

# 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                            |
| RPFGs          | = | 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 BRRI hybrid dhan1 (24.68 gm).

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 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%), 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. The protein content was 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%). 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.

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 other 4 varieties had almost same but lower insect infestation than that of BRRI hybrid dhan1. 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. 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 BRRI 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 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). 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 BRRI 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 BRRI developed rice hybrid in the name of **BRRI 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

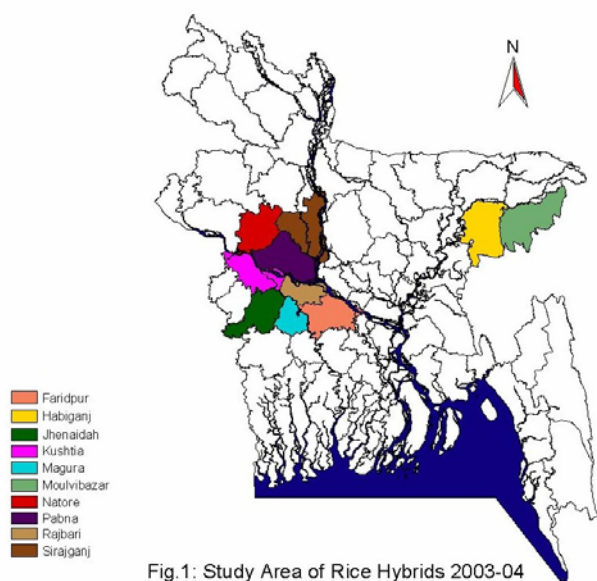


Fig.1: Study Area of Rice Hybrids 2003-04

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, Gurudaspur, Singra, Baraigram |             | 8                   |                   |
|              | Natore      |             |                                                  |             | 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                   |                   |
| <b>Total</b> |             | <b>10</b>   |                                                  | <b>18</b>   | <b>75</b>           | <b>75</b>         |

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         |
| <b>Total</b> |                                                      | <b>23</b> |

## 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            |

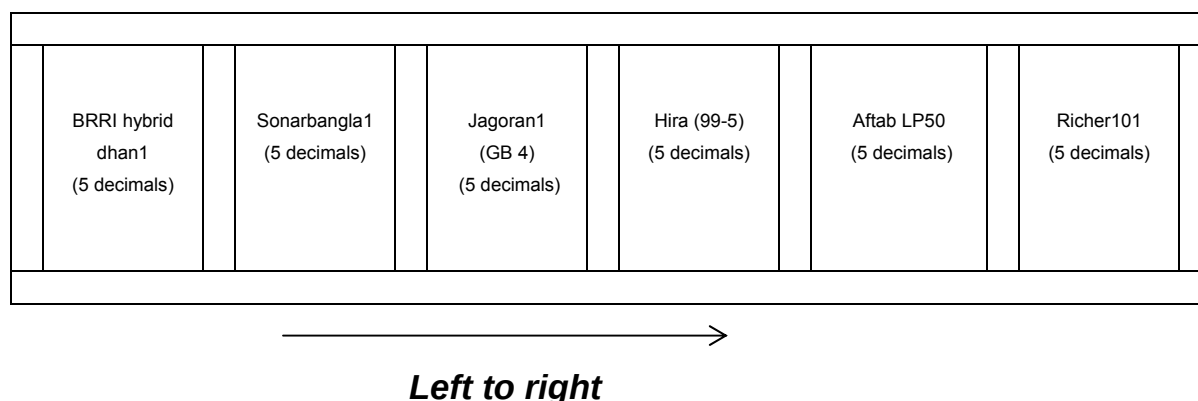
Germination test of seed of six cultivars of rice hybrid were done by AAS after procurement and before distribution among the trained farmer researchers. To study the comparison among the varieties of hybrid rice, 75 villages were selected in three regions of Bangladesh. The awareness cum motivational meetings was conducted at 75 selected villages in ten districts of three regions. During such meetings, 75 Resource Poor Farmer Groups (RPFs) 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                  |
| <b>Total</b> | <b>144</b>                 | <b>135</b>               | <b>130</b>                   | <b>21</b>                | <b>109</b>          |

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 F<sub>1</sub> 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<br>(Moulvibazar,<br>Habiganj) | 14               | 507                | 136        | 14            |
| Northwest (Pabna,<br>Sirajganj, Natore) | 16               | 679                | -          | 16            |
| Southwest<br>(Magura,<br>Jhenaidah)     | 12               | 641                | 2          | 10            |
| <b>Total</b>                            | <b>42</b>        | <b>1827</b>        | <b>138</b> | <b>40</b>     |

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

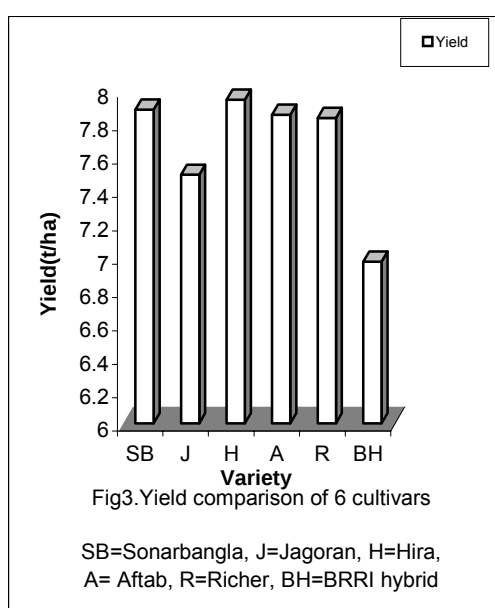
#### Grain yield and yield potentiality

**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                       |
| BRRI 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 BRRI 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 <sup>1</sup>  | NA <sup>1</sup>  |
| 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                       | -                | -                |
| BRRI hybrid dhan1 | 1                                | 10.64                | 10.64                       | -                | -                |

<sup>1</sup>NA= 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)).

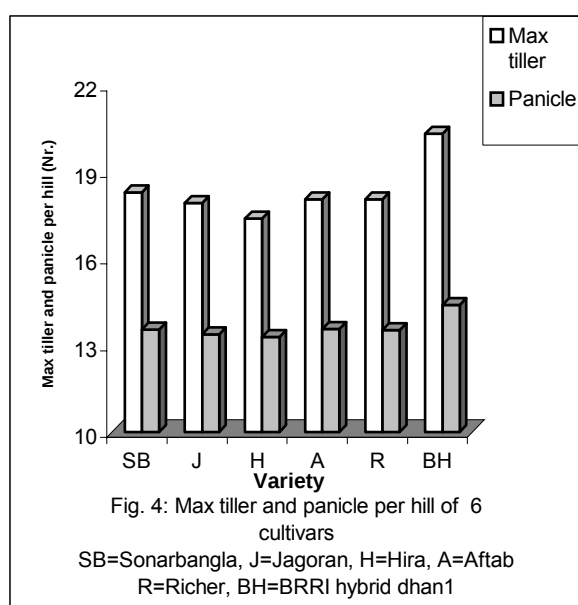
In Northwest region, the average maximum numbers of tillers per hill was the highest with 17.69 tillers in BRRI hybrid dhan1 and the lowest was with 16.67 tillers per hill in Hira. The maximum tiller production per hill of Sonarbangla1, Jagoran1, Hira, Aftab LP50 and Richer101 were lower than that of 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 BRRI hybrid dhan1. Though the control variety, BRRI 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 BRRI 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 BRRI hybrid dhan1. The percentage effective tiller of Sonarbangla1, Jagoran1, Hira, Aftab LP50 and Richer101 were higher than that of BRRI 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 BRRI hybrid dhan1. The percent effective tiller of Sonarbangla1, Jagoran1, Hira, Aftab LP50 and Richer101 were higher than that of BRRI 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  |
| BRRI 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 BRRI hybrid dhan1. The filled grain formation of Sonarbangla1, Jagoran1, Hira, Aftab LP50 and Richer101 was higher than that of BRRI 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 BRRI hybrid dhan1. The filled grain formation per panicle of Sonarbangla1, Jagoran1, Hira, Aftab LP50 and Richer101 was higher than that of BRRI 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 BRRI hybrid dhan1 (Annex-I(ii)). The filled grain formation per panicle of Sonarbangla1, Jagoran1, Hira, Aftab LP50 and Richer101 was higher than that of BRRI 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 BRRI 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 BRRI hybrid dhan1.

**Unfilled grain per panicle:** The average highest unfilled grains per panicle was 41.07 in BRRI 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 BRRI hybrid dhan1 (Table 13).

In Northeast region, average highest unfilled grains numbers per panicle was with 42.29 in BRRI 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 BRRI hybrid dhan1 (Annex-I(i)).

Similarly in Northwest region, average highest unfilled grain numbers per panicle was 49.89 in BRRI 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 BRRI 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 BRRI 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 BRRI 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 BRRI 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 BRRI 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 BRRI 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 BRRI 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 BRRI 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<br>(1-9 scale) |        | Disease infection<br>(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<br>(1-9 scale) |        | Crop damage due to storm,<br>hailstorm and flash flood<br>(%) |
|-------------------|------------------------|--------|---------------------------------------------------------------|
|                   | 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 |
|---------------------------------------------------------------|--------------|----------|---------------|------------|------------|-------------------|
| <b>Gross-return (Tk/ha)</b>                                   | 62,252       | 59,171   | <b>62,726</b> | 62,015     | 61,857     | <b>55,063</b>     |
| <b>Total cost (Tk/ha):</b>                                    |              |          |               |            |            |                   |
| (i) Full cost basis                                           | 37,873       | 37,873   | 37,873        | 37,873     | 37,873     | 37,873            |
| (ii) Cash cost basis                                          | 16,996       | 16,996   | 16,996        | 16,996     | 16,996     | 16,996            |
| <b>Net-return (Tk/ha):</b>                                    |              |          |               |            |            |                   |
| (i) Full cost basis                                           | 24,379       | 21,298   | <b>24,853</b> | 24,142     | 23,984     | <b>17,190</b>     |
| (ii) Cash cost basis                                          | 45,256       | 42,175   | <b>45,730</b> | 45,019     | 44,861     | <b>38,067</b>     |
| <b>Benefit-cost-ratio:</b>                                    |              |          |               |            |            |                   |
| (i) Full cost basis                                           | 1.65         | 1.56     | <b>1.66</b>   | 1.64       | 1.63       | <b>1.45</b>       |
| (ii) Cash cost basis                                          | 3.66         | 3.48     | <b>3.69</b>   | 3.65       | 3.64       | <b>3.24</b>       |
| <b>Net-return in terms of gross value of the product (%):</b> |              |          |               |            |            |                   |
| (i) Full cost basis                                           | 39.16        | 35.99    | <b>39.62</b>  | 38.93      | 38.77      | <b>31.22</b>      |
| (ii) Cash cost basis                                          | 72.70        | 71.28    | <b>72.90</b>  | 72.59      | 72.52      | <b>69.13</b>      |

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).

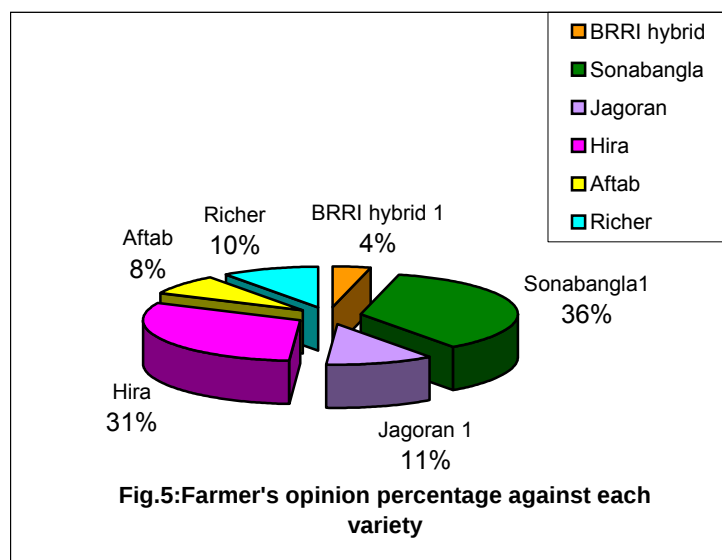
On full cost basis, the net-return in term of gross value of the product was the highest with 39.62% in Hira followed in order by Sonarbangla1 (39.16%), Aftab LP50 (38.93%), Richer101 (38.77%), Jagoran1 (35.99%) and BRRI hybrid dhan1 (31.22%).

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     |                                           |      |
| BRRI 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    |
| <b>Total</b>      | <b>29</b>                                                 | <b>26</b> | <b>33</b> | <b>88</b> | <b>100</b>                                |      |

## 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., BRRI dhan28 and BRRI 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 (BRRI dhan29 and BRRI 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., BRRI dhan28 and BRRI dhan29) during Boro season.

- ✓ Recommended dose of fertilizer for BRRI dhan29 is best suited for the rice hybrid varieties. Urea topdressing for BRRI hybrid dhan1 needs to be done carefully. Less unfilled grain can be produced with BRRI 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, BRRI 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 BRRI dhan29 and BRRI 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 BRRI 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 BRRI 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 BRRI 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 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 exceeded 10 ton/ha for all 6 cultivars (maximum individual grain yield).

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

## **5.2 Recommendations**

Six rice hybrids, Sonarbangla1, Jagoran1, Hira (99-5), Aftab LP50, Richer101 and BRRI 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 BRRI hybrid dhan1. So the above mentioned 5 Chinese hybrid rice varieties, should be adopted in Boro season within and outside of the project areas. BRRI hybrid dhan1 should be adopted in Northwest region as well as Southwest region. But in Northeast region where early flood is a problem, BRRI 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/<br>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 |
| <b>Tiller and panicles productions:</b> |              |        |      |          |        |      |        |        |      |            |        |      |           |        |      |                   |        |      |
| 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 |
| <b>Grain production:</b>                |              |        |      |          |        |      |        |        |      |            |        |      |           |        |      |                   |        |      |
| 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/<br>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 |
| <b>Tiller and panicles productions:</b> |              |        |      |          |        |      |        |        |      |            |        |      |           |        |      |                   |        |      |
| 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 |
| <b>Grain production:</b>                |              |        |      |          |        |      |        |        |      |            |        |      |           |        |      |                   |        |      |
| 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 BRRi hybrid dhan1 in 2003-04 Boro season of Southwest region

| Characteristics/<br>Parameters          | Sonarbangla1 |        |      | Jagoran1 |        |      | Hira   |        |      | Aftab LP50 |        |      | Richer101 |        |      | BRRi 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 |
| <b>Tiller and panicles productions:</b> |              |        |      |          |        |      |        |        |      |            |        |      |           |        |      |                   |        |      |
| 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 |
| <b>Grain production:</b>                |              |        |      |          |        |      |        |        |      |            |        |      |           |        |      |                   |        |      |
| 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<br>outturn<br>(%) | Head rice<br>yield<br>(%) | Chalkiness | Appearance | Length<br>(L)<br>mm | Breadth<br>(B)<br>mm | L/B<br>ratio | Size<br>and<br>shape | Amylose<br>(%) | Protein<br>(%) | Cooking<br>time<br>(min) | ER  | IR  |
|-------------------|---------------------------|---------------------------|------------|------------|---------------------|----------------------|--------------|----------------------|----------------|----------------|--------------------------|-----|-----|
| <b>Northeast:</b> |                           |                           |            |            |                     |                      |              |                      |                |                |                          |     |     |
| BRRI 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 |
| <b>Northwest</b>  |                           |                           |            |            |                     |                      |              |                      |                |                |                          |     |     |
| BRRI 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 |
| <b>Southwest</b>  |                           |                           |            |            |                     |                      |              |                      |                |                |                          |     |     |
| BRRI 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/<br>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)            | 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/<br>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)            | 3.76         | 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/<br>Parameters                  | BRRI hybrid1 |           |      | Sonarbangla1 |           |      | Jagoran1 |           |      | Hira |           |      | Aftab LP50 |           |      | Richer101 |           |      |
|-------------------------------------------------|--------------|-----------|------|--------------|-----------|------|----------|-----------|------|------|-----------|------|------------|-----------|------|-----------|-----------|------|
|                                                 | Mean         | CV<br>(%) | SE   | Mean         | CV<br>(%) | SE   | Mean     | CV<br>(%) | SE   | Mean | CV<br>(%) | SE   | Mean       | CV<br>(%) | SE   | Mean      | CV<br>(%) | SE   |
| Insect infestation<br>(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<br>infection<br>(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<br>(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<br>due to storm or<br>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              |
| <b>Gross return (Tk/ha)</b>                                  | 56,169       | 53325          | 59961 | 55932      | 56169     | 52219             |
| <b>Total Cost (Tk/ha)</b>                                    |              |                |       |            |           |                   |
| (i) Full cost basis*                                         | 34491        | 34491          | 34491 | 34491      | 31491     | 34491             |
| (ii) Cash cost basis**                                       | 13538        | 13538          | 13538 | 13538      | 13538     | 13538             |
| <b>Net return (Tk/ha)</b>                                    |              |                |       |            |           |                   |
| (i) Full cost basis                                          | 21678        | 18834          | 25470 | 21441      | 21678     | 17728             |
| (ii) Cash cost                                               | 42631        | 39787          | 46423 | 42394      | 42631     | 38681             |
| <b>Benefit-cost ratio</b>                                    |              |                |       |            |           |                   |
| (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              |
| <b>Net return in terms of gross value of the product (%)</b> |              |                |       |            |           |                   |
| (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 | BRRI 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              |
| <b>Gross return (Tk/ha)</b>                                  | 65965        | 64148          | 65728 | 66834      | 66202     | 60435             |
| <b>Total Cost (Tk/ha)</b>                                    |              |                |       |            |           |                   |
| (i) Full cost basis*                                         | 39955        | 39955          | 39955 | 39955      | 39955     | 39955             |
| (ii) Cash cost basis**                                       | 17994        | 17994          | 17994 | 17994      | 17994     | 17994             |
| <b>Net return (Tk/ha)</b>                                    |              |                |       |            |           |                   |
| (i) Full cost basis                                          | 26010        | 24193          | 25773 | 26879      | 26247     | 20480             |
| (ii) Cash cost basis                                         | 47971        | 46154          | 47734 | 48840      | 48208     | 42441             |
| <b>Benefit-cost ratio</b>                                    |              |                |       |            |           |                   |
| (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              |
| <b>Net return in terms of gross value of the product (%)</b> |              |                |       |            |           |                   |
| (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 | BRRi 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              |
| <b>Gross return (Tk/ha)</b>                                  | 64622        | 56564          | 62410 | 63200      | 63121     | 52456             |
| <b>Total Cost (Tk/ha)</b>                                    |              |                |       |            |           |                   |
| (i) Full cost basis*                                         | 39172        | 30172          | 39172 | 39172      | 39172     | 39772             |
| (ii) Cash cost basis**                                       | 19456        | 19456          | 19456 | 19456      | 19456     | 19456             |
| <b>Net return (Tk/ha)</b>                                    |              |                |       |            |           |                   |
| (i) Full cost basis                                          | 25540        | 17392          | 23238 | 24028      | 23949     | 13284             |
| (ii) Cash cost                                               | 45166        | 37108          | 42954 | 43774      | 43665     | 33000             |
| <b>Benefit-cost ratio</b>                                    |              |                |       |            |           |                   |
| (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              |
| <b>Net return in terms of gross value of the product (%)</b> |              |                |       |            |           |                   |
| (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)**

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

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