Program Area: Varietal Development

Plant Breeding Division

A total of 172 crosses were made and 186 were confirmed. In total 5,786 progenies were selected from F_2 populations. From segregating generations 9,893 plants and 297 fixed lines were selected. Two hundred sixty-five advanced lines were selected from observational and yield trials. A total of 81 germplasm from ten nursery sets of INGER were selected for using in the breeding programme.

National Seed Board (NSB) of Bangladesh approved releasing of five varieties viz BRRI dhan51, BRRI dhan52, BRRI dhan53, BRRI dhan54. BRRI dhan51 released for T.Aman season having tolerance to 10-15 days of flash flood submergence at vegetative stage. At normal rainfed condition, grain yield of 4.5 t/ha and growth duration of 142 days of this variety are similar to the check variety Swarna. Whereas under around two weeks flash flooding condition, grain yield of BRRI dhan51 is 4 t/ha and growth duration is 155-160 days. BRRI dhan52 was released for T. Aman season having tolerance to 10-15 days of flash flood submergence at vegetative stage.

The variety was developed in collaboration with IRRI through introgressing *Sub1* gene into BR11 following marker-assisted backcrossing. Both the varieties are weakly photosensitive. At normal rainfed condition, grain yield 5.0-5.5 t/ha and growth duration 140-145 days of this variety is similar to standard check variety BR11. Whereas under around two weeks flash flooding condition, grain yield of BRRI dhan52 is 3.5-4.0 t/ha and growth duration is 155-160 days. BRRI dhan53 was released for T. Aman season having tolerance against EC 8-10 dS/m of soil salinity level at vegetative and reproductive stage. The variety is photo-insensitive and 14 days earlier along with yield (4.7 t/ha) higher than BRRI dhan41 (4 t/ha). Additionally, BRRI dhan54 released for T. Aman season having tolerance against EC 8-10 dS/m of soil salinity level at vegetative and reproductive stage. The variety is weakly photosensitive and 12 days earlier along with yield (5 t/ha) higher than BRRI dhan41 (4.0 t/ha). BRRI dhan53 and BRRI dhan54 are specially recommended for brackish shrimp field of coastal saline prone areas of Bangladesh but can be cultivated at normal rainfed condition.
Under drought resistance programme, in PVS trial at two locations the preference score showed the highest rank of 1st, 2nd and 3rd positions respectively for the varieties IR74371-70-1-1, IR74371-54-1-1 and BINA dhan7. The near isogenic line BR7873-5* (NIL)-51-HR6 was also preferred by farmers for high tillering, earliness and fine grain quality as compared with existing early variety BRRI dhan33.

Hybrid Rice Component

During T. Aman season 2009, 104 test crosses and 63 (A × R) crosses were made from source nursery. A total of 121 one test crosses were evaluated under test cross nursery of which 15 entries showed complete sterility and they were immediately backcrossed with their corresponding male parents for conversion. Fifteen BC_6 generations were designated as new CMS lines and included into CMS maintenance and evaluation nursery. Sixty-one CMS lines were maintained by hand crossing for seed increasing and genetic purity.

Seventy-three test crosses and 92 (A x R) crosses were made using nine CMS lines during Boro season 2009-10 from source nursery. A total of 104 test crosses (F_1s) were evaluated for their pollen fertility status under test cross nursery of which 16 entries have been shown complete sterile and they were immediately back crossed with their corresponding male parents for conversion. Backcross generations were advanced upon desired pollen sterility and other agronomic characters. Seventy-six CMS lines were maintained by hand crossing for seed increase and genetic purity.
In T. Aman, three experiments viz observational trial (OT), MLT and combining ability were conducted. Results are summarized as, the hybrid combination BR10A/LV020 showed the highest yield (2.0 t/ha) advantage over BRRI dhan39. On the other hand, in MLT experiment BR9A/BR12R produced 2.27 t/ha yield advantage over the same check with similar growth

duration at Comilla. From the combining ability effect, GuiA/BR12R was found as the highest (18.02 gm/plant) yielder.

During Boro 2009-10, three experiments were conducted. They were combining ability analysis, multilocation trial (MLT) of promising hybrids and parental lines and evaluation of available maintainers and restorers. In case of combining ability effect, BR9A/BR12R and BR9A produced 21.98 g and 19.44 g/ plant as the highest yield. In MLT experiments BR10A/ BR13R showed 2.56 ton/ha higher yield over BRRI dhan28 with similar growth duration. On the basis of yield and agronomic performance 12 maintainers and 12 restorers were selected. Fourteen promising hybrid combinations were used to produce 459.75 kg F_1 seeds during T. Aman 2009. Other experiments were conducted on effect of row-ratio and spacing on out crossing rate. Results were found that 2:10 row-ratio with 15 × 15 cm spacing produced the highest yield for both T. Aman and Boro seasons. For parental line purification, 12000 F_1 seeds of BRRI hybrid dhan2 were obtained by hand crossing.

During Boro 2009-10, a total of 1,786 kg of F_1 seed and 1,304 kg of CMS seeds of BRRI hybrid dhan2 and BRRI hybrid dhan3 were produced.

Biotechnology Division

The broad objectives of the Biotechnology Division are molecular characterization of important rice genotypes, development of modern rice varieties through different biotechnological techniques and carry out basic or upstream research that is pertinent and applicable to the development of improved variety. Keeping these views Biotechnology Division of BRRI conducted nine experiments under three projects. Fourteen salt tolerant and 19 high yielding double haploid green plants were regenerated from calli of hybrid anthers. A total of 354 plants were selected and 22 apparently homozygous lines were bulked. Fifteen apparently superior genotypes were selected for further evaluation.

Two backcrosses were made for pyramiding bacterial blight genes and 1917 BC_1F_1 and 361 BC_2F_1 seeds were obtained, respectively. In yield enhancement QTLs programme, 942 BC_1F_1 seeds were obtained and 35 primers showed polymorphism among 100 tested SSR markers. In identification of salinity QTLs programme 2108 F_2 seeds were collected and 11 primers showed polymorphism among 69 tested SSR markers. Among 91 SSR markers, 51 markers showed polymorphism and 195 alleles were detected across 94 Aus rice genotypes. The highest genetic dissimilarity (1.000) was found among the Aus genotypes of Ausa Bogi , Aus Gram Binni, Monshi Murali, Kachilon (2), Panki Raj, Agaua, Chandra Moni and Khusni, whereas the lowest genetic dissimilarity was found between BRRI dhan42 and BRRI dhan43 (0.1176) followed by Kautukomni and Korchamuri (0.1373). Most local Aus genotypes showed broad genetic base, whereas BRRI released modern Aus variety showed narrow genetic base. Four BRRI hybrid varieties grouped in four distinct clusters along with their parental lines indicating their high genetic diversity.

Genetic Resources and Seed Division

A total of 810 of which 413 Aus, 345 Aman and 52 Boro rice germplasms, were collected from different districts including hilly areas as well as other divisions of BRRI. Among these, three varieties were received from Nepal. A total of 357 germplasms were characterized with 45 morpho-agronomic characters during T. Aman and Boro seasons. Besides, 2,420 accessions including 182 new collections in T. Aman and Boro were rejuvenated during the reporting year. Apart from these, 181 new collections were registered with accession number, molecular characterization by SSR markers and genetic diversity was evaluated for 24 germplasms. Genebank database preparation is going on and about 400 accessions have been entered into the database with available information during the reporting year. Genetic diversity was pronounced in 58 T. Aman rice germplasm and the varieties were grouped into nine clusters. All the test 150 germplasms, were susceptible to BPH, GLH and WBPH except 17 as they showed preliminarily moderate resistance against WBPH. Among 150

germplasms, nine were found resistant (score: 0-3), 67 were moderate (score: 3-6) and 74 were susceptible (score: 6-9) to rice blast. The resistant genotypes were BR5, BR12, BR16, BR18, BR20, BR26, Shamrat, Malshira, Betu.

A total of 48 BRRI developed and recommended varieties were maintained as nucleus stock. A total of 124.59 tons of breeder seed of which 34.72 tons from 25 varieties in T. Aman and 89.87 tons from 10 varieties in Boro seasons were produced during 2009-10. About 20.56 tons of breeder seed from 18 varieties in T. Aman and 69.5 tons from 10 varieties in Boro and 4.12 tons from nine varieties in Aus seasons were distributed. Around 1.23 tons of truthfully labelled seeds (TLS) from nine varieties of T. Aman and 11.77 tons from nine varieties of Boro were available for distribution. Around 0.79 ton seeds from six varieties of T. Aman and 10.2 tons seeds from nine varieties of Boro and 90 kg from one variety of Aus were distributed as quality seed (TLS) during reporting year. A total of 35.00 tons of TLS were also produced under 17.15% yield increase programme for rice at BRRI HQ and regional stations while 26.30 ton seeds were distributed to farmers through DAE as quality seed (TLS) during 2009-10.

Four training programmes entitled “Foundation seed production and preservation techniques of rice” were organized under breeder seed project for the scientists of BRRI and SeedNet partners. Ten training programmes entitled “Foundation seed production and preservation techniques of rice” were organized under STRASA, funded by Bill and Melinda Gates Foundation for SeedNet partners of stress prone areas. Three training programmes entitled “Importance and procedure of rice germplasm collection” were organized under CGP-KGF, project for SeedNet partners of the country.

Grain Quality and Nutrition Division

Forty-five premium quality Boro breeding lines were evaluated for physico-chemical properties. Among them, 18 lines had >25% amylose content. The IR of all lines varied from 3.0-4.7 and protein content was 7-10%.

Fourteen SYT, RYT and PVS Boro breeding lines were analyzed. Milling outturn was from 67%-71%. Only two lines had amylose content more than 25%, and protein content of five lines was below 7%.

Out of 103 balam genotypes, 32 cultivars had milling outturn >70%. Amylose content of 27 genotypes varied from 25-27%. Protein content of 85 cultivars varied from 7.0%-12.4%. The IR was highly desirable (3.3-4.3).

Amylose content of 22 local varieties (out of 28) was more than 25.0%, four had intermediate and two had low amylose. All the varieties contain protein 6.5-8.9%. The ASV was 3.2-6.4.

Most of the hybrid rice varieties produced lower milling yield. Out of 66 varieties, 15 had >25% and others had low to intermediate amylose content. Eighteen varieties had <7.0% protein.

Milling outturn of all the promising genotypes (9) was 67-70%. Chalkiness (white belly) was in two genotypes. Only two genotypes had 25% and the rest contain low to intermediate amylose content. Two genotypes had <7.0% protein.

Total yield of puffed rice was 60-87% of which fully puffed rice was 60-85%. The length and breadth of puffed rice was doubled compared to milled rice. Puffed rice volume was 3-7 times higher than milled rice. NaCl concentration (5-20%) produced better puffed rice over the traditional (2%) concentration.

Program Area: Crop Soil Water Management

Agronomy Division

The tested hybrid rice varieties produced higher grain yield than BRRI dhan29 up to mid-January but in February planting BRRI dhan29 produced the highest grain yield.

The line BR7155-20-1-3 may be considered as potential advanced line and may be tested further as late planting material in *T. Aman* season.

Fresh poultry litter (FPL) @ 6 t/ha along with 1/3 of soil test based N could be used as a best option for Boro rice cultivation. Application of 2.5 and 3.5 t/ha FPL and the rest amount of nutrients as of STB from chemical fertilizers was the best option for higher grain yield in T. Aman and Boro seasons respectively.A portion of N fertilizer might be saved through urea spraying after fully canopy development of rice maintaining proper urea concentration.
Integrated use of 2.5 t/ha fresh poultry litter along with ½ of the STB fertilizer was better than sole chemical based rice cultivation. Sole organic based rice cultivation reduced rice yield drastically. BRRI dhan46 could be grown through broadcasting of sprouted seeds @ 45-60 kg/ha applying 60-80, 12 and 30 kg/ha of NPK fertilizers respectively for higher grain yield in late Aman situation.

BRRI dhan49 could be grown with 20% higher grain yield than STB fertilizer maintaining 20- × 20-cm and 20 × 15-cm spacing.
It was better to apply TSP as basal for higher grain yield. However, it could be applied at 30 DAT in unfavourable situation for satisfactory grain yield in Boro rice. Grain yield of direct wet seeded Boro rice increased up to 200 kg N ha^{-1} and it was statistically identical with 160 kg N ha^{-1}.

Higher weed density was observed in Boro-Fallow-Fallow cropping pattern due to longer fallow period. Rice based cropping pattern produced higher number of grasses and sedges. However higher number of broadleaf was found in Potato-Boro-T. Aman pattern.
The threshold level to control a mixed population weed was 10 in number per square meter for T. Aman rice cultivation. Similarly, 20 weeds of *Scirpus maritimus* per square meter could be allowed to grow without significant yield reduction in Boro season.
Pre-emergence herbicide Superclean 53% wp (Mefenacet + Bensulfuran methyl) @ 1111g ha^{-1} + 1 HW and post emergence herbicide Saathi (Pyrazosulfuran ethyl 10 WP) performed better in respect of weed control and grain yield than other weed management options in direct wet seeded Boro rice.

Soil Science Division

In Potato-Maize-T. Aman rice cropping pattern, soil test based (STB) fertilizer with poultry manure @ 3 t/ha as IPNS produced the highest crop yield in Rangpur and Gazipur. The highest annual yield (11.5 t/ha/year) in triple cropping was observed in 50% of NPKS + mixed manure (cowdung @ 2 t/ha + 1 t Ash/ha + 1 layer Azolla) compared to 8.7 t/ha in double rice cropping. The inherent NPK supplying capacity of different soils was determined by QUEFTS model. The predicted yield potential of these soils showed a logarithmic relationship with the measured organic matter. In T. Aman, the estimated optimum doses of N, P and K for BRRI dhan49, BRRI dhan7155-20-1-3, EH3 and EH4 were 40 kg N/ha, 15 kg P/ha and 60 kg K/ha. In Boro season, the estimated optimum N, P and K doses for BRRI dhan45, BRRI dhan50, EH5 and EH6 were 160 kg N/ha, 20 kg P/ha and 60 kg K/ha. In the long-term missing element study, rice yield reduced significantly due to omission of N during T. Aman while in Boro, P and K omission drastically reduced grain yield. Applied organic materials (cowdung, poultry manure, oil cake and mixed manure) slightly increased the grain yield compared to completely omission of nutrients. After 29 years of continuous triple rice cropping the annual production of rice in unfertilized plots reduced to 2.6 t/ha per year. In contrast, NPKS fertilization over this period increased or maintained annual grain production. Pot experiment with water hyacinth showed that it could be used as an effective bio-accumulator to remove As from water.

Irrigation and Water Management Division

AWD method was found most suitable for water and fuel saving technology during dry season. It saved four irrigations and increased yield benefit of Tk 8,345 per hectare and Tk 5,329 for BRRI dhan28 and BRRI dhan29 respectively.

Among the three crop sequence, water productivity was maximum ((12.90 kg/ha-mm) in T. Aman-Potato-Rice. Also maximum year round rice equivalent yield (27,820 kg/ha) and net return (Tk 3,73,700) was recorded in T. Aman- Potato-Rice crop sequence. Therefore T. Aman-Potato-Rice cropping pattern was the best for year round cropping plan. Effect of drought on growth phases of Aman rice indicated that under the drought spell percent of yield reduction was more at ripening phase (from flowering to dough stage) compared to the reproductive phase (from PI to before flowering). Therefore, ripening phase is more vulnerable to water stress compared to reproductive phase.

Utilization of fresh groundwater from deeper zone showed potential of increasing HYV Boro cultivation in fallow coastal areas (Munshiganj, Satkhira and BRRI RS, Sonagazi). It was also observed that pond water could be used for Boro crop establishment. The study indicates that farmers have started using of ground water and pond water for Boro rice cultivation by installing STWs in deeper zone.

Rainwater harvesting in a reservoir with 25 cm height embankment conserved more water than without embankment, which could increase area to irrigate Rabi crops in the coastal area. Rainfed HYV T.Aman rice-Tomato with irrigation cropping sequence was more profitable than other cropping sequences in Sonagazi coastal saline area.

Groundwater level is declining rapidly in many parts of the country. At BRRI Gazipur the groundwater level goes below about 12 m (from 15 m to 27 m) in dry season (during the last 10 years), which indicates alarming situation for groundwater use in Gazipur area. Therefore, efficient use of ground and surface water sources may reduce pressure on groundwater.
The activities performed in different locations of Bangladesh for piloting and dissemination AWD technology for Boro rice cultivation found suitable for water and fuel saving irrigation practices. It saved about 21% to 25% water by which farmers saved about Tk 1,765/ha to Tk 1,833/ha.

Plant Physiology Division

Considering survival percentage and visual score, out of 103 genotypes 31 genotypes (T. Aman, 2009 and 2010, Boro 2009-10) were found tolerant to moderately tolerant (score 3-5) at the seedling stage under high (12dS/m) salinity stress. In terms of seedling emergence, fast growth from deep seeding and deep rooting ability some varieties/breeding lines were quite promising. The survival ability of rice plant under complete submergence affects remarkably by environmental characterstics especially by water temperature and light intensity. The highest yielding *Sub1*-line produced around 2.5 t/ha more yield compared to the check variety BR11 and the *Sub1*-line was 12 days earlier than BR11. Swarna-*Sub1* produced 5.33 t/ha grain yield with 155 days growth duration reflecting that this *Sub1*-line produced 3.4 t/ha more yield with nine days earlier growth duration than the check Swarna. Mukta dhan, Saita, Cheng Sail, Binna Phul, Khazar, Til Kabur, Puti depa and lakhi are the best genotypes having a complete shock of 14-day submergence. Submergence tolerant genotypes have higher seedling strength and lower elongation ability. Out of 44 genotypes only two genotypes (BR7414-22-1, BR7414-25-1) were selected as tolerant to high temperature among 55 genotypes four showed good yield ability (>300g/m^2) under high temperature conditions. Photosynthetic performance depends a little on chlorophyll but (mainly) on envijronmental conditions. Early planted BRRI hybrid dhan2 performed relatively better as T. Aman crop. The best planting time for BRRI dhan46 is 16 July to first week of August. Hybrid varieties (Hera2 and BRRI hybrid dhan2) were sensitive to warm temperature (Aus compared to potential inbred BRRI dhan48). Hera2 and BRRI hybrid dhan2 produced higher amount of total dry matter due to their higher LAI and longer duration of maturity. Rate of photosynthesis gradually decreased with delayed planting in both the hybrids, whereas in BRRI dhan45, photosynthetics rate increased with late planting. Results indicated that BRRI dhan45 was relatively adaptable to high temperature at reproductive statge compared to the hbybrid one. We observe more or less a chain of event relationship (previous years SSTA,

previous year rainfall and next year Boro rice production and area coveage) only for Boro (irrigated rice) season. The June-October-October SSTA (ENSO) have quite significant netgative impact on the same year November rainfall. The regression equation reveals that 1°C rise of SSTA from June to Octover is supposed to reduce November rainfall from 17 mm to 28 mm. Therefore it appears that (Previous year) ENSO has significant influence on the next year Boro (November-May crop) rice through November rainfall. A degree of previous year SSTA increase for June, July and August would decrease 3.6%, 3.8%, and 2.5% of the next year Boro total production respectively. These values (next year Boro production) due to September and October previous year SSTA were 2.2% and 2.5% respectively. The corresponding (next year) area reductions due to June, July, August and September previous year SSTA were 5.0%, 4.9%, 4.0% respectively. The (next year) area reduction due to the September and October previous year SSTA were 3.8% and 3.79% respectively. The SSTA effect on area coverag was stronger compared to that of total production. However, no similar relationship is observed between SSTA and yield.

Program Area: Pest Management

Entomology Division

Three BRRI varieties, BR15, BRRI dhan38 and BR12 showed low yield loss despite a considerable level of hispa damage. These varieties might be recommended for hispa prone areas in different seasons. A total of 121 insecticides (65 against brown planthopper, 37 against rice hispa and 19 against yellow stemborer) were found effective out of 167 candidate insecticides tested in 2009-10. Three materials were found moderately resistant to BPH out of 587 entries tested against different insect pests of rice. However, 30 other entries were also found promising against WBPH, but could not be confirmed. The preliminary screening for the determination of biotype of BPH showed some difference in the reactions of the plants of differential materials against the different BPH populations. However, it needs confirmation by retest and other supporting experiments. Refinement of GM rearing technique is going on. A suitable technique will be developed within a short time. Protocols for DNA analysis of GM have been developed. Determination of GM biotype will be accomplished up on the availability of RAPD primers. Rate of emergence of GM adults was found higher on BR11 plants. Parasitic activity on hispa eggs was found highest in the T. Aman season. Higher parasitic activity was observed at the reproductive stage of the Boro crop while that was higher at the vegetative stage of the crop in Aus and T. Aman seasons. Multiple parasitism was found very common in *T. zahiri*. The mean developmental period of *T. zahiri* ranged between 7.65-9.37 days irrespective of sex. The sex ratio of *T. zahiri* was not affected by weather factors. Out of the six parasitoids considered in the study, only *T. zahiri* parasitized hispa eggs and the average rate of parasitism was 77.57%. The overall insect pest incidence in the reporting year was low. However, GLH, WLH and GHs dominated the pest population. The highest incidence of GLH was observed in seed beds of Boro. On the contrary T. Aman seed beds harbored the lower population of GLH in comparison to the other habitats. STPD, SPD and LBB were the dominant natural enemy populations in the reporting year. The domination of SPD population, irrespective of habitats, was observed in Aus and Aman seasons, but that of LBB was observed in seed beds, grass fallow lands and irrigated rice of Boro season. The light trap catch of rice insect pests was found the highest at Gazipur than those of the other stations. GLH, WLH, ZLH, BPH, WBPH, YSB and LHC were the dominant ones among the pests observed in light traps. BPH population was high at all the stations in November. The highest population of YSB was observed at Barisal in November. Unlike the other years, the YSB population of Barisal showed two other unusual small peaks in February and June. The natural enemy population, found in light trap was the highest at Gazipur. However, that of Rajshahi didn't show much variation in term of numbers. LBB and CBD at Rajshahi and STPD and GMB at Gazipur dominated the natural enemy population respectively. Barisal showed considerably higher population of GMB.

Plant Pathology Division

Eighty-five F_2 plants in T. Aman and 20 in Boro showed moderately resistance to resistant (MR-R) reaction against bacterial blight (BB) disease. Twenty-six INGER materials showed resistant reaction against the most virulent isolate (BXO9) of BB pathogen. Among 51 advanced breeding materials only one entry IR77542-551-1-1-1-1-2 showed moderately resistant (MR) reaction to BB in Boro. Among 12 pyramid materials, IRBB54, IRBB55, IRBB58, IRBB59, IRBB60, IRBB65, IRBB66 and resistant check IRBB21 (monogenic line) showed resistant reaction to all the 6 races. In the pathotypic diversity study, only *Xa21* gene showed resistant reactions to all of the tested isolates. Most of the pyramid lines showed resistant reaction against the BB pathogen under natural condition in different AEZs. In case of sheath blight disease (ShB), none of the materials showed physiological resistance in detached tiller method in Boro season.

Additional K application did not show any significant effect on BB management in field in Boro. Rice husk @ 2.5 t/ha and rice husk ash@ 2.0 t/ha suppressed sheath blight disease. Temperature at 60°C for 15 minutes exposure completely eradicated reduced *F. moniliforme* and at 55°C for 5 and 55°C for 15 minutes exposure eradicated *T. padwikii* and *Curvularia* sp.Among 21 fungicides 16 were highly effective (>80 % reduction) against sheath blight disease. Carzeb, Sunphanate, Nativo and Bavistin @ 2.5g/kg seeds inhibited 100% of *F. moniliforme*. Tall and Rovral reduced the spotted grain percentage significantly.

Neem extract reduced damaged tiller, ufra-1, ufra-2 and increased yield. Plant extracts of garlic at 40% concentration were effective in reducing the seed-borne infection of *F. moniliforme*.

Program Area: Rice Farming Systems

Rice Farming Systems Division

Preliminary information of cropping patterns under greater Khulna, Kushtia and Jessore districts have been reported during 2009-10:
In greater Khulna districts, Fallow-Fallow-T. Aman was the most dominant cropping pattern in most of the upazilas. Boro-Fallow-T. Aman, Potato or Maize-Fallow-T. Aman, Pulses-T. Aus-T.Aman and Boro-Fallow-Fallow were the most dominant cropping patterns in some upazilas. In greater Kushtia district, Boro-Fallow-T. Aman were the dominant cropping patterns in most of the upazilas. Fallow-Fallow-T. Aman, Wheat-Jute-T. Aman Tobacco-Jute-T. Aman were the most dominant cropping patterns in some upazilas. In greater Jessore district, Boro-Fallow-T. Aman was the most dominant cropping pattern in most of the upazilas. Pulses-Jute-T. Aman and Boro-Aus-B. Aman were the most dominant cropping patterns in some upazilas.

Annual income of landless and small farmers under interventions were increased by 18.3 and 44% respectively compared to base year data at FSR and D site, Kapasia, Gazipur. Higher income was associated with interventions of technologies, off-farm and non-farm activities.
Mango trees were sprayed with fungicide both at flowering and pea size stage increased an average yield of 30 kg/plant of landless farmers over the control trees. Fertilized Jackfruit trees at FSR & D site, Kapasia gave higher return of landless farmers (64.6%) than unfertilized trees. Rearing of goat increased the income of the landless farmers and about 100% cash benefit could be earned from it.

An average yield of BRRI dhan46 and BRRI dhan28 increased by the use of LCC in N management were 0.24 t/ha and 0.46 t/ha in T. Aman and Boro seasons respectively over the farmer's practice. On average about 15.70 kg N/ha and 18.60 kg N/ha were saved, respectively by the small farmers.

By the adoption of water saving technologies the small farmer were able to reduce irrigation cost and increased rice yield. Each farmers earned Tk 170 to 1920 by growing high value

summer and winter vegetable in the homestead area. Average yield of turmeric was 32 kg and gross margins of Tk 1,637 were earned by the small farmers from homestead area of 21.7m^2.
In a yield gap experiment at Kapasia it was found that the BRRI management practice, use of quality seed, LCC and USG contributed to higher yield.

Evaluation of different cropping pattern in medium highland irrigated ecosystems indicated that rice equivalent yield of T. Aman-Potato-T. Aus cropping pattern was the highest, which was followed by T. Aman-Boro-Fallow, T. Aman-Mustard-T. Aus, T. Aman-Boro-T. Aus cropping patterns.

Under late situation, double transplanting done on the same day of normal transplanting (25 September in T. Aman and 25 February in Boro) gave significantly higher grain yield than that of normal transplanting in both the seasons.
In a comparison of transplanting with direct seeded Boro rice, transplanted BRRI dhan29 produced 6.02 t/ha grain yield, which was 23.10 and 13.16% higher than broadcast and drum seeding respectively.

Productivity of three rice cropped cropping patterns indicated that highest total grain yield of rice was obtained from the cropping pattern BRRI dhan28-BR26-BRRI dhan49 (12.92 t/ha) followed by BRRI dhan28-BR26-BRRI dhan46 (12.81 t/ha), BRRI dhan28-BR26-farmer's variety (12.02 t/ha) and BRRI dhan28-BR26-BRRI dhan33 (11.85 t/ha).
In a study of evaluation of BRRI Aman varieties and early Rabi vegetables for Aman-Vegetable cropping pattern in partially irrigated highland ecosystem indicated that BRRI dhan33-Tomato-Mungbean produced the highest total REY, gross return and gross margin.

Program Area: Farm Mechanization

Farm Machinery and Postharvest Technology Division

BRRI developed inclined plate type multi crop seeder was tested in the divisional soil bin bed. During operation furrow open, seed dispensing, covering, line to line spacing etc was found good. Seed rate was found 20-25 kg/ha. Hill type seeding can be adjusted at a proper distance by changing sprocket number/ratio.

The experiment on reduced tillage by PTO seeder was conducted at Mayshan, Kapasia in Boro 2009-10 seasons. The field capacity of the PTO seeder was 0.15 ha per hour. It saved 50% seed compared to conventional practice. In strip DSR (T_1) seeding and strip tillage transplanting (T_3), 33% less irrigation water was required compared to conventional (T_4). No significant yield difference was observed between T_4 and T_1. Crop yield was found 4.08, 3.36 and 4.11 ton/ha for the treatments of T_1, T_3 and T_4 respectively.

BRRI USG applicator was modified considering line to line and plant to plant spacing of 18 × 20 cm, 20 × 20 cm and 22 × 20 cm and fabricated in the FMPHT divisional research workshop for double rows operation in rice field. Modified applicator was evaluated in laboratory and field condition and compared with fixed type applicator. Dispensing efficiency was found 99% in laboratory condition. The field capacity of the modified applicator was 35 decimal per hour whereas field capacity of the fixed type applicator was 36 decimal per hour. This might be loss of time during adjustment. Farmers can use anyone of the fixed and adjustable type applicator.

The quality of seedling is very important for successful operation of mechanical rice transplanter. The seedling height should be 10-12 cm with 3-4 leaves, 2-4 seedling per square centimeter and a 2.0 - 2.5cm soil thickness are appropriate for mechanical transplanting. The seedling raised on levelled wet bed on polythene sheet using wooden strip to separate the individual seedling block and soil as seed covering materials gave better seedling strength.

The field performance of mechanical rice transplanter was found satisfactory. There was no missing and damaged hill per square meter whereas floating and buried hill per square meter was found one during operation. Transplanting of seedlings in row, placement of seedlings at proper depth was uniform.

The experiment on conservation agriculture was conducted with minimum tillage puddle, unpuddled bed and strip tillage conditions in the drought-prone area Rajshahi during T. Aman 2009 to assess establishment methods. Eighty-five percent fuel was saved in land preparation by the strip tillage technique among the tillage treatments. The highest land preparation cost was obtained in bed formed by shaper (7,554 Tk/ha) and the lowest cost (1,765 Tk/ha) was obtained in strip tillage because of low fuel and labour requirement. Almost double time required to transplant seedlings in unpuddled condition compared to puddled condition. Weeding cost by hand was significantly higher in bed formed by machine and strip tillage plot compared to other tillage treatments. The highest grain yield was 4.56 t/ha on bed formed by VMP plot.

Postharvest rice loss assessment study was conducted to assess the loss of rice in Gazipur district in Aus, Aman and Boro seasons of 2008-2009. The common postharvest practices of the farmers were used in the study. The average postharvest losses were found 10.13, 10.06 and 9.87% in Aus, Aman and Boro seasons for field operations (harvesting to drying). Considering three seasons, major losses were found in harvesting, threshing and drying operations. Postharvest loss was the highest in threshing operation (3.19%) followed by drying losses (2.98%).

Day long training programme on operation, repair and maintenance of farm machinery was conducted at Natore, Rajshahi, Kushtia, Rangpur and Dinajpur districts. A total of 300 participants including farmers, operators and Sub-Assistant Agriculture Officers attended each of the training programmes. The participants opined that timely harvesting, threshing and cleaning operation by the farm machinery has minimized postharvest losses and save time for them.

Program Area: Socio-economics and Policy

Agricultural Economics Division

BRRI dhan28 and BRRI dhan29 were the most popular varieties in Boro season covering 32% and 28% areas respectively. BR11 is still the dominant variety in T. Aman season covering about 22% of the total T. Aman area, while in Aus season, the area coverage of BRRI dhan28 was the highest (about 18%). Among BRRI varieties, BRRI dhan29 was the top yielder (5.42 t/ha) in Boro season. BRRI dhan44 was the top yielder (4.25 t/ha) in T. Aman, while BRRI dhan29 produced the highest yield (4.95 t/ha) in Aus season.

Rice farmers used more seed (51-58 kg/ha) than the recommended rate (35-40 kg/ha) irrespective of cropping seasons. Farmers applied comparatively lower amount of TSP and MP fertilizer in MV Aus and MV T. Aman crop. Boro growers obtained higher yield and consequently get higher net return.

Farmers were very much interested to cultivate aromatic rice due to higher return. BRRI dhan34 produced higher yield and price compared to other aromatic varieties resulted to obtain satisfactory level of benefit.

Farmers are adopting Hybrid rice varieties due to higher productivity, profitability and survival in the saline condition. Hybrid rice produced higher yield compared to BRRI dhan28 in Southern parts of Bangladesh. Per unit production cost of BRRI dhan28 (Tk 16.81/kg) was higher compared to hybrid rice (Tk 15.26/kg). However, per hectare yield and gross return of hybrid rice was 21% and 17% higher compared to that of BRRI dhan28.

Price of paddy/rice remained to some extent lower in Khagrachhari district compared to Bandarban throughout the year. Every tribal family or settlers of Khagrachhari district get 40/kg of rice per month from the government as ration, which kept the rice price level a bit lower in this district. Farm-retail price spread was 25-26% of consumers' price, which is not so bulky in Bangladesh perspective.

Farmers obtained higher yield from the diesel subsidzed plots due to application of adequate irrigation in proper time. Present subsidy programme would be more effective if farmers receive diesel in kinds by producing their subsidy card.

Farmers believed that, besides drinking of tube well water, consumption of contaminated rice was another cause of arsenicosis disease. Due to the application of extra fertilizer and additional labour, the cost of Boro production for the arsenic affected plots was much higher compared to that of non-affected plots in all the locations. On average, the yield of Boro in more arsenic contaminated plots was 40-50% lower compared to less arsenic contaminated plots. Degradation of land happened due to the use of arsenic contaminated irrigation water.

Agricultural Statistics Division

In the reporting period BRRI dhan32, BRRI dhan40, BRRI dhan41 and BR11 were found most stable in T. Aman season, while BR3 and BRRI dhan33 appeared to be unstable among the non-aromatic rice. In case of aromatic rice, BRRI dhan38 appeared to be most stable followed by BRRI dhan37. BRRI dhan29 was the only most stable variety and BR6 appeared to be unstable in Boro season.

BR11, BR22 and BRRI dhan32, BR16, BRRI dhan28 and BRRI dhan29, BR9, BR16 and BR20 were found to be more preferable and cultivable varieties due to higher yield in T. Aman, Boro and Aus seasons respectively among the producers and producer-cum-consumers. Pure consumers were found to prefer rice varieties on the basis of taste of the varieties.

The overall rice production trend in Bangladesh is quite satisfactory. The average yield of rice is double in period-II compared to period-I. Growth rate in production and rice yield is greater than growth rate in area. Therefore, scientists should give more attention to develop sustainable variety in unfavourable weather to meet the increasing demand.
Overall wheat production in Bangladesh was not satisfactory during the study period. So, scientists should give more attention to develop sustainable wheat variety in unfavourable weather to meet the increasing demand.

The overall trend of maize production in Bangladesh is quite satisfactory. The average yield of maize was double in period-II compared to period-I. This indicates that maize production in Bangladesh has a bright future to meet the increasing demand.
The overall trend of potato production in Bangladesh is quite satisfactory. The average potato area and production are double in period-II compared to period-I.. Thus the prospect of potato production in Bangladesh is bright to meet the increasing demand.
Overall condition of tomato production in Bangladesh was satisfactory during the study period. Similarly, the overall trend of jute production in Bangladesh is not satisfactory. The average yield of jute is double in period-II compared to period-I. Growth rate in yield of jute is greater than growth rate in area.
A total of 110 different analyses were performed during the reporting year. Besides, a number of maps were prepared using GIS and supplied to the scientists of other divisions whenever required.

Farm management Division

An experiment was conducted at the west byde of BRRI farm, Gazipur during Boro 2009-10 season to determine the relative profitability of different sources of N (PU and USG) and weed control methods (Herbicide Refit, herbicide Super clean and Hand weeding) in relation to labour utilization for rice cultivation. The treatments were arranged in a randomized complete block design with three replications. BRRI dhan29 was used for experimental purpose. The interaction effect of weed control methods and nitrogenous fertilizer was significant on tiller number m^{-2}, panicle number $^{-2}$, grain panicle^{-1} and grain yield. In PU applied plots, hand weeding produced significantly the highest number of tiller m^{-2} followed by super clean and the lowest in refit applied plot.

In USG applied plots, hand weeding also produced the highest number of tiller m^{-2} followed by super clean and the lowest in refit applied plot. Irrespective of weed control method, USG applied plots produced the highest number of tiller and panicle m^{-2} than PU plots. Panicle number was not significantly affected by weed control method. Irrespective of weed control method USG applied plots produced the highest number of panicle than PU applied plots. In PU applied plots, the highest grain number was observed in hand weeding, followed by super clean and lowest in refit. In USG applied plots, application of refit produced the highest number of grain panicle^{-1} followed by super clean and the lowest in hand weeding. Irrespective of weed control method, USG applied plots produced the highest number of grain than PU applied plots.

In PU applied plots, super clean produced the highest grain yield followed by refit and the lowest in hand weeding. In USG applied plots, grain yield was not significantly affected by weed control methods. USG applied plots produced the highest grain yield than PU applied plots. Application of super clean instead of refit the profit was Tk 1,010 ha^{-1}. Application of super clean instead of hand weeding the profit was Tk 6,959 ha^{-1}. Application of refit instead of hand weeding the profit was Tk 5,949 ha^{-1} and application of USG instead of PU the profit was Tk 8,214 ha^{-1}.

The experiment was carried out to identify an appropriate rice harvest day for quality seed production. Seeds were harvested at 24 to 34 days after flowering maintaining two days interval. Among the studied qualitative characters, percentage of germination and seed vigour index gradually increased with harvest days but, a dramatic fall observed when seed harvested after 32 DAF. Over maturity might be a problem for quality seed production which needs to reconfirm.

Another experiment was conducted during Aus 2009, T. Aman 2009 and Boro 2009-10 seasons at the west byde of the BRRI farm, Gazipur to determine the cost and return of HYV rice cultivation in existing situation. The tested varieties were BR26, BRRI dhan41 and BRRI dhan29 for Aus, Aman and Boro season respectively. The results showed that total labour requirement for different operations was 265, 265 and 269 md ha^{-1} in Aus, Boro and Aman seasons respectively. Total variable cost was Tk 63,005, 69,933 and 79,712 in Aus, Aman and Boro seasons respectively. Gross margin also the highest in the Boro season (Tk 99,788) followed by Aman (Tk 72,567) and Aus (Tk 46,595) season. The cost of production of per kg rice was the highest in Aus season (Tk 15.8) followed by Aman (Tk 13.3) and Boro season (Tk 11.9). The BCR was 1.74, 2.04 and 2.25 in Aus, Aman and Boro seasons respectively.

Survey and monitoring of labourer's wage rate at different locations around BRRI HQ such as Joydebpur, Chowrasta, Salna, Board Bazar, Konabari were conducted throughout the year and observed that the average wage rate day^{-1} varies from Tk 244 to 270. The wage rate day^{-1}during the peak periods of the year was Tk 275 to 295 in May, Tk 240 to 290 in July-August and Tk 270 to 290 in December-January. During February to October 2010 the wage rate varied between Tk 190-250, 170-190, 150-180, 230-260 150-190, 200-250 and 150-200 at Habiganj, Rangpur, Rajshahi, Barisal, Sonagazi, Comilla and Satkhira respectively.

About 34,870 kg rice was produced by this division of which 19,073 kg was seed, 15,797 kg was mixed rice. These seeds were deposited to BRRI general store. This division also produced 7,998 kg breeder seed in collaboration with the GRS division.

Including regional stations BRRI had 483 labours of which 239 regular and 244 irregular. In BRRI HQ, total labour was 292 of which 137 regular and 155 irregular. The institute had 274 ha of land of which 163 ha was cultivable. Total labour utilization in different divisions for research purpose was 62,771 man days of which 59.64% 35.51% and 4.85% were utilized for research, support service and holidays respectively. A total of Tk 56,15,100 and Tk 33,43,650, 3,19,402 and 4,57,050 were paid to the labours for research work, support service works and leaves, respectively. About 83.1 ha of land was utilized by different divisions in different seasons of which 16.6 ha in Aus, 35.1 ha in Aman and 31.4 ha in Boro season. This division also responsible for the management of BRRI garden to maintain the aesthetic view of the campus, this division created a visible flower garden during summer and winter seasons.

Program Area: Technology Transfer

Adaptive Research

In T. Aman 2009 six advanced lines (premium quality rice) along with BRRI dhan37 and Kataribhog as checks were tested in eight different locations of Bangladesh. Based on farmers' views, grain yield, growth duration and lodging tendency, BR6926-1-1-1-1-2, BR6926-1-1-1-3-2 and BR6922-4-4-4 were found suitable for proposed variety trial (PVT).
Three advanced lines (rainfed low land rice) along with Guti Swarna as check were also tested in ten locations. Considering grain yield and growth duration, none of the lines were found suitable for PVT.

Eight *Sub1* and IR lines along with Swarna and BR11 as checks were tested in Sylhet (Bishonath and Golapganj). Based on the performance from two sites in only one district it was difficult to make conclusive recommendation. However, two IR lines, IR85260-66-654 Gaz 2 and IR85260-66-217 Gaz 2 seemed potential regarding submergence tolerance as with BR11-*Sub1*and Swarna-*Sub1* and deserve further investigation.

In Boro 2010, seven advanced lines along with BRRI dhan28 and BRRI dhan29 as checks were tested in different locations of the country. BRRI dhan29 produced better yield (5.42-7.55 t/ha) than the other lines in all locations having average yield of 6.93 t/ha. BR7011-89-3-7 and BR7230-7-4-2 produced similar average yield like BRRI dhan29 (6.88 and 6.80 t/ha respectively).

In *Lum* system (Aus-Aman mixed cropping) at Nesarabad, most farmers were interested to grow BRRI dhan27 instead of local Aus cultivar, for its higher yield and taller plant type. In Aman season BRRI dhan46 could not replace the local Joina because of its shorter plant type compared to Joina.

In Aus 2009, T. Aman 2009 and Boro 2010, SPDPs were conducted by using USG, LCC and AWD technologies at different locations of Bangladesh, from where about 135 tons of quality seeds were retained by the farmer for the next year use. About 23,046 farmers were motivated to adopt these technologies.

Applications of poultry manure @ 1.5 t/ha could substitute 16 kg/bigha phosphate fertilizer.
The Adaptive Research Division (ARD) conducted 21 Rice Schools and 34 field days at different locations of the country in which 735 trainees and 1149 persons participated, respectively.
About four tons of quality seeds of the current rice varieties were produced at BRRI farm by ARD, which were used for conducting adaptive trials at different locations of the country.

Training

The Training Division has conducted 44 training programmes in the reporting period with course duration from 1-day to 1-month depending on their nature and requirement. A total of 1,278 participants from different government and non-government organizations and farmers were trained through these courses. Need based course curriculum was developed for these courses. The highest number of participants was from the Department of Agricultural Extension followed by farmers. All the participants of one-month training achieved the distinction category certificates with 155% knowledge improvement.

The overall improvement of knowledge of extension personnel through 1-week Rice Production Training (RPT) was 248%. The improvement result indicated a need for RPT of extension personnel to improve their knowledge. From 1974 to June 2010 BRRI completed 2,199 training programmes through which 60,865 participants were trained on different aspects of rice production technologies. Effectiveness of imparted trainings was determined on the basis of feedback remarks on different aspect. Most of the trainees expressed positive views about the course content and method of training. Most of the BRRI's speakers' performance was very good.

Workshop Machinery and Maintenance Division

A self-propelled reaper for rice and wheat was designed and developed in the research workshop of BRRI. The gearbox was mounted to the chassis of the reaper and tested for 1.0 and 1.2-meter reapers. The effective field capacities of 1.0 and 1.2-meter reapers were 0.251 and 0.31 hectare per hour respectively for harvesting rice. The equivalent values for wheat were 0.246 and 0.32 ha/hr respectively. Similarly, field efficiency of 1.0 and 1.2-meter reapers was 71.7 and 73.8% respectively for rice. The equivalent values for wheat were 70.3 and 76.2% respectively.

Comparative study of the performances of different field mowers was evaluated in BRRI play ground. The forward speed, effective field capacity, fuel consumption of BRRI field mower was found 3.02 km/hr, 0.22-0.24 ha/hr, 1.2 l/ha (Diesel) respectively. It has 78 cm long blade. Tk 52 is needed to cut grass per hectare. Its initial cost is very low (approximately Tk 60,000). The cutting height of grass is ranged from 4-6 cm from the surface. Its performance is better than other mowers in terms of fuel cost, time, labour and maintenance cost.

It was found that the cone penetration resistance is decreased with the increased moisture content (MC). The maximum cone penetration resistance was found 4000 kN/m^2 at 15.41% MC. The cone penetration resistance is decreased at an increasing rate up to 22.2% MC. At 22.2% mc, minimum cone penetration resistance is found (347 kN/m^2). For rice bed soil (clay loam), 22.2% MC is optimum for minimum tillage.
As support services, 2,358 repair and maintenance works have been done. The total cost of major and moderate/minor repair and maintenance was Tk 19,37,137 from July 2008 to June 2009. Among these major repair and maintenance cost was Tk 14,80,032 and moderate/minor repair and maintenance cost was Tk 4,57,100.

Regional Station

BRRI RS, Barisal

In observational trial BR7449-10-3-1, BR7449-30-2-1, BR7460-5-5-3, BR7461-6-2-2, BR7448-41-3-2 and BR7459-15-5-1 1 performed better than the check BRRI dhan44 with higher plant height.
In secondary yield trial BR7608-9-2-1 and BR7610-26-1-1 performed better than the check BRRI dhan44 with higher plant height, but higher growth duration.
In advanced yield trial AS996 and BRRI dhan29-SC3-28-L16 performed better than the check BRRI dhan28. BRRI dhan29-SC3-28-L16-P1-7-R-6 and BRRI dhan29-SC3-28-L16-P1-9-R-1 performed better than the check BRRI dhan29.

In nutrient manipulated experiment no significant variations on spotted grain incidence and yield were observed in T. Aman season but grain spot incidence differed insignificantly and yield differed significantly in Boro season among the treatments.
In bacterial blight management through nutrient manipulation no significant variations on the incidence of spotted grain, lesion height of bacterial blight and yield were observed among the treatments in T. Aman season but only yield significantly differed in Boro season among the treatments.

The calculated optimum N and P doses for different soil fertility grades were much less than the soil test based doses in both location Bakergonj and Kathaltoli. Dibbling and line sowing produced higher grain yield in the crop establishment methods.

Use of poultry liter, dhaincha incorporation, khesery relay and red clover produced non-significant yield increase in T. Aman but significant yield increase in Boro season.
None of the popular T. Aman varieties including submergence tolerant lines with 30-day-old seedlings survived after 2nd spell of tidal submergence.

Organic manure like cow-dung slurry, poultry liter, and oil cake produced 0.7-1.5 t ha^{-1} higher grain yield compared to recommended fertilizer dose. The NPK briquette (2.4 g × 2) produced higher grain yield. On the basis of farmers' perception fertile land produced the higher grain yield compared to medium and non-fertile.

Complete treatment (NPKSZn) produced the highest yield compared to other treatments.
In Boro season 150 kg N ha^{-1} seems to be optimum and economic for BRRI dhan29 in BRRI RS farm, Sagordi. Grain yield in fustigation compared to broadcast fertilization was increased for all three N rates. Water salinity increased exponentially with the decrease in distance from the coast line of the Bay of Bengal.

BRRI RS, Bhanga

Pedigree nursery
Rapid generation advance
Introduced breeding lines from IRRI
Screening for high zinc genotypes
Seed production
Workshop and trainings

BRRI RS, Comilla

Fifty crosses were made and 23 F_1s were confirmed and 176, 681, 367 and 417 plant progenies with desirable plant type were selected from F_2, F_3, F_4 and F_5 generations, respectively under the varietal development programme.

Five and ten genotypes of hybrid rice were tested at BRRI regional station (RS), Comilla as a part of multilocation trial in T. Aman and Boro seasons respectively. Their yield ranged from 3.11 to 5.38 and 5.66 to 8.20 t/ha with growth duration ranged from 107 to 132 and 132 to 151 days respectively.

A total of 24,077 kg breeder seeds of BRRI dhan28, BRRI dhan29 and BRRI dhan50 and 4,650 kg breeder seeds of BR11 and BRRI dhan27 were produced.
In a Rice-Rice cropping pattern, the grain yield of T. Aman rice increased with increase in N doses up to 40 kg/ha in case of hybrid entry 2 (EH2) and BR7870-5*(NIL)-7-HR1 and up to 80 kg/ha in case of hybrid entry 1 (EH1) and BRRI dhan49. In Boro season, grain yield of BRRI dhan45 and BRRI dhan50 increased up to 120 kg N/ha while the yield of BRRI hybrid dhan2 increased up to 160 kg/ha.

Twenty-one T. Aman and 23 Boro rice varieties were evaluated at BRRI RS, Comilla farm to identify stability index. Considering yield performance, the best two varieties in T. Aman were BRRI dhan49 and BR23 and in Boro those were BRRI dhan29 and BRRI dhan35.
BRRI dhan48 produced an average of 0.87 t/ha more yield than BR26 in demonstration plots at eight farmer's field of Comilla region during Aus season.

A total of 436 farmers and 60 SAAOS of DAE from Comilla, Chandpur and B Baria districts attended day-long 12 training programmes on rice production technologies.

BRRI RS, Kushtia

Four lines were tested in regional yield trial (RYT) using standard cheeks BRRI dhan48 and BR26 in T. Aus 2009-10. BR7414-22-1 (4.9 t/ha) was the only line, which produced slightly higher grain yield than the check BR26 (4.7 t/ha). Growth durations of all the lines were more or less similar to standard checks..

BRRI dhan33 (short duration) and BR11 (long duration) varieties were grown on four different transplanting dates to observe the effect of drought severity and to find out suitable date of transplanting under climate change situation. Drought at ripening stage was found less harmful for rice than the vegetative and reproductive stages. Considering T. Aman 2009-10 season, transplanting on 24 July and 31 July might be suitable for short duration variety like BRRI dhan33 and transplanting on 17 July and 24 July can be recommended for long duration variety like BR11.

BR11 was established through supplemental irrigation on 17 July 2009 (T_1). In another treatment (T_2), the variety was transplanted under rainfed condition and it was 14 days later than that of T_1. Early transplanted treatment T_1 through supplemental irrigation effectively escaped terminal drought at the reproductive stage. Yield loss was 1.25 t/ha due to terminal drought at reproductive stage in treatment T_2 and it was about 25 percent less than the treatment T_1. Supplemental irrigation application also mitigated vegetative stage drought.

Efficiency of natural enemies was studied at Kushtia sadar upazila in Aus and T. Aman seasons 2009. Only one species of parasitoid (*Elasmus* sp.) was found to infect the pest. Rate of parasitism was found to be 5.83% and 9% in Aus and T. Aman seasons respectively. Prolonged drought situation in the seasons was the probable reason of the low parasitism rate.
Yield and growth duration of 21 BRRI varieties were studied. All the 21 test varieties produced lower yield than the standard yields determined for them. The reduction ranged from 0.02 t/ha (BRRI dhan40) to 1.71 t/ha (BRRI dhan44). Growth duration of some of the varieties decreased (up to 15 days), whereas in some varieties it increased (up to 39 days) than the standard durations.

BRRI dhan34, BRRI dhan39 and BRRI dhan49 were used in SPDP during T. Aman 2009 for demonstration and quality seed production. About 3,760 kg seeds were produced through SPDP of which about 62% was retained by the farmers for further propagation. Most of the farmers preferred BRRI dhan49 due to grain quality, higher yield and earliness than BR11.
In total, thirteen trainings (12 farmer trainings and one SAAO training) were conducted in which around 360 farmers and 80 SAAOs of DAE participated. One field day was organized to demonstrate water management technologies. We attended agriculture fair, national agriculture day rally and discussion meetings.

BRRI RS, Rajshahi

Varietal development. Under severe drought stress at the reproductive stage, eight genotypes were selected. Among them, IR833377-B-B-93-3 (3.4 t/ha), IR83376-B-B-130-2 (3.3 t/ha) and IR83388-B-B-8-3 (3.2 t/ha) were better.

Under controlled irrigated condition, same set of entries (OYT-RSD), four entries IR 83388-B-B-8-3 (5.3 t/ha), IR 83376-B-B-86-3 (5.1 t/ha), IR 83383-B-B-141-4 (5.0 t/ha), IR 83383-B-B-141-2 (5.0 t/ha) were selected. In both the sets RSD and controlled irrigated environment genotype IR833377-B-B-93-3 was common and found potential for drought environment of Rajshahi region.

Ten genotypes were selected mainly based on yield as compared to standard checks (BRRI dhan33, BRRI dhan39, BINA dhan7 and IR64 checks. Of them four entries were the best in terms of yield IR 83614-427-B (3.2 t/ha), IR 80461-B-79-3 (3.1 t/ha), IR83614-143-B (3.4 t/ha), IR83614-879-B (3.6 t/ha).

Genotype IR83614-798-B and IR80973-B-186-U1-2 produced similar yield (4.4 t/ha) of BRRI dhan33 (check) with similar growth duration.
Under drought stress, three entries IR80416-B-152-4, IR84882-B and IR78555-3-2-2-2 and IR82948-14 (DT44015-14) were out yielded than Apo where other checks could not be flowered.

In both drought and controlled conditions IR78875-207-B-3-B was the best and may be selected for further evaluation.Two hybrid lines IR82372H and IR81956H out yielded BRRI dhan33 and BINA dhan7 irrigated condition. Farmers preference score for IR74371-70-1-1, IR74371-54-1-1 and BINA dhan7 were 1st, 2nd and 3rd respectively in Godagari. In Nachole, BRRI dhan32 was preferred more than Barkhe3004.

Single genotype BR7873*5 (Nils)-37-HR4 was superior in terms of growth duration and yield than the check variety BRRI dhan33. Yield of five genotypes BR7877-*5 (Nils)-63, BR7877-*5 (Nils)-64, BR7150-11-5-4-2-11, BR7150-11-7-4-2-12 and BR7150-11-3-4-2-19 were better than the check variety BRRI dhan39.

None of the genotypes out yielded BRRI dhan49. However, majority of the test lines produced higher yield compared to Dadkhani and BRRI dhan34. Among the three somaclones BRRI dhan29-SC3-28-L4-HR2 was the best as test materials. However the growth duration was higher than BRRI dhan28 and similar with BRRI dhan29.
Highest yield was recorded with soma clone line but highly susceptible to cold. AS9996 grains are bold but tolerant to cold with one week earlier than soma clone material and comparable with BRRI dhan28.
BR7414-25-1 and BR7414-22-1 were better than the standard check BR26 and BRRI dhan48.

BRRI RS, Rangpur

Nine *Sub1* entries, Swarna-*Sub1*, BR11-*Sub1*, IR64-*Sub1*, and Samba Mahsuri-*Sub1* established in 14 days submergence and non-submergence condition in PVS mother trial at BRRI regional station, Rangpur in Aman season.

Swarna-*Sub1*, BR11-*Sub1*, IR64-*Sub1*, and Samba Mahsuri-*Sub1* showed survival percent 98.9, 98.6, 98.3 and 98.1 in 14 days water stress condition.

Crop condition of all four *Sub1* entries after post flood submergence in Aman (wet season) was good and the early maturing submergence line IR64-*Sub1* matured within 121 days in non- submergence condition and obtained 3.49 t/ha.

Three mother trials under PVS established in on-farm at Kachirchar (Sadar, Kurigram), Palashbari (Gaibandha) and Kamarkhand (Sirajgonj) during Aman season.

All four submergence tolerant lines, Swarna-*Sub1*, BR11-*Sub1*, IR64-*Sub1* and Samba Mahsuri-*Sub1* survived for 5-22 days in natural flash flood condition at Kachirchar and Polashbari but no flood occurred at Kamarkhand.

Early maturing line IR64-*Sub1* produced yield about two t/ha after three times flooding in Polashbari and Kachirchar. Preference analysis of PVS mother trials conducted by social scientist, plant breeder and agronomist with four *Sub1* entries in above mentioned farmers' fields. In Rangpur region most of the land become available for planting in February. So, if hybrid rice transplanted from 1-15 February, more grain yield was found than BRRI dhan28.

Thirty-day-old seedlings produced higher grain yield and lower sterility than 45- and 60-day-old- seedlings in both transplanting times. Sixty-day-old seedling produced higher grain yield than 45-day-old seedling due to more grains per panicle and some cases more panicles per unit area than 45-day-old seedling.

The tiller, panicle, taller plant and higher grain yield in T_4 (12 DAT) but survival percentage higher in T_2 (4 DAT) in Swarna-*Sub1*. BR11-*Sub1* produced the highest panicle, taller plant and higher grain yield in T_4 (12 DAT), but survival percentage and higher grain yield in T_2 (4 DAT). In 16 DAT of submergence higher tiller no. due to almost low survival percentage in IR85260-66-258 higher tiller, panicle, taller plant in 0 DAT, but the highest survival percentage and grain yield in T_2 (4 DAT).

In spacing management trial the data revealed that 15 cm × 15 cm produced highest grain yield for all *Sub1* varieties/lines such as BR11-*Sub1* and IR85260-66-258 (7.4 t/ha), Swarna-*Sub1* (6.6 t/ha), IR85260-66-654(6.0t/ha), Samba Mahsuri-*Sub1* (4.4 t/ha) and IR64-*Sub1* (2.9 t/ha) respectively.

Dry DSR with the pre-germinated seed (T_2) produced the higher grain yield in both the varieties (4.04-5.41 t/ha). Among TPR T_3 performed better only in BR11 *Sub1*. In both the varieties bolan practice (T_6) produced more or less satisfactory grain yield (2.52-3.85 t/ha). Irrespective of establishment method, BR11 *Sub1* produced more or less 1 t/ha higher grain yield than BR11 (ck)

To assess the impact of different crop establishment practices on productivity and to study the weed successions, we initiated a long-term experiment on the Rice-Maize-Mungbean (R-M-MB) system at BRRI RS, Rangpur. BRRI dhan33 produced the highest yield with CA based ZTDSR (Zero tillage under direct seeded rice) that was 15-20% higher than conventional methods. Yield obtained from ZTDSR 6.677 tha^{-1} and 5.794 and 5.572 tha^{-1} from CTDSR (Conventional tillage under direct seeded rice) and TPR (Transplanted puddled rice). Yield varied in different weed control options and the highest yield obtained from CW (Chemical weeding) plots except CTDSR due to more weed infestation in the CTDSR CW plots. The lowest yield obtained from CTDSR than other methods due high weed density per m^2, lodging condition and rat damage. The land preparation cost in ZTDSR showed the lowest cost (4149 Tk/ha) followed by TPR (4710 Tk/ha) and CTDSR (7542 Tk/ha). Thus land preparation cost was reduced by 13 and 81.8% in ZTDSR compared to TPR and CTDSR respectively.

Hybrid maize NK 40 produced the highest yield with conventional tillage methods than CA based ZT maize. The yield obtained from ZT maize 7.64 t/ha and 8.03 t/ha from CT maize. The highest yield of CT maize associated with cobs/$5m^2$, 100-seed weight and grains/cob. The stover yield was also higher in CT maize (10.01 t/ha) than ZT maize (9.71 t/ha). The ZT maize was more profitable then CT maize.

In the plant population trial the maximum grain yields 8.71 t/ha was obtained from the crop at 60 × 22 cm plant spacing. On the contrary, the minimum grain yield (7.40 t/ha) was recorded in the crop raised at 75 × 25 cm plant spacing. The trend in the plant height, 100-grain weight, grain /cob was contrary to that of grain yield.

The farmers' participatory SSNM experiment includes 16 farmers field in Rangpur. Ten farmers' fields were selected for omission trial and six farmers were selected for NM trial.

The omission trial with one set of the seven treatments and the NM trial with one set of the five treatments will be conducted at each field location.

In omission trial the maximum yield was recorded (6 t/ha) in T_4 (NPKSZn) treatment. All fertilizer doses were present in this treatment. On the contrary, the lowest yield (4.66 t/ha) was recorded in the crop raised at T_1 (-N, PKSZn) treatment where N fertilizer was not applied. In NM trial the maximum grain yield (6.18 t/ha) was recorded in T_3 (NPK based on NM+ S & Zn based on BRRI) treatment. The minimum yield was found in T_1 (Farmer's field practice) treatment (5.13 t/ha).

Conventional tillage produced the highest grain yield (6.43) followed by reduced, strip and zero tillage. There was no significant difference on yield within pre- and post-emergence herbicide. The lowest production cost was found in post-emergence herbicide (Sirious and Sunrise) and strip tillage practices. The post-emergence herbicide (Sirious and Sunrise) controlled the weeds effectively. The highest number of weed species and dry mater was found in pre-emergence herbicide. The lowest weed species and dry matter was found in conventional tillage practices followed by reduced, strip and zero tillage conditions.

Continuing the *monga* mitigation programme as per action plan 2008-10. A total of 37,804 ha land was cultivated of BRRI dhan33 during this period under GO-NGO collaboration. The highest grain yield was found in Nilphamari district in DSR by PTOS (6 t/ha) method and the lowest yield was found in TPR (3.76 t/ha) method. There was no grain yield difference within five districts in TPR condition.

BRRI RS, Satkhira

Monitoring of water salinity of the river Betna at Benerpota farm in Satkhira Managing salinity on rice crop production. Evaluation of different cropping patterns in medium high land eco-system in the south-western region. Development of a new cropping pattern as Boro-Jute-T. Aman, where the existing pattern is Wheat-Jute-Fallow in medium high land eco-system.
Development of a new cropping pattern as Boro-T. Aus-Fallow where the existing pattern is single Boro in medium low land eco-system. Development of a new cropping pattern as Boro-B. Aman-Fallow where the existing pattern is single Boro in medium low land eco-system.

Minimizing the yield gap by exploiting BRRI technologies in Boro and T. Aman rice in Boro-Fallow-T. Aman cropping system.

Integrated Rice + Fish culture in DWR after Boro in single Boro cropping system.Quality seed production, demonstration, dessimination and achievement in farmers' field.

Quality seed production of BRRI rice varieties at farmers level in Boro and T. Aman seasons

BRRI RS, Sonagazi

The optimum dose of N for BRRI dhan40 and BRRI dhan41 in coastal charland situation may be 60 kg N per hectare during T. Aman season. N is the major yield limiting factor for Aman and Boro seasons under the Sonagazi farm soil.Rainwater harvesting in a reservoir with 25 cm high embankment can conserve more water than without embankment, which could increase area to irrigate Rabi crops in the coastal area. Genotype IR76393-2B-7-1-1-3-1 and BR7084-4R-1 having its yield capacity more than 7 t/ha may be considered as proposed varieties in saline prone area during Boro season. AS996 has the potential to be a variety due to its higher yield (about 7 t/ha) with a reasonable growth duration (about 150 days) in Boro season. Cost of paddy production per kilogram was Tk 11.30, 14.18 and 16.13 in farmer's situation, at BRRI farm and its contactor's management respectively.

BRRI RS, Habiganj

Four tested entries out yielded BR26 and BRRI dhan48 with similar growth duration in RYT, Aus 2009. Sixty four F_6 plants and 205 F_7s plants of DWR were selected from four F_5s and 18 F_6s respectively. In secondary yield trial of DWR, BR224-2B-2-5(2.5 t/ha), BR5925-B-2(2.4

t/ha), BR5915-B-34(2.4 t/ha) and BR6716-2B-5(2.2 t/ha) yielded higher than HbjAIV (1.90 t/ha) with almost similar survivality. Bazail-65 (2.5 t/ha), Gabura (2.6 t/ha) and Lalkhama (2.4 t/ha) yielded higher compared to check Hbj A IV (2.0 t/ha) and showed consistent yield for last four years with higher survivality in secondary yield trial of locally collected materials. In Boro season, 195 F_5s plant were selected from 18 F_4s with high yield, short duration, tall plant type and strong culm.

Another 349 F_5s plant were selected from 11 crosses with high yield, short duration, tall plant type and strong culm. Eighty-two F_3 plants were selected from F_2 population with desirable characters for the development of varieties suitable for Haor Areas. None of the lines out yielded BRRI dhan29 (8.7 t/ha) but four entries yielded closed to BRRI dhan29 with similar growth duration. However in AYT Boro all tested entries yielded higher than BRRI dhan28. In RYT Boro, yield of all tested entries were lower than BRRI dhan29. But three entries yielded higher than BRRI dhan28 with 4-7 days longer growth duration.

Four desirable rows (pure lines) were selected in respect of phenotypic traits and uniformity in purification of BR19 trial. The highest rice grain yield of 8.36 t/ha was obtained with complete NPKS treatment and the lowest (4.69 t/ha) was obtained with all the missing treatment. The highest rice yield of 7.15 t/ha was obtained from 100 kg K/ha and the lowest (6.13 t/ha) was obtained from zero K fertilizer. Yield range of fallow-BR1-BRRI dhan46 cropping pattern was varied from 5.20 to 6.30 t/ha with the mean of 5.81 t/ha that was 26% higher than farmers' existing pattern.

All participated farmers' express their satisfaction about performance of BRRI dhan46 in respect of high yield, suitable for late transplanting, less disease and insect infestation and non-lodging characteristics. BRRI dhan48 was preferred by the farmers due to higher grain yield (4.65 t/ha), fine grain quality and less disease and insect infestation. Seed treatment with fungicide for Bakanae disease control was found effective in respect to disease control and higher grain yield and was preferred by the farmers. BR11-Sub1 and IR85260-66-654-Gaz2 yielded higher than other lines and checks in PVS trial. In PVT trial (Boro, 10), AS996 and BRRI dhan29-SC3-28-16-4-HR2 out yielded BR14 and BRRI dhan28. Twenty-three one day training for 652 farmers from villages of Habiganj were conducted on modern rice cultivation. The highest yield was obtained from BRRI dhan29 (7.50 t/ha) followed by BR9 (7.30 t/ha), BR15 (7.00 t/ha) and BR16 (7.00 t/ha) in stability analysis trial. About 71 tons seeds of different varieties of B. Aman, T. Aman, Boro ahd BRRI hybrid dhan2 were produced.