7.50	7.50	7.50
Straw yield (kg/ha)	8350	8120	8320	8460	8380	7650
Price of straw (Tk/kg)	0.40	0.40	0.40	0.40	0.40	0.40
Gross return (Tk/ha)	65965	64148	65728	66834	66202	60435
Total Cost (Tk/ha)						
(i) Full cost basis*	39955	39955	39955	39955	39955	39955
(ii) Cash cost basis**	17994	17994	17994	17994	17994	17994
Net return (Tk/ha)						
(i) Full cost basis	26010	24193	25773	26879	26247	20480
(ii) Cash cost	47971	46154	47734	48840	48208	42441
Benefit-cost ratio						
(i) Full cost basis	1.65	1.61	1.65	1.67	1.66	1.51
(ii) Cash cost basis	3.67	3.56	3.65	3.71	3.67	3.36
Net return in terms of gross value of the product (%)						
(i) Full cost basis	39.43	37.71	39.21	40.22	39.65	33.89
(ii) Cash cost basis	72.72	71.95	72.62	73.08	72.82	70.23

* Full cost basis includes human labour, bullock power, seeds, fertilizers, insecticides, irrigation, interest on working capital and land rent.

** Cash-cost includes seeds, fertilizers, insecticides irrigation and interest of the outflow cash.

* Grain and straw is considered at 1:1 for this cost analysis.

Annex-IV(iii). Cost and return of the six cultivars for 2003-04 Boro season under rice hybrid trials in Southwest region

Items	Variety					
	Sonarbangla1	Jagoran1 (GB4)	Hira	Aftab LP50	Richer101	BRR1 hybrid dhan1
Paddy Yield (Kg/ha)	8180	7610	7900	8000	7990	6640
Price of Paddy Tk/kg)	7.50	7.50	7.50	7.50	7.50	7.50
Straw yield (kg/ha)	8180	7610	7900	8000	7990	6640
Price of straw (Tk/kg)	0.40	0.40	0.40	0.40	0.40	0.40
Gross return (Tk/ha)	64622	56564	62410	63200	63121	52456
Total Cost (Tk/ha)						
(i) Full cost basis*	39172	30172	39172	39172	39172	39772
(ii) Cash cost basis**	19456	19456	19456	19456	19456	19456
Net return (Tk/ha)						
(i) Full cost basis	25540	17392	23238	24028	23949	13284
(ii) Cash cost	45166	37108	42954	43774	43665	33000
Benefit-cost ratio						
(i) Full cost basis	1.65	1.44	1.59	1.61	1.61	1.34
(ii) Cash cost basis	3.32	2.91	3.21	3.25	3.24	2.70
Net return in terms of gross value of the product (%)						
(i) Full cost basis	39.38	30.75	37.23	38.02	37.94	25.32
(ii) Cash cost basis	69.89	65.60	68.83	69.22	69.18	62.91

* Full cost basis includes human labour, bullock power, seeds, fertilizers, insecticides, and irrigation, interest on working capital and land rent.

** Cash-cost includes seeds, fertilizers, insecticides, irrigation and interest of the outflow cash.

* Grain and straw is considered at 1:1 for this cost analysis.

Annex-V. List of Farmers of Rice Hybrid trial (2003-04 Boro season)

SL Nr	Farmer's Name	Village	Upazila	District
1	Md. Lutfar Rahman	Rangunia	Moulvibazar Sadar	Moulvibazar
2	Md. Abdul Haque	Mohammadpur	Moulvibazar Sadar	Moulvibazar
3	Md. Maruf Miah	Mohammadpur	Moulvibazar Sadar	Moulvibazar
4	Ratan Dev	West Varaura	Srimangal	Moulvibazar
5	Md. Nuruddin	South Pachaun	Srimangal	Moulvibazar
6	Md. Mosaddar Ali	South Varaura	Srimangal	Moulvibazar
7	Ranadhir Datta	Nischintapur	Srimangal	Moulvibazar
8	Md. Muhibur Rahman	South Mirnagar	Srimangal	Moulvibazar
9	Md. Mojahid Alam	South Lamuya	Srimangal	Moulvibazar
10	Md. Arab Ali	South Mirnagar	Srimangal	Moulvibazar
11	Md. Samsul Islam	Gopinathpur	Madhabpur	Habiganj
12	Md. Ali Hossain	NE Chhatian	Madhabpur	Habiganj
13	Mahesh Dev	Nagura	Baniachang	Habiganj
14	Md. Abdul Awal	Sultan Mohammadpur	Habiganj sadar	Habiganj
15	Ali Ahmad	West Madhabpur	Habiganj sadar	Habiganj
16	Ayesha Aktar	Krishnanagar	Madhabpur	Habiganj
17	Masuda Begum	Krishnanagar	Madhabpur	Habiganj
18	Md. Asadullah	Awaula Para	Madhabpur	Habiganj
19	Hannan Miah	Baneshwar	Madhabpur	Habiganj
20	Ms. Afia	Alakpur	Madhabpur	Habiganj
21	Ayub Ali	Barachardura	Madhabpur	Habiganj
22	Md. Awal Miah	Bhunabir	Srimangal	Moulvibazar
23	Md. Alfu Miah	Baranpur	Srimangal	Moulvibazar
24	Chayan Datta	Nischchintapur	Srimangal	Moulvibazar
25	Sadhan Paul	Chhatrabat	Srimangal	Moulvibazar
26	Md. Jahangir Alam	South Pachaun	Srimangal	Moulvibazar
27	Ranu Dev	Jatra Pasha	Srimangal	Moulvibazar
28	Samiran	Jatra Pasha	Srimangal	Moulvibazar
29	Md. Jalal Miah	Alisharkul	Srimangal	Moulvibazar
30	Md. Kala Miah	Alisharakul	Srimangal	Moulvibazar
31	Md. Frahim Miah	North. Varaura	Srimangal	Moulvibazar
32	Prajesh Dev	North. Varaura	Srimangal	Moulvibazar
33	Md. shamsuddin Miah	Lalbag	Srimangal	Moulvibazar
34	Sunil Baidya	Vimsi	Srimangal	Moulvibazar
35	Jagannath	Nagura	Bariachang	Habiganj
36	Manaruddin	Shajanpur	Madhabpur	Habiganj
37	Md. Kaiyum	Shajanpur	Madhabpur	Habiganj
38	Md. Babu	Naguna	Bariachang	Habiganj
39	Md. Jalal Miah	Bangaduda	Madhabpur	Habiganj
40	Md. Abdus Salam	Bangaduda	Madhabpur	Habiganj
41	Md. Roushan Ali	Basepatiyata	Madhabpur	Pabna
42	Md. Abdul Mannan	Vengri	Chatmohar	Pabna

SL Nr	Farmer's Name	Village	Upazila	District
43	Md. Roushan Ali	Basepatiyata	Madhabpur	Pabna
44	Md. Abdul Mannan	Vengri	Chatmohar	Pabna
45	Shahidul Islam	Baghal Barikai	Chatmohar	Pabna
46	Shah Alam	Baghal Barikai	Chatmohar	Pabna
47	Abdur Rashid	Baghal Barikai	Chatmohar	Pabna
48	Golam Kibria	Hamkuria	Tarash	Sirajganj
49	Shamsul Alam	Pukurpar	Ullahpara	Sirajganj
50	Md. Ibrahim Hossain	Pukurpar	Ullahpara	Sirajganj
51	Bahadur Ali	Chakmehedi	Ullahpara	Sirajganj
52	Ruhum Amin	Chakmehedi	Ullahpara	Sirajganj
53	Farhad Ali	Dabirganj	Ullahpara	Sirajganj
54	Khalilur Rahman	Dabirganj	Ullahpara	Sirajganj
55	Abdul Kuddus	Chakjoy Krishnapur	Tarash	Sirajganj
56	Alauddin	Bri-Pachan	Tarash	Sirajganj
57	Rejaul Karim (Labu)	Bri-Pachan	Tarash	Sirajganj
58	Sir Syed Ali	Chak Rasullah	Tarash	Sirajganj
59	Juyel Mirza	Chak Rasullah	Tarash	Sirajganj
60	Biplab Mirza	Chak Rasullah	Tarash	Sirajganj
61	Altab Ali	Goyalgram	Tarash	Sirajganj
62	Md. Ashraf Ali	Goyal gram	Tarash	Sirajganj
63	Taiyabur Rashid	Bamanbaria	Gurudaspur	Natore
64	Shariful Islam	Bilsa	Gurudaspur	Natore
65	Abdul Mannan	Sonabaria	Gurudaspur	Natore
66	Jarip Mollah	Jhakra	Gurudaspur	Natore
67	Julmat Ali	Jhakra	Gurudaspur	Natore
68	Mohammad Ali	Roushanpu	Gurudaspur	Natore
69	Ahad Ali	Roushanpu	Gurudaspur	Natore
70	AK Azad	Teltupi	Gurudaspur	Natore
71	Rejaul Karim	Teltupi	Gurudaspur	Natore
72	Ali Haidar	Teltupi	Gurudaspur	Natore
73	Abdus Salam	Makimpur	Gurudaspur	Natore
74	Faraz Ali	Harobaria	Singra	Natore
75	Abdul Malek	Raninagar	Singra	Natore
76	Samjan Ali	Goyalfa	Baraigram	Natore
77	Ramjan Ali	Goyalfa	Baraigram	Natore
78	Jabed Ali	Natabaria	Baraigram	Natore
79	Sukchand Pramanik	Natabaria	Baraigram	Natore
80	Saimuddin	Mahishvanga	Baraigram	Natore
81	Anwar Hossain	Mahishvanga	Baraigram	Natore
82	Abdul Malek	Raninagar	Singra	Natore
83	Riyaz Pramanik	Chakmehedi	Ullahpara	Sirajganj
84	Abdur Rashid	Kechuyakora	Baraigram	Natore

SL Nr	Farmer's Name	Village	Upazila	District
85	Md. Ziaur Rahman	Chatkabaria	Shalikha	Magura
86	Md. Kubad Ali	Chatkabaria	Shalikha	Magura
87	Md. Paku Biswas	Nariekel Baria	Sadar	Jhenaidah
88	Md. Jinnat Ali	Darbanarayanpur	Sadar	Rajbari
89	Md. Tarek Shekh	Darbanarayanpur	Sadar	Rajbari
90	Gourangakumar Paul	Jithar Vabanipur	Sadar	Jhenaidah
91	Md. Badsha Mollah	Jithar Vabanipur	Sadar	Jhenaidah
92	Md. Babur Ali Mollah	Dhaneshargati	Shalikha	Magura
93	Md. Nurul Islam	Dhaneshargati	Shalikha	Magura
94	Md. Motalep Mollah	Lakshipur	Sadar	Magura
95	Md. Sabedur Rahman	Lakshipur	Sadar	Magura
96	Md. Siddik Mondal	Paka	Sadar	Jhenaidah
97	Md. Akabbar Mollah	Paka	Sadar	Jhenaidah
98	Md. Thandu Mollah	Paka	Sadar	Jhenaidah
99	Md. Badsha Musalli	Kalukandi	Mohammadpur	Magura
100	Md. Sultap Biswas	Kalukandi	Mohammadpur	Magura
101	Md. Mukidul Islam	Goyalpara	Sadar	Jhenaidah
102	Md. Abu Taleb	Goyalpara	Sadar	Jhenaidah
103	Md. Mostafa Kamal	Chando	Sadar	Jhenaidah
104	Md. Saha Alam	Ghorshal	Sadar	Jhenaidah
105	Md. Atiwar	Ghorshal	Sadar	Jhenaidah
106	Md. Abdul Hamid	Ghorshal	Sadar	Jhenaidah
107	Md. Daud Hossain	Ghorshal	Sadar	Jhenaidah
108	Md. Haidar Ali	Ghorshal	Sadar	Jhenaidah
109	Md. Pannu Shekh	Eshan Gopalpur	Sadar	Faridpur
110	Md. Nilu Mallik	Eshan Gopalpur	Sadar	Faridpur
111	Md. Toaz Ahmed	Dougachhi	Sadar	Faridpur
112	Md. Akinur Rahman	Dougachhi	Sadar	Faridpur
113	Md. Sabur Hossain	Kushabaria	Sadar	Jhenaidah
114	Md. Rafiqul Islam	Kushabaria	Sadar	Jhenaidah
115	Md. Aminul Islam	Baniahaha	Sadar	Jhenaidah
116	Md. Sayeed Biswas	Baniahaha	Sadar	Jhenaidah
117	Md. Abdul Mojid Mondal	Madhunathpur	Sadar	Jhenaidah
118	Md. Babul Mondal	Madhunathpur	Sadar	Jhenaidah
119	Md. Hiro	Ujangram	EB Shekhpara	Kushtia
120	Md. Ruhul Amin	Ujangram	EB Shekhpara	Kushtia
121	Ratan Kumar Biswas	Jalhar	Sadar	Jhenaidah
122	Gurupada Biswas	Jalhar	Sadar	Jhenaidah
123	Mir. Suraib Hossain	Sani Ar-Para	Shalikha	Magura
124	Mir Md. Nawab	Sani Ar-Para	Shalikha	Magura
125	Sucharu Kumar Biswas	Shikarapur	Sadar	Jhenaidah
126	Md. Bilash Kumar Biswas	Shikarapur	Sadar	Jhenaidah
127	Bivash Gayen	Barathai para	Shalikha	Magura
128	Alok Biswas	Barathai para	Shalikha	Magura
129	Parimal Kumar Biswas	Chhata thai para	Shalikha	Magura
130	Bishwajit Kumar Biswas	Chhata thai para	Shalikha	Magura

Annex-VI: List of Partner organizations (NGOs/CBOs) involved in rice hybrids trials in 3 regions

SI Nr.	Partner NGOs/CBOs' contact person, name, and address	Project Area		
		Village	Upazila	District
1	Ms. Lutfun Nesa Executive Director Women Development Project (WDP) Hospital Road, Tarash, Sirajganj	Chak Joy krishnapur, Chakmehedi, Pukurpar	Tarash, Ullahpara	Sirajganj
2	Md. Azim Haidar Executive director Sirajganj Flood Forum (SFF) Handial, Chatmohar, Pabna	Hamkuria, Goyalgram, Baghal Bari Kai, Basepatia	Tarash, Chatmahar	Sirajganj, Pabna
3	Md. Shahinur Islam ED, Sabuj Bangla (SB) Handial, Chatmohar, Pabna	Vengri	Chatmahar	Pabna
4	Md. Shahjahan Ali ED, SSUK, Chachkair, Gurudaspur, Natore	Bilsa, Bamanbaria	Gurudaspur	Natore
5	Md. Hamid Kousar ED, Bhai Bhai Sangstha (BBS) Chachkair, Gurudaspur, Natore	Sonabaju	Gurudaspur	Natore
6	Md. Mazibur Rahman Maznu ED, BDSC, Gurudaspur, Natore	Jhakra, Roushanpur	Gurudaspur	Natore
7	Ferdous Feruki Director Aso Kaj Kari (AKK) Najirpur, Gurudaspur, Natore	Teltupi	Gurudaspur	Natore
8	A Z M Asrafuzzam Vice president Kechuya Para Krishak Samabai Samity (KPKSS), Baraigram, Natore	Makimpur, Goyalfa, Natabaria, Mahishvanga, kechuya para	Gurudaspur , Baraigram	Natore
9	Ms. Jahanara Beauty ED, NEDA Dighapatia, Natore	Harobaria, Raninagar	Singra	Natore
10	Dulal Sutradhar ED, AURD Mission Road, Habiganj	Sultan Mohammadpur, Nagura	Sadar, Baniachang	Habiganj
11	Mozahid Bin Islam ED, MKS Nouyapara, Saihamnagar Madhabpur, Habiganj	Chhatiyan, Bangaduda	Madhabpur	Habiganj
12	Md. Moklesur Rahman ED, BASA Teliapara, Madhabpur, Habiganj	Shahjanpur	Madhabpur	Habiganj
13	Amio Prova Roy Choudhury ED, MBNMS Thana Road Madhabpur, Habiganj	West Madhabpur, Krishnanagar, Araulapara, Baneshwar, Alakpur, Barochandura	Habiganj Sadar, Madhabpur	Habiganj

14	S A Hamid Chief Executive Mac- Bangladesh Sirajnagar, Srimangal Moulvibazar	Rangunia, Mohammadpur, South Mirnagar, South Lamuya	Moulvibazar Sadar, Srimangal	Moulvibazar
15	Ranadhir Datta Chief Executive Nishchintapur Krishak Samabai Samity (NKSS) Nishchintapur, Moulvibazar	South Pachaun, Nishchintapur, Sultan Mohammadpur, Baranpur, Satrabat, Jatrapasha, West Varaura	Srimangal, Habiganj Sadar,	Moulvibazar Habiganj
16	Nikesh Gop Vice president Uttar Varaura Udayan Bahumukhi Samabai Samity (UVUBSS), Srimangal, Moulvibazar	Alisharkul, North Varaura, Lalbag	Srimangal	Moulvibazar
17	Md. Hasem Ali Director, Kalyani 158, Sher-E-Bangla Road, Sadar, Jhenaidah	-	Jhenaidah Sadar	Jhenaidah
18	M.A.Sattar ED, Atmobiswas Jheneda (AJ), Sher-E-Bangla Road, Sadar, Jhenaidah-7300	-	Jhenaidah Sadar	Jhenaidah
19	Syed Shamsul Islam ED, Dipshikha Anirban (DA) Kabi Sukanto Sarak, Jhenaidah- 7300	-	Jhenaidah Sadar	Jhenaidah
20	Md.Shahidul Islam ED, Chetona Jessore Road, Jhenaidah	-	Jhenaidah Sadar	Jhenaidah
21	Md. Jakir Hossain ED, Kalpotaru Jessore Road, Jhenaidah	-	Jhenaidah Sadar	Jhenaidah
22	Md. Rejaul Karim ED, Jamuna Samaj Kalyan Sangstha (JSKS) Jessore Road, Jhenaidah	-	Jhenaidah Sadar	Jhenaidah
23	Md. Nantu Jardar ED, ADD Kushtia Road, Arappur, Jhenaidah	-	Jhenaidah Sadar	Jhenaidah

Annex-VII(i): Participants list of field days of rice hybrid in Northeast region

SI Nr.	Site	Date	Participants (Nr.)		Demonstrating Village	Upazila	District
			Male	Female			
1	Abdul Haque's Plot	01.05.04	66	1	Mohammadpur	Sadar	Moulvibazar
2	Lutfar Rahman's Plot	01.05.04	48	-	Rangunia	Sadar	Moulvibazar
3	Mojahid Alam's Plot	02.05.04	49	-	North Lalmutya	Srimangal	Moulvibazar
4	Mosaddar Ali's Plot	18.05.04	42	-	West Varaura	-Do-	-Do-
5	Sufiyan's Plot	22.04.04	40	-	Lalbag	-Do-	-Do-
6	Sharifa Aktar's Plot	24.04.04	25	23	Baneshwar	Madhabpur	Habiganj
7	Afiya Begum's Plot	21.04.04	6	40	Alakpur	-Do-	-Do-
8	Asadullah's Plot	22.04.04	11	32	Awaula para	-Do-	-Do-
9	Haris Miah's Plot	24.04.04	11	40	South Madhabpur	-Do-	-Do-
10	Ali Hossain's Plot	20.04.04	52	-	NE Chhatian	-Do-	-Do-
11	Shamsul Islam's Plot	21.04.04	47	-	Gopinathpur	-Do-	-Do-
12	Manaruddin & Kaiyum's Plots	20.04.04	49	-	Shajahanpur	-Do-	-Do-
13	Mahesh & Jagannath's Plots	26.04.04	38	-	Naguna	Baniachang	-Do-
14	Awal's Plot	27.04.04	23	-	Sultan Mohammadpur	Sadar	-Do-

Annex-VII(ii): Participants list of field days of rice hybrid in Northwest region

SI Nr.	Site	Date	Participants (Nr.)		Demonstrating Village	Upazila	District
			Male	Female			
1	AK Azad's Plot	25-04-04	44	-	Teltupi	Gurudaspur	Natore
2	Ahsan Mollah's Plots	09-05-04	48	-	Mahishvanga	Gurudaspur	Natore
3	Md. Abdur Rashid's Plots	30-04-04	32	-	Baghalbari Kai	Chatmohar	Pabna
4	Taiyabur Rasid's Plots	01.05-04	40	-	Bamanbaria	Gurudaspur	Natore
5	Aftab Hossain's Plots	03-05-04	40	-	Goyal gram	Tarash	Sirajganj
6	Mariyam Bibi's Plots	05-04-04	32	-	Pukurpar	Ullahpara	Sirajganj
7	Mannan Sardar's Plots	29-04-04	40	-	Sonabaju	Gurudaspur	Natore
8	Mohammad Ali's Plots	25-04-04	47	-	Roushanpur	Gurudaspur	Natore
9	Ramjan Ali's Plots	26-04-04	32	-	Goyalfa	Baraigram	Natore
10	Sukchand's Plots	11-05-04	41	-	Natabaria	Baraigram	Natore
11	Julmat's Plots	21-04-04	61	-	Jhakra	Gurudaspur	Natore
12	Alauddin's Plots	23-04-04	69	-	Bri-Pachan	Tarash	Sirajganj
13	Golam Kibria's Plots	22-04-04	38	-	Hamkuria	Tarash	Sirajganj
14	Juyel Mirza's Plots	24-04-04	50	-	Chak Rasulah	Tarash	Sirajganj
15	Farhad's Plots	24-04-04	31	-	Ramkrishnapur	Ullahpara	Sirajganj
16	Ali Hidar's Plots	27-04-04	34	-	Makimpur	Gurudaspur	Natore

Annex-VII(iii): Participants list of field days of rice hybrid in Southwest region

SI Nr.	Site	Date	Participants (Nr.)		Demonstrating Village	Upazila	District
			Male	Female			
1	Md. Sorap Mir's Plot	22.04.04	32	-	Sani Ar-Para	Shalikha	Magura
2	Alok Biswas's Plot	28.04.04	24	2	Bara Thai Para	Shalikha	Magura
3	Sucharu Basu's Plot	27.04.04	25	-	Shikarpur	Sadar	Jhenaidah
4	Abdul Majid's Plot	25.04.04	36	-	Madhunathpur	Sadar	Jhenaidah
5	Md. Akinur's Plot	25.04.04	27	-	Dougachhi	Sadar	Jhenaidah
6	Md. Babur Ali's Plot	24.04.04	25	-	Dhaneshwargati	Shalikha	Magura
7	Badsha Mollah's Plot	24.04.04	35	-	Jithar Vabanipur	Sadar	Jhenaidah
8	Sabur Hossain's Plot	23.04.04	49	-	Kushabaria	Sadar	Jhenaidah
9	Haidar Ali's Plot	3.05.04	270	-	Ghorshal	Sadar	Jhenaidah
10	Akbbar's Plot	3.05.04	34	-	Paka	Sadar	Jhenaidah
11	Sha Alam's Plot	3.05.04	33	-	Ghorshal	Sadar	Jhenaidah
12	Daud's Plot	19.04.04	51	-	Ghorshal	Sadar	Jhenaidah