Research Progress 2018-2019

VARIETAL DEVELOPMENT PROGRAM PROGRAM AREA

PLANT BREEDING DIVISION

Research Progress 2018-2019

Research Progress	Expected Output
Program Area/Project (Duration): Varietal Development program (VDP)	
1. Rice Breeding	
1.1 Development of Upland Rice (B. Aus) Twenty five crosses were made using 19 parents and 29 crosses were confirmed as true hybrid. A total of 25,137 segregating progenies were obtained from 18 crosses from F_3 generation through Field RGA (FRGA). Moreover, 746 progenies and 210 fixed lines were selected from pedigree nurseries. Thirty four entries were selected fromf 104 entries under observational yield trial (OYT) based on growth duration, yield, homogeneity and other morpho-agronomic traits. Seven advanced lines were selected under preliminary yield trial (PYT) and secondary yield trial (SYT) for further evaluation. Two leading breeding lines were selected underregional yield trials (RYT) for further evaluation in different upland rice areas of Bangladesh.	Promising lines/varieties will be developed with short duration: 90-95 days, yield potential: 4.0 – 4.5 t/ha, with early vigor.
1.2 Development of T Aus Rice Total, 13 crosses were made and 19 crosses were confirmed as true hybrids. A total of 60,792 progenies from 19 crosses of F_2 generation, 16,658 progenies from 13 crosses of F_3 generation and 14,113 progenies from 22 crosses of F_4– F_6 generations were advanced through transplanted field RGA. Moreover, 3,922 progenies from 19 crosses of F4 generations and 1,200 progenies from 4 crosses of F5 were advanced through direct seeded field RGA. Six genotypes were selected from twenty seven entries in OYT and eight advanced lines were selected from seventeen entries in PYT on the basis of homogeneity with respect to plant height,	Promising lines/varieties will be developed with better yield potential (5.0–5.5 t/ha) and shorter growth duration (105–110 days) comparison to existing varieties

phenotypic acceptability (PACP) at vegetative and maturity stages and physicochemical properties. From RYT, five genotypes were selected based on growth duration, PAcp, grain quality and grain yield compared with BR26 and BRRI dhan48. One genotype BR9011-67-4-1 was recommended as candidate T. aus variety under PVT of ARD in different agro-ecological zones.	
1.3 Development of Shallow Flooded Rice varieties In total, 31 (11+20) crosses were made using 35 parents and 3569 F_1 seeds were produced from five crosses. Sixteen single crosses and 11 crosses were confirmed from multiple crosses. A total of 4,690 F_2 progenies, 193 F_6 progenies were advanced through FRGA. In addition, 211 progenies were also advanced through pedigree selection. Five modern deep water advanced lines having medium elongation under semi-deep flooded conditions were selected. Nine local deep water rice varieties having faster elongation under very deep flooded conditions were selected. Seed of the local cultivars were increased for genetic purity. Besides, four genotypes including a lead breeding line BR8159-20-8-5-8-2 (5.2 t/ha) showing 1.2 t/ha higher yield than the check variety BRRI dhan52 (4.4t/ha) and BRRI dhan44 (4.4 t/ha) were selected from multi-location trials (MLT). An advanced line BR10230-15-27-7B was evaluated by the National Seed Board (NSB) team in Proposed Variety Trial (PVT) for releasing as deep water rice variety for semi-deep flooded B. Aman areas. It has very strong stem and showed lodging tolerance with 185 cm plant height and gave 1.33 t/ha higher yield than the check variety Fulkore in Broadcast Aman season 2018-19.	High yielding (4.0-5.0 t/ha) deep water rice varieties for shallow flooded (up to 1.0 m depth) and medium deep area (50-60 cm water) along with submergence tolerance, facultative elongation ability and hypoxia tolerance will be developed.
1.4 Development of Rainfed Lowland Rice (RLR) In the reporting year 8,420 F_1 seeds were produced from 12 single crosses and five multiple crosses were made; four F_1 crosses were confirmed as true hybrid. A total of 12,931 panicles from F_2 and 8,211 from F_4 generation were harvested and preserved with proper labels. From F_3 generation 930 progenies of 33 crosses, from F_4 generation 370 progenies of 18 crosses, from F_5 generation 197 progenies of 10 crosses were selected and from F_6 generation 39 progenies were bulked through	Short duration varieties (105-115 days) with 4.5-5.0 t/ha yield potential and medium duration (116-130 days) varieties with 6.0-7.0 t/ha yield potential will be developed.

Pedigree method. In different yield trials, 326 genotypes were tested and 104 genotypes were selected. Two RYT's were conducted at seven regional stations of BRRI. In RYT#1, two genotypes were selected out of five and in RYT#2, two genotypes were selected out of six for ALART. The mean heritability estimates obtained from yield were 79% and 78% respectively, indicating high level of precision of these experiments. Also two PVTs were conducted. The proposed lines BR-RS(Raj)-PL4-B, BR-SF(Rang)-PL1-B and BR8210-10-3-1-2 produced 5.8, 5.7 and 5.6 t/ha grain yield respectively which were significantly higher than the grain yield of BRRI dhan49 (5.06 t/ha). In Boro 2018-19, 17 F_1 crosses were confirmed. Panicles of 3,318 from F_2, 9,877 from F_3 and 9,534 from F_5 generation were harvested and preserved.	
1.5 Development of Salt Tolerant Rice (STR) In T. Aman season, 30 crosses were made using 13 parents. A total of 28 F_1s for T. Aman season were confirmed. The Field Rapid Generation Advance was done at BRRI Farm, Gazipur and Satkhira. Yield trials were conducted in Gazipur, Khulna and Satkhirain both T. Aman and Boro season with salinity level (EC) of 2 dS/m to 9 dS/m (Fig. 1). In T. Aman, season 53,800 segregating progenies from 42 crosses (F_2-F_5 generations) were advanced using FRGA technique. From LST trials, 666 lines were selected from 2,882 breeding lines of 11 crosses based on strong plant type, grain type, and uniformity. Seventy five genotypes out of 120 genotypes were selected in OYT. Twenty four genotypes out of 67 genotypes were selected from four PYT trials. Five genotypes out of 14 genotypes were selected from SYT. In Boro Season, 32 crosses were made. A total of 31 F_1S was confirmed. In Boro season 86,083 segregating progenies from 60 crosses (F_2-F_5) were advanced using FRGA technique. From LST trial, 1,749 lines were selected on the basis of plant type, grain quality and uniformity from 6,126 breeding lines derived from 11 crosses under field condition. Thirty seven entries (out of 170 genotypes) were selected from OYT. Forty three entries (out of 88 genotypes) were selected from PYT#1, PYT#2, PYT#3 and PYT#4. Four entries (out of 12 genotypes) were selected	Salt tolerant varieties for farmers and consumers preference will be developed with seedling stage (14 dS/m) & reproductive stage tolerance (EC = 8-10 dS/m) and better yield potential (5.0-5.5 t/h for T. Aman and 6.0-7.0 for Boro season)

from AYT. Three salinity tolerant lines **(**IR83484-3-B-7-1-1-1, HHZ12-SAL2-Y3-Y2 and HHZ5-DT20-DT2-DT1) were evaluated in eight coastal saline location as Proposed Variety Trial (PVT).The highest level of salinity (EC) found at Kaliganj which ranged from 6 dS/m to 16 dS/m (Fig. 4) and the responses of genotypes to high salinity stress are shown in Fig. 5. Two lines such as IR83484-3-B-7-1-1-1 and HHZ5-DT20-DT2-DT1 performed better compared with checks in terms of yield and salinity tolerance.	
1.6 Development of Premium Quality Rice (PQR) for T. Aman and Boro Seasons In T. Aman, total 41 crosses (21 crosses for PQR, 15 for anti-oxidant enriched rice and 5 for photosensitive fine quality rice) were made, Thirty five crosses were confirmed and 3850 F_2 progenies were grown from 3 crosses. From pedigree nurseries, 194 progenies with 42 fixed lines were selected from 230 progenies of 30 crosses in F_3-F_6 populations. A total of 88 genotypes selected out of 173 from OYT based on growth duration, yield, and homogeneity. From PYT, 25 genotypes were selected out of 74 genotypes. From SYT#1 & 2 total 8 genotypes showing 0.7-1.3 t/ha yield advantage over check varieties Kalizira, Chinigura, Kataribhog, BRRI dhan34 and BRRI dhan37 were selected out of 20 genotypes. Seven genotypes showing 0.6-1.2 t/ha yield advantage over the check varieties Kalizira, Chinigura, Kataribhog, BRRI dhan34 and BRRI dhan37 were selected from RYT. A lead breeding line (BR8535-2-1-2) showing yield 4.63 – 5.56 ton/ha with premium grain quality (grain size and shape similar to BRRI dhan34 and mild aroma but photoperiod insensitive) was evaluated in Proposed Variety Trial (PVT). This proposed line produced 1.0-1.4 t/ha higher yield with around 22 days earlier than BRRI dhan34. In Boro season, a total of 5,815 F_1 seeds were produced from 16 crosses. Four F_1 crosses were confirmed out of nine crosses. In total 6,365 panicles from F_2 and 12,347 from F_3 generation were harvested and preserved. From F_4 generation 67 progenies of eight crosses were selected and from F_6 generation 68 progenies were bulked. In DTR 16,485 progenies and in RLR 9,534 progenies were harvested and preserved. In different yield trials, 84	National and international grade (Kalizira, Chinigura, Kataribhog, Basmati, Jasmine, Banglamoti and BRRI dhan34 type) high yielding aromatic varieties with earliness and good plant type will be developed

genotypes were tested and 36 genotypes were selected. In RYT, two genotypes were selected out of four genotypes.	
1.7. Development of Zinc Enriched Rice (ZER) In T. Aman season, 33 single crosses were made. A total of 44 crosses were confirmed and registered. Totally 23,626 progenies were advanced through Field RGA. Totally 2775 individual progenies and 141 fixed lines were isolated from pedigree nurseries. From OYT, 40 genotypes were selected based on yield and growth duration considering significant difference in growth duration from the check variety. Totally, 44 genotypes from PYT-1, PYT-2 and PYT-3, seven genotypes from SYT, 11 genotypes from RYT-1, RYT-2 and RYT-3. Two genotypes from ALART were selected for the better than check varieties in terms of grain yield. One advanced breeding line (BR7528-2R-HR16-2-24-1) was evaluated at ten locations in Proposed Variety Trial. This line showed 0.22 t/ha yields along with five days shorter growth duration than BRRI dhan39. Nucleus seed of BRRI dhban62 and BRRI dhan72 were produced. In Boro season, 50 single crosses were made. A total of 25 crosses were selected and confirmed. Totally 10,675 progenies were advanced through Field RGA. Totally 3,240 individual progenies and eight fixed lines were isolated from pedigree nurseries. From OYT, 17 uniform genotypes were selected based on yield and growth duration. Totally three genotypes from PYT, three genotypes from SYT and two genotypes from RYT were selected. One elite breeding (BR8631-12-3-5-P2) from ALART was selected for PVT. Nucleus seed of BRRI dhan74 and BRRI dhban84 were produced 450 kg and 960 kg, respectively.	High iron and zinc content with resistance to major insect pests and diseases and acceptable grain quality rice will be developed.

1.8 Development of Insect Resistant Rice (IRR) In T. Aman season, 20 crosses were made using 16 parents. Sixteen crosses were confirmed. In T.Aman season 41,817 segregating progenies from 52 crosses were advanced using FRGA technique. Twenty three out of 60 lines were selected from OYT. 15 out of 36 lines were selected from IRBPHN. 11 lines from two PYT's were selected. Ten out of 20 lines from SYT were selected. Two promising lines were evaluated in ALART and one line (BR8693-8-4-2-1) was recommended for PVT. In Boro season, 20 crosses were made and 22 crosses were confirmed. A total of 74,368 segregating progenies from 78 crosses were advanced using FRGA technique. In LST, 356 lines were selected from 3062 breeding lines of 8 crosses with strong plant type, grain quality and uniformity. Eleven out of 41 lines were selected from OYT. Fifteen out of 36 lines were selected from IRBPHN. Four out of 20 lines from SYT were selected. One advanced line (BR8340-5-6-1) was recommended as candidate variety from ALART for conducting PVT.	BPH and Gall midge resistant variety will be developed with better yield potential (5.0 – 5.5 t/ha for T. Aman and 6.0-7.0 t/ha for irrigated Boro season).
1.9 Development of Disease Resistant Rice (DRR) Ten crosses for BB and nine for Blast during T. Aman and 10 crosses for BB and nine for Blast in Boro were confirmed. In T. Aman, 22,643 progenies of 11 crosses and 15,878 progenies of eight crosses were advanced for BB and Blast, respectively from F_2; 6,632 progenies of nine crosses and 3,302 progenies of six crosses were advanced for BB and Blast respectively from $F_{3;}$ 14,886 progenies of 19 crosses and 4,542 progenies of eight crosses were advanced for BB and Blast respectively from F_4 - F_6 generations in FRGA-Transplanted. On the other hand, 12,680 progenies of nine crosses and 312 progenies from one cross were advanced for BB and Blast respectively from $F_{4;}$ 1,528 progenies of 8 crosses and 748 progenies of 3 crosses were advanced for BB and Blast respectively from F_{5-} F_6 generations in modified FRGA. In Boro, 10 crosses for BB and nine crosses for Blast were made and 11 crosses for BB and nine crosses for blast were confirmed. A total of 11,500 F_2 progenies for BB were advanced from 11 crosses and 9,500 progenies for blast were advanced from nine crosses; 7,704 progenies for BB were advanced	BB, Blast and RTV resistant varieties will be developed with better yield potential (5.5 – 6.0 t/ha).

from 17 crosses and 6,485 progenies for blast were advanced from 11 crosses of F_{3}- F_4 generations and 5,842 progenies for BB were advanced from 10 crosses and 4,070 progenies for blast were advanced from 11 crosses of F_5– F_6 generations. In total 2,830 BB and 165 blast resistance lines were evaluated in LST. Forty advanced lines were selected for BB in OYT. Six entries from PYT for BB resistance were selected and three entries were selected for BB resistance in RYT. Although one genotype BR9838-19-4-3-1-1 was recommended for PVT but it will be re-evaluated under different agro-ecological zones by ARD.	
1.10 Development of Favorable Boro Rice (FBR) In the reporting year, seven crosses were made. Twenty six crosses were confirmed. A total of 62,269 individual panicles were collected from 62,269 individual plants of 64 cross combination of F_2-F_6 generations. Out of 2500 lines, 411 uniform lines were identified from LST based on uniformity in heading, plant height and grain type, also disease incidence was recorded. Twenty two genotypes from PYT and 10 genotypes from AYT were selected for further evaluation. Advanced line BRRI dhan29-SC3-28-16-10-8-HR1 (Com) was released by the NSB as BRRI dhan88 for favorable Boro ecosystem. It showed 0.2- 0.6 t/ha higher yield with 2-3 days earlier growth duration than BRRI dhan28. As part of nucleus seed maintenance of Boro rice varieties, a total of 42 varieties were grown in varietal display lot and bulked seeds were collected.	Rice varieties for favorable irrigated ecosystem will be developed with high yield potential (7.0-8.5 t/ha), earliness and acceptable grain quality.
1.11 Development of Cold Tolerance Rice (CTR) Thirteen crosses were made. Thirty three crosses were confirmed as true F_1 through F_1 verification using QC genotyping with purity SNP panel. In total 68,531 individual plants were harvested from 83 crosses of F_2-F_6 generation by RGA system. Out of 5370 lines, 963 uniform lines were selected from LST based on uniformity in heading, plant height and grain type, also disease incidence was recorded. Fifty eight genotypes were selected from OYT. In PYT, 22 genotypes were selected from 70 genotypes and had yield advantage over check varieties BRRI dhan28, BRRI dhan58, BRRI dhan69 and BRRI dhan36. From AYT, three genotypes viz. BR8910-B-6-3-CS1-5-CS2-P3-1-1, BR8909-B-12-2-CS1-4-	Cold tolerance rice varieties will be developed for cold affected northern, western and Haor region with high yield potential (6.5-7.5 t/ha).

CS2-P5-3-3 and BR8910-B-6-3-CS1-5-CS2-P3-1-3 had yield advantage over check varieties BRRI dhan58 and BRRI dhan69. In multi-location trials in Haor areas, two genotypes were selected based on growth duration, yield and other morpho-agronomic traits. In addition, 76 parental genotypes were maintained through QC genotyping with purity SNPs.	
1.12 Development of Submergence and Water Stagnation Tolerant Rice varieties Totally 5,680 F_1 seeds were obtained from single cross and 235 F_1 seeds were obtained from multiple cross. Twenty three single and 14 multiple F_1s crosses were confirmed. Panicles of 12,467 from F_2, 12,595 from F_5, 3,830 from F_6 individuals were harvested and preserved with proper labels. From LST population, a total of 12,860 lines were genotyped with trait markers using custom SNP panel and finally 1321 lines were selected. In yield trial, 351 genotypes were tested out of which 58 genotypes were selected. In PVS, IR13F441 showed the highest survival (67%) with a pooled grain yield of 5.1t/ha under rainfed condition. However, BR9175-9-2-1-12-5 and BR9175-9-1-3-31-3 got the highest preference score in PVS function in flood prone farmers' field of Domdoma and Dorshona respectively because of their higher yield performance but there was no flood this year. The pooled heritability obtained from grain yield of PVS trial conducted under flooding condition was 94%, indicating acceptable level of precision in this experiment.	Short duration and high yielding rice varieties with three weeks submergence, stagnant flood and anaerobic germination tolerances with yield target 6.0-6.5 t/ha in normal condition and 5.0 t/ha in stress condition.
1.13 Development of Water Saving and Aerobic Rice varieties A total of eight crosses were made using 6 parents. Following field RGA technique a total of 2000 individuals of F_6 generation were harvested. From yield trial conducted under AWD condition a total of three genotypes from PYT and four genotypes from AYT were selected. However none of the genotypes gave higher yield than the check varieties BRRI dhan28, BRRI dhan29 and BRRI dhan58. Only based on the similar yield performance and phenotypic acceptance the genotypes were selected for further evaluation.	Water saving (20-30% water) rice varieties will be developed for boro season giving significantly similar yield compared to standard checks.

1.14 Development of Drought Tolerant Rice (DTR) In T. Aman 2018-19 season, 3,990 F_1 seeds were obtained from seven crosses. Nine F_1 crosses were confirmed out of 11 crosses as true hybrid. A total of 18,795 panicles from F_2 and 6,763 from F_4 generation were harvested at the time of maturity and preserved and processed with proper labels through RGA method following SSD. Besides, from F_3 generation 380 progenies of 28 crosses, from F_4 generation 235 progenies of 16 crosses, from F_5 generation 230 progenies of 17 crosses were selected and from F_6 generation 54 progenies were bulked and selected following pedigree method. In different yield trials, 99 genotypes were tested and 22 genotypes were selected on the basis of grain yield and phenotypic acceptance. In Boro 2018-19, 10 F_1 crosses were confirmed as true hybrid. Single panicles of 4,263 individual plants from F_2, 6,636 from F_3 and 5,586 from F_5 generation were harvested at the time of maturity and preserved and processed with proper labels through RGA method.	Drought Tolerant Varieties for T. Aman season will be developed with potential yield target (5.0 – 6.0 t/ha).
1.15 Development of Green Super Rice (GSR) In T Aman season, 16 genotypes from SYT and two genotypes from PVS were selected for further evaluation. In Boro Season, 12 genotypes out of 31 were selected in OYT; 24 genotypes out of 54 were selected from PYT and 10 genotypes out of 22 were selected from SYT. In AYT, two advanced lines were selected. Two genotypes were evaluated by NSB team in eight locations of saline prone areas.	Development of less input but high yield potential (7.00 t/ha) genotypes with tolerance to different stresses (abiotic and biotic).
1.16 Development of provitamin A, High Iron and Zinc Rice Enriched Rice In T. Aman season, totally 47 F_1s were confirmed from three backcrosse. Mature F_1 seeds were harvested, sun dried and stored separately in paper bags with proper labeling. In Boro season, a total of 164 individual progenies comprising three backcrosses from BC_3F_2 generation were selected. High Iron and Zinc Rice event IRS495-274 introgressed lines showed acceptable performance in contained trial and seven promising entries were selected for next trial based on their grain yield and other parameters. One GR2E line namely IR112060 GR2-E:2-7-63-2-96 was evaluated with standard check BRRI dhan29 in a confined field trial	Development of high yielding rice varieties with enhanced Provitamin A, high Iron and Zinc content in polished rice grain.

condition at eight location (Gazipur, Rajshahi, Cumilla, Barishal, Habiganj, Satkhira, Rangpur and Sonagazi) under government approval. For evaluating potential unintended effects of the genetic modification, data from GR2E introgression line in BRRI dhan29 was pooled for across-sites and single-site statistical analyses. In the across-sites analysis, the statistically significant differences between GR2E and near-isogenic control BRRI dhan29 in measured agronomic parameters were in days to maturity, plant height, panicle number per plant, flag leaf length, number of unfilled spikelet per plant and grain length, where the differences were very marginal, but were still within the range of values recorded for the control entry.	

Hybrid Rice Division

Research Progress 2018-2019

Sl. No	Research Progress	Expected Output
	Project: Material development, seed production and its distribution	
01.	One potential Aus hybrid rice variety submitted to SCA as BRRI hybrid dhan7 having yield potentiality 6-6.5 t/ha coupled with slender grain and growth duration 105-110 days. First year evaluation report is satisfactory. Hopefully this variety will be released within year of 2019.	This variety will bring new era for Aus growing areas of Bangladesh
02.	Six new CMS (A) lines were developed having diverse characters were developed. Among them two for T Aman and four for Boro season	This CMS lines will use for new hybrid rice variety development for T Aman and Boro season.
03.	CMS multiplication and seed production package development of promising CMS lines and hybrid combinations has been initiated	After study of commercial seed production feasibility, the selected combination will submit to Seed Certification Agency (SCA) for registration as new release hybrid.
04.	A total of 5000 kg of F_1 seeds of BRRI hybrid dhan2, BRRI hybrid dhan3, BRRI hybrid dhan4, BRRI hybrid dhan5 and BRRI hybrid dhan6 were distributed among farmers and different seed companies through	Popularization of BRRI released hybrid varieties.

	Head Quarter and Regional Stations of BRRI	
05.	Seed production program of BRRI hybrid dhan3, BRRI hybrid dhan4, BRRI hybrid dhan5 and BRRI hybrid dhan6 was initiated at farmers level under Mymensingh, Gopalganj, Ishrdi (Pabna), Sirajganj, Sherpur, Rangpur, Lalmonirhat and Khulna district	Farmers shall be able to produce own F_1 seeds of BRRI released hybrid rice varieties and in such a way small entrepreneurship will be developed at farmers level

Genetic Resources and Seed Division (GRSD)

Research Progress 2018-2019

Sl. No.	Research Progress	Expected Output
Program Area 01: Varietal Development Program (VDP)		
3	**Sub-program area: Rice Germplasm and Seed**	
3.1	**Project: Rice germplasm conservation and management** • Collection of 139 germplasm. • Rejuvenation of 1,977 germplasm and characterization of 103 germplasm with 51 morpho-agronomic characters were completed. A total of 342 new germplasm were registered as new accessions (from acc. 8237 to 8578) in Genebank. • Characterization of 70 local germplasm for boosting yield through trait discovery in changing climatic conditions. • Molecular characterization of 94 red and black Aus rice germplasm using 61 SSR markers along with 48 T. Aman germplasm using 54 SSR markers under PBRG/NATP-2. • Supply of 2,188 samples of which 1,441 accessions and 747 seed/non-seed of BRRI varieties for research and demonstration.	Long term conservation of the rice germplasm and utilization for future research and breeding. Characterized and as well as conserved germplasm would be utilized in trait specific breeding program.
3.2	**Project: Seed production and variety maintenance** • All BRRI developed (85) and recommended (14) rice varieties were maintained as nucleus stock. • In total, 226.86 tons of breeder seed of which 72.47 tons from 43 varieties in T. Aman and 154.39 tons from 24 varieties in Boro seasons were produced. • At the same time, 181.97 tons of breeder seed of which 113.22 tons from 23 varieties in Boro, 7.35 tons from 15 varieties in Aus and 61.40 tons from 33 varieties in T. Aman seasons were distributed.	Maintenance of pure seed stock and supply of Breeder seed to GO, NGO and private seed producing organizations according to their demand under rice seed network of BRRI.
3.3	**Project: Exploratory and genetic studies**	

Sl. No.	Research Progress	Expected Output
	• Sixty (60) Jhum rice germplasm were characterized to study the selection criteria and would be purify afterward. • Four (4) popular Jirasail germplasm along with BRRI dhan81 as standard check were evaluated as Preliminary Yield Trial (PYT). • One Balam (acc. 516), two Jesso-Balam (2464, 2472) and one Sada Mota (7888) were selected for PYT during T. Aman 2019. • Eleven (11) aromatic rice germplasm along with standard check BRRI dhan34 had been evaluated as PYT.	Estimated genetic variability, character associations, genetic relationships and selection criteria for yield and yield components of rice germplasm would be used for clear understanding of genetic makeup of the tested germplasm.
3.4	**Project: Documentation of technology** During the reporting year, 1000 accessions were documented in computer through *Microsoft Office Excel* program with collected available information.	Characterized information of the germplasm could be utilized for selecting parent(s) in breeding program.
3.5	**Project: Seed Technology Packages** Two leaflet on 'Identification and roguing of Off-type' for Rice Seed Network partners and 'BRRI Genebank-A very short introduction' for BRRI Genebank visitors were published.	The quality seed production related important/current problems at farmers' field would be solved.

Biotechnology Division

Research Progress 2018- 2019

Sl. No.	Research Progress	Expected Output
1	**Project I: Development of double haploid rice variety (Duration)**	
	Expt.1.1 Development of low glycemic index (GI) rice variety through anther culture A total of 30569 anthers were plated on to M10 & N6 media. From these 1181 calli were produced. A total of 12 green plants were obtained.	Low glycemic index (GI) rice variety will be developed from this experiment.
	Expt. 1.2 Development of salt tolerant rice variety through anther culture A total of 6425 and 6723 anthers were plated on to M10 & N6 media. Only 32 calli were produced. No green plants were obtained. Fifteen (15) cross were done for further anther culture for salt tolerant rice development. From those crosses a total of 709 F1 seeds were harvested for further anther culture.	Salt tolerant rice lines will be developed.

	Expt.1.3 Development of premium quality rice variety through anther culture About 15189 and 10468 F_1 anthers were plated in N6 and M10 media. Among them 181 calli and 115 albino plants were produced but no green plants were regenerated. During T. Aman 2018, a total of 280 F_1 seeds were harvested from eight (8) crosses for future anther culture program.	Aromatic and fine grain rice lines will be developed.
	Expt. 1.4 Development of Aus rice variety through anther culture A total of 177 F_1 seeds were harvested from five crosses for further anther culture.	Short duration, high yielding Aus rice variety will be developed.
	Expt 1.5 Development of antioxidant enriched black rice variety A total of 4431 hybrid anthers from six crosses were plated in N6 media. In total 12 calli were obtained from three crosses. A total of 516 F_1 seeds were harvested from nine crosses for future anther culture program	Antioxidant enriched black rice variety will be developed.
2	**Project II: Development of rice variety through somaclonal variation**	
	Exp 2.1 Development of somaclone using EMS treated rice seed During Aus and T. Aman 2018, a total of 542 and 66 and 48 EMS treated somaclonal plants (M_1SC_3) were selected from BRRI dhan48, BR11 and, Tilbajal respectively. On the other hand during Boro 2018-19, a total of 32, 10, 240 and 8 somaclones were selected from BRRI dhan28, BRRI dhan29, BRRI dhan86 and BRRI dhan92 respectively.	High yielding rice variety for Aus, Aman and Boro will be created develop through somaclonal variation.
	Exp 2.2 Development of high yielding Aus variety through somaclonal variation A total of 39 somaclonal lines (SC3) of BRRIdhan48 were evaluated during Aus 2018. From them 81 plants were selected. Eighteen fixed somaclonal lines were evaluated as OT during Aus season 2018. From them nine lines were selected and these lines are being evaluating as PYT, 2019.	High yielding Aus variety will be developed.
	Exp 2.3 Improvement of BRRI dhan47 through somclonal variation During Boro 2018-2019 five (5) SC_4 somaclone lines developed from BRRI dhan47 were evaluated as PYT. Among them three	Shattering reduced BRRI dhan47 will be created.

	lines were selected. Moreover, ten (10) SC_4 somaclone lines developed from BRRI dhan47 were grown as OT in Boro 2018-2019. Among them three lines were selected.	
	Exp 2.4 Development of antioxidant enriched rice variety through somaclonal variation A total of 140 (SC_2) plants were selected from 37 lines (SC_1) plants.	Antioxidant enriched high yielding somaclonal modern rice varieties will be developed.
3	**Project III: Field evaluation of tissue culture derived advanced breeding lines.**	
	Expt. 3 .1 Progeny selection A total of 39 somaclone lines (SC_3) developed from BRRI dhan48 were evaluated during Aus season. From them the 81 plants were selected for further evaluation. During Boro/2018-19, 201 plants were selected and 31 lines were bulked from 322 pedigree lines for further evaluation. Six(s) anther culture derived rice lines for low GI and four(s) anther culture derived rice lines for premium quality rice were grown for generation advancement,. **Expt. 3.2 Observational trails** During Boro2018-19, 23 anther culture derived doubled haploid lines were evaluated in two OT with standard checks to select agronomically desirable and high yield potential materials. Among them seven (7) lines were selected depending on the duration and comparable yield with checks for further evaluation **Expt. 3.3 Preliminary Yield Trial** During T. Aman/2018, 5 advanced breeding materials were evaluated in PYT with standard checks. Three (3) lines were selected for further evaluation. During T. Aman/2018, six doubled haploid lines were evaluated with standard checks in a PYT. Among them none was selected. During Boro 2017-18, six anther culture derived doubled haploid lines were evaluated in one PYT with standard checks. Among them four (4) lines were selected depending on the duration and comparable yield with checks for further evaluation. **Expt. 3.5 Regional Yield Trial** Two advanced materials from identification of salt QTL were evaluated at 9 regional levels during T. Aman/2018 as RYT-1.	New rice variety will be developed from these lines Short duration Boro rice variety will be developed from this study.

	None breeding lines were selected. Three advanced materials from yield enhancement QTL were evaluated at 9 regional levels during T Aman/2018 as RYT-2. Two lines were selected	
4	**Project IV: Development of rice variety through wide hybridization**	
	Expt 4.1 Development of rice variety through wide hybridization followed by embryo rescue Seven (7) wide crosses were done. In total 6 plants were regenerated through embryo rescue technique from four wide cross. Embryo rescued plants were backcrossed with high yielding rice variety. A total of 295 F_1 seeds were collected from twelve different wide crosses for further backcrossing. A total of 144 BC_1F_1 seeds were harvested from embryo rescued plants of three different wide crosses for further backcrossing. 34 rice lines of different generations were selected from four different wide crosses for further evaluation.	Different stress tolerant rice variety will be developed through wide hybridization
5	**Project V: Rice transformation studies**	
	Expt.5.1 Development of salt tolerant transgenic rice BRRI dhan29 was transformed with salt tolerant genes (*GlyI and GlyII)* and five (5) plants were confirmed by both *GlyI* and *GlyII* gene specific primer. T_1 putative transformants were also confirmed by gene specific primer and sequencing.	Salt tolerant rice lines will be developed through genetic transformation.
	Expt.5.2: Introgression of salt tolerant mangrove gene Salt tolerant AeMDHAR (from mangrove plant) gene containing MT24 rice genotype was crossed with BRRI dhan28, BRRI dhan29, BRRI dhan67, BRRI dhan86 and BINA dhan10 to introgress AeMDHAR gene into them. After F_1 confirmation backcrosses were made and Five BC_1F_1 plants were confirmed by gene specific primer	Salt tolerant rice lines will be developed through genetic transformation.
6	**Project VI: Allele Mining**	
	Expt 6.1 Identification of yield enhancement QTLs Three advanced materials from yield enhancement QTL were evaluated at 9 regional levels during T Aman/2018 as RYT-2. Two materials were selected.	High yielding rice varieties will be developed.
	Expt 6.2 Identification of QTLs for salinity tolerance both at seedling and reproductive stage Two advanced materials from identification of salt QTL were evaluated at 9 regional levels during T. Aman/2018 as RYT-1.	QTLs for salt tolerance both at seedling and reproductive stage will

	None was selected.	be identified and high yielding rice varieties will be developed.
	Expt 6.3 Identification of QTLs for taller seedling height QTL mapping population was developed by crossing between BRRIdhan11/Shadamota (acc.no.1576). Parental polymorphism survey was carried out and a total of 125 SSR markers were identified as polymorphic. DNA extracted from leaf of F_2 population consisting with 185 individual. Genotyping was done using 7 polymorphic primers of F_2 population consisting of 185 individuals.	QTLs for taller seedling height will be identified for developing tidal submergence tolerant rice variety.
7	**Project VII: Gene Pyramiding**	
	Expt 7.1 Gene pyramiding for resistance to bacterial blight (BB) During Boro/2017-18, nine advanced breeding lines were tested along with standard checks in a PYT. Among them five lines were selected depending on yield performance and duration. Bacterial Blight (BB) gene pyramided three BRRI dhan29 rice lines were evaluated in ALART during Boro 2017-18 with standard checks conducted by Adaptive Research Division, BRRI at 10 locations. Among them one was selected for PVT.	Breeding lines possessing multiple BB resistance genes will be developed through Marker Assisted Selection
	Ex.7.2 Validation of a simple functional marker for fragrance in non-Basmati fragrant rice varieties Aroma detection was carried out with 41 F_2 progenies of BRRI dhan28 and Kalizira cross by panel test and genotyping to differentiate aromatic and non aromatic progenies. 41 selected F_2 progenies were screened against functional marker of fragrance gene *BADH2.* Among them 9 were identified as aromatic and 32 were non aromatic. On the other hand, 10 progenies were found aromatic and 31 were non aromatic when used KOH for aroma testing. One aromatic line amplified like non aromatic genotype that might be the presence of another mutation other than 8bp deletion of exon 7 on chromosome 8.	
8	**Project VIII: Gene Cloning**	
	Expt 8.1 Isolation and cloning of salt tolerant gene cDNA was synthesized from RNA of treated *P. coarctata* and amplified with vacuolar ATPase (PVA) primer followed by sequence analysis. Sequence of amplified PCR products was 99% identical with *Vacuolar ATPase (PVA)* of *Porteresia coarctata.* After confirmation, PCR product was then clone into	Salt and drought tolerant genes will be isolated and cloning

	TOPO TA cloning vector and confirmed by PCR. Gateway cloning technique was used for construct preparation followed by transformation into *Agrobacterium* LBA4404.	

CROP SOIL WATER MANAGEMENT PROGRAM AREA

Agronomy Division

Research Progress, 2018-2019

Sl. No.	*Programme area (Duration)*	*Research progress*
Planting Practices		
1	Effect of time of planting on growth and yield of advanced lines during T. Aus season (Aus 2018)	In T. Aus 2018, BR9011-67-4-1 produced the highest grain yield (4.47-5.22 t ha^{-1}) compared to check variety BR26 planted on 24 May to 8 June and matured within 103-108 days.
2	Effect of time of planting on growth and yield of advanced lines during T. Aman season (T. Aman 2018)	In T. Aman 2018, advanced breeding lines BR8189-10-2-3-1-5-RAN7 and BR10238-5-1-RAN6 produced significantly higher grain yield (4.82-5.32 t ha^{-1}) than check variety BRRI dhan52 (3.03-4.95 t ha^{-1}) in different time of planting in Rangpur. Zinc enriched lines (ZER), BR8442-12-1-3-1-B5 produced the highest grain yield (5.19-5.39 t ha^{-1}) over check variety BRRI dhan72 (4.74-4.84 t ha^{-1}) up to 11 August planting and it matured within 136-141 days. Advanced breeding lines BR(Bio)8961-AC22-14 and BR(Bio)8961-AC22-16 produced significantly higher grain yield (5.39 t ha^{-1}) over check variety BRRI dhan49 (4.74 t ha^{-1}) up to 11 August planting with similar growth duration. None of the promising line from rainfed lowland rice performed better than check variety irrespective of planting dates.
3	Effect of time of planting on growth and yield of advanced lines in Boro season (Boro 2018-19)	In Boro 2018-19, none of the promising lines (FBR & PQR) performed better than ck. varieties. ZER lines, BR8631-12-3-5-P2 and BR8631-12-3-6-P3 gave higher grain yield (6.19 t ha^{-1}) than

		check variety BRRI dhan74 (4.86 t ha^{-1}) only at 9 January planting with similar growth duration (146-148 days) under ALART. Under ALART (Favorable Boro) of Biotech, BR(Bio)9777-26-4-3 and BR(Bio)9777-118-6-4 gave higher grain yield (6.71-8.20 t ha^{-1}) over check variety BRRI dhan58 (5.19-6.06 t ha^{-1}) up to 9 January planting and matured within 153-160 days. BR (Bio) 9777-26-4-3 line produced 7.07 t ha^{-1} grain yield with growth duration 147 days even when planted on 24 January.
Fertilizer Management		
1	Nitrogen management for BRRI dhan71 with aged seedlings at variable time of planting	In T. Aman season, BRRI dhan71 performed better in 15 July planting. Soil test basis nitrogen (87 kg ha^{-1}) gave higher yield (4.65-6.06t ha^{-1}) than BRRI recommended dose (70 kg ha^{-1})of nitrogen (4.32-5.22 t ha^{-1}) in all planting date (15 July, 30 July and 15 August). Forty-day-old seedlings gave satisfactory yield when nitrogen applied in soil test based.
2	Effect of N management at the reproductive phase of rice	Application of 69 kg N ha^{-1} ($^1/_3$ as basal + $^1/_3$ at 15 DAT + $^1/_3$ at BPI) followed by 69 kg N ha^{-1} (29.5 kg as basal + 29.5 kg at 15 DAT + 10 kg ha^{-1} at heading) would be a better option for higher yield 5.32 t ha^{-1} by reducing sterility% in T. Aman rice.
Weed Management		
1	Screening of rice varieties for weed competitiveness	Grain yield of BR17 were 5.05 and 5.06 t ha^{-1} in weedy and unweeded plot respectively at Gazipur and at Kapasia, BR17 obtained 5.06 and 5.64 t ha^{-1} in weedy plots and weed free plots. BRRI dhan45 and BRRI hybrid dhan5, Hybrid mollica and SL8 showed to some extent weed competiveness based on weed population, weed dry matter weight, plant height, initial tillering ability and dry matter weight of crops.
2	Study on bio-efficacy and varietal sensitivity of different herbicides	No phyto-toxicity was observed due to application of herbicide in BRRI dhan28, BRRI dhan29, BRRI dhan58 and BRRI dhan81. Weed management by pre and post emergence

		herbicide effectively control weeds in different varieties. Weed number and dry matter weight was lower in herbicidal treatment. Weed control efficiency (%) was observed 91-96% in 3 hand weeding plots although herbicidal treatment observed 87-93% weed control efficiency.
3	Evaluation of candidate herbicides for transplanted rice	Most of the herbicide obtained more than 80% weed control efficiency in different weed populations observed in the field. *Cynodon dactylon* cannot be control >80% by any herbicide. Among nine groups of herbicide four groups were for post emergence weed control and five were pre emergence weed control.
Yield Maximization		
1	Yield maximization of aromatic rice through integrated nutrient management	Higher grain yield of 5.4 and 5.2 t ha^{-1} was observed in BRRI dhan75 and BRRI dhan70 respectively with 75% BRRI recommended fertilizer dose + 25% N from poultry manure (PM) followed by 5.16 t ha^{-1} grain yield from 75% RRF+ 25% N from vermin-compost in BRRI dhan75 and 5.13 t ha^{-1} grain yield from RRF with DAP in BRRI dhan70.

Irrigation and Water Management Division

Research Progress 2018-2019

Sl. No.	Research Progress	Expected Output
	Sub-Program: Irrigation and Water Management	
Sub-Sub-Program I: Water Use Efficiency Improvement in Irrigated Agriculture		
01	**Water Requirement** ***Experiments:***	

	1.1 Automated Alternate Wetting and Drying Irrigation System for Rice Production **Progress:** The study is ongoing in collaboration with Department of Computer Science and Engineering, United International University (UIU), Bangladesh. The primary objective is to modernize the conventional or manual system of implementation of AWD technology by introducing digital irrigation application system. A sensor-based technique has been adopted for applying water efficiently and properly in AWD irrigation system. Sensors are developed to detect water level in installed PVC pipes. When depth of water level goes below soil surface at expected level, the pump starts automatically. The pump stops automatically when water level in the PVC pipe comes at the desired level above the ground surface. An Arduino pro mini as processing power, sonar sensor for measuring the water level and RF module for communication between field monitoring device and the base station (pump turning on/off) are the components of the automated irrigation system.	The outcomes are expected to reduce irrigation cost by 30%, to increase water productivity and to reduce labor involvement in irrigation as well as introducing digitalization in irrigation system.
	1.2 Optimization of irrigation water use for Boro cultivation under different establishment methods **Progress:** Shifting from continuous standing water (CSW) irrigation to thin irrigation practice (TIP)-Transplanted rice (TP) resulted in 17% water saving. While shifting from CSW irrigation to TIP irrigation, direct seeded (DS) rice resulted in 14% water saving. Alternate wetting and drying (AWD) irrigation saved 7 to 10% water over CSW irrigation. Among all eight treatments the largest (245 mm) water saving was achieved by DS-TIP irrigation compared to TP-CSW irrigation. The result suggests that this amount of water was saved firstly by shifting from TP to DS rice (160 mm) which is attributed to the water saving in land preparation and secondly by shifting from CSW to TIP irrigation (85 mm). Wet direct seeded establishment with thin irrigation practice yielded 5.02 T ha^{-1} rice grain which is to some extent comparable to the yield achieved by transplanted rice with AWD irrigation (5.04 T ha^{-1}).	Thin irrigation practice with wet direct seeding was found better for both irrigation water saving and satisfactory yield. Dry direct seeding was found better for all the water management practices.
	1.3 Study on water stress tolerance for different advanced rice genotype of BRRI **Progress:** Two ALART material BR(Bio)8961-AC22-14 and	Both the ALART lines and BRRI dhan49 have water

	BR(Bio)8961-AC26-16 along with a check variety BRRI dhan49 evaluated for their yield response to water stress in Aman season. Higher grain yield of two ALART lines and BRRI dhan49 was observed at water stress -10 kPa matric potential. But when the water stress increased to -30 kPa the yield reduction was 37 to 67% compared to yield at -10 kPa. At matric potential -60 kPa, the yield was further reduced to 62 to 71% compared to the yield a -10 kPa.	stress tolerance capacity of -10 kPa. BR(Bio)8961-AC26-16 performed better than LARTBR(Bio)8961-AC22-14 and BRRI dhan49 in terms of yield at -10 kPa.
Sub- Sub Program II: Utilization of Water Resources in Rainfed Environment		
02	**Water Management for rice cultivation in climate change environment** ***Experiments:***	
	2.1 Agricultural drought forecasting for mitigating drought in T. Aman rice **Progress:** Treatment without supplemental irrigation gave lower yield (4.08 t/ha) compare to the yield (5.20 t/ha) under treatment with supplemental irrigation based on drought forecasting using Toufiq's model and yield (5.46 t/ha) under treatment with supplemental irrigation based on field monitoring of perched water table.	Variation of drought forecasting using model and field monitoring was 10%. Supplemental irrigation based on both using model and field monitoring gave similar rice yield.
Sub- Sub Program III: Land and Water Resources Use for Sustainable Crop Production		
03	**Land and Water Resources Use for Sustainable Crop Production** ***Experiments:***	
	3.1 Water resources assessment for dry season crop cultivation in selected polders of coastal region **Progress:** The study was conducted in polder number 43/1 situated at Amtali, Barguna to delineate suitable water resources during dry season and to determine the amount of fresh water available during the period. The peripheral length of the polder is about 66.9 km and the total area enclosed by the polder is 13,539 ha. Total 151 km long primary and secondary canals were surveyed in polder 43/1. Among the surveyed canal 11.1 km long canal was affected by salinity	There is a large possibility of dry season crop cultivation using canal water in polder 43/1.

	ranges from 1-2.2 dS m^{-1}. Total stored water was 7414503 m^3 in April which can be used to irrigate 4878 ha, 1800 ha and 634 ha of land for Sunflower, Maize and Boro rice cultivation, respectively.	
	3.2 Assessment of suitable water resources availability for irrigation to increase crop production in tidal areas of Barishal region **Progress:** A continued study was taken to identify suitable water resources for dry season crop production in the Barishal division. Four major river systems were: Tentulia, Buriswar, Biskhali and Boleswar. Water samples were collected from the rivers in different locations. to measure the electrical conductivity. The water salinity in the upstream of the saline sweet-water interface of Boleswar, Bishkhali, Buriswar and Tentulia river was close to 1 dS/m during the dry season of 2018-19. The saline-sweet water interface is located at 34 km for Boleswar river, 24 Km for Bishkhali river, 18 km for Buriswar river, and 17 km for Tentulia river from the respected estuaries. The maximum electrical conductivity in Boleswar river at Chotomasua, Mothbaria was found as 2.287dS/m.	Water from the upstream side of the interface was suitable for irrigation during dry season. The adjacent area of the rivers could be used for irrigated crop production.
	3.3 Use of less saline water resources for increasing cropping intensity in Barisal region **Progress:** This experiment was conducted at Bakerganj, Barisal, Nolcity and Sadarupazila of Jhalokathi district during 2018-19 to bring fallow land under Boro cultivation and to improve water and land productivity in the region by technology intervention such as low lift pump, plastic pipe distribution system and AWD technology. Boro cultivation was done using fresh tidal water from canal. A total of 7.3 ha of fallow lands were brought under cultivation by BRRI dhan47, BRRI dhan58, BRRI dhan67 and BRRI dhan74.The water salinity was measured in both locations throughout the period and was less than 0.5dS/m, which is very suitable for irrigation. Water was available in the canal during the whole season. In Nolcity, Jhalokati, the highest 18 numbers of irrigation (1050 mm) was applied in BRRI dhan58. Enough water was present in the canal during the whole growing period to irrigate more fields. In Nolcity, Jhalokati, BRRI dhan74 gave the highest yield of 6.3 t/ha. In Jhalokathi sadar, BRRI dhan74 gave the higher yield of 6.1t/ha. In Bakergonj BRRI dhan 74 performed the best among the four varieties.	Enough water is available round the year in the canals of Barishal region. Salinity of these water remains in permissible limit for irrigation. There is a large scope of crop intensification through boro rice cultivation.
Sub- Sub Program IV: Sustainable Management of Groundwater		

04	**Surface and Ground Water Assessment** ***Experiments:***	
	4.1 Monitoring of groundwater fluctuation and safe utilization in different geo-hydrological regions **Progress:** In this study, available water level recorder was used for measuring groundwater fluctuation in BRRI Gazipur and all regional stations. Data were recorded weekly. Weekly records were calculated to obtain monthly average. Monthly groundwater level fluctuations at Gazipur suggest that maximum lowering of groundwater (41.94 m) was observed in April and minimum (37.08 m) in May. The fluctuation was within 4.86 m. The fluctuation was lower than the previous year due to early start rainy season. In 1998 the maximum groundwater level was about 11.68 m from the ground surface which was 41.94 m in 2018. So, the lowering was about 30.26 m in last 21 years. During the initial five years, the lowering rate was not so high, and it was only 2.89 m. But during last five years (2013- 2018) the lowering was about 9.46 m. Groundwater levels in the southern areas (Bhanga, Faridpur and Barishal) were within the suction limit of STW (8 m), whereas, in Rajshahi that goes below suction limit at peak irrigation period. In Habiganj, GW level was in critical level of STW suction limit.	Within 21 years, groundwater level at Gazipur declined more than 30 m. Groundwater level in Bhanga, Faridpur and Barishal were within the suction limit but at Rajshahi the Groundwater was below the suction limit.
Sub- Sub Program V: RENEWABLE ENERGY		
05	**RENEWABLE ENERGY** ***Experiments:***	
	5.1 Evaluation of smallholder surface water solar irrigation system for crop production **Progress:** BRRI IWMD have designed and implemented a portable type 2.56 kW solar panel that can run a 2 HP irrigation pump comfortably at BRRI Farm, Gazipur during 2018-19. The panel is provided a foldable facility to reduce surface area of the panel for easy movement from place to place. This 2-HP solar pump had a discharge of 5-8 liter/sec even at a suction lift of 6.73 m (surface water) and average operating hours found ranging from 7.48 to 7.53 when delivery head is constant. Average operating times were found between 8.06 to 8.31 hours, when the suction head was constant. The test results were obtained in the month of October and November, 2018. As an additional activity, the solar system could operate a 1.5 kW BRRI open drum paddy thresher at a rate 250-350 kg paddy/hr. On the other hand, it can generate about 7-10 KWHr energy per day when it is	BRRI developed portable solar pump system is suitable for surface water irrigation. In the off-season it can be used to operate small agricultural equipments. It can be also used in on grid solar home system and contribute to electricity in the grid line.

	connected in on-grid at off season.	
Sub-Sub Program VI: Water Management Technologies Demonstration and Dissemination at Farmers' Field		
06	**Technology Validation in the Farmers' Field** ***Experiments:***	
	6.1 Evaluation of different mulching materials in rice under saline areas **Progress:** The study was conducted at Dacope, Khulna and Amtali, Barguna during the dry season of 2018-19. The experiment involved five mulching treatments viz. No mulch, mulching with ash, mulching with saw dust, mulching with rich husk and mulching with rich straw. Measured quantities of irrigation water with flow meter were applied directly to the experimental plots. The highest grain yield was found in ash mulching and the lowest grain yield was found in saw dust mulching in both the locations. It was observed that the saw dust might have developed toxicity in the field after application and in both the location the water colour became red and crop appeared to be stunted. Ash mulching treatment produced comparatively higher yield in both the location. This could be attributed due to higher potassium content in ash, which may also reduce the salinity effect from rice field.	Ash mulching showed 3.25 to 7.35% yield advantage over the conventional no mulching treatment.
	6.2 Salinity dynamics of water in coastal areas of Bangladesh **Progress:** This study was conducted at Dacope, Khulna and Amtali, Barguna during 2016 to 2019 to determine salinity level of the river and groundwater in project sites. Soil salinity from rice field was measured weekly and non-rice field was measured at 15 days intervals after transplanting at 0-15, 15-30, 30-45 and 45-60 cm soil depth. Based on the three years monitoring data (2016-19), average salinity of the river water remained below 1.0 dS/m up to December and is considered highly suitable for irrigating crops in both the locations. Even river water remained suitable (<4.0 dS/m) for irrigation up to end of December. After that the river water salinity gradually increased and at the end of Rabi/Boro season it reached about 24 dS/m. The canal water was trapped within December at the period of high tide making canal water salinity of about 1.0 dS/m. Its salinity increased in a slower rate and reached up to 3 dS/m in May due to evaporation and influence of groundwater flow. Generally, average groundwater level and salinity at Pankhali, Dacope varied between 0.04-1.09 m below the field surface and 0.4-2.9 dS/m, respectively. The lowest value	Fresh river water entrapping into the existing canals of polder areas was found suitable for dry season crop cultivation in Dacope, Khulna areas.

	prevailed (about 0.4 dS/m) from July to November and the highest (2.9 dS/m) from April to May. In Dacope, groundwater salinity remained less than 4.0 dS/m and is considered suitable for irrigation development. Average groundwater level at Sekandarkhali, Amtali varied between 0.8 to 1.8 m from ground surface and groundwater salinity at 3.24 to 10.8 dS/m. The lowest value of 3.24 dS/m was observed in November-December and the highest value of 10.8 dS/m in May-June.	
	6.3 Technological interventions for improving water use efficiency in the northwest region of Bangladesh **Progress:** Results shows that use of polythene pipe irrigation water distribution system was found effective for minimizing conveyance loss of water. It may reduce water supply by 20-25% and saves irrigation time by 25%. There was no problem of STW operation in Pabna, Rangpur and Thakurgaon as the groundwater level did not drop below the suction limit. Only in Bogura water level fell below the suction limit (8.8 m) whereas deep set STW was needed for pumping of water. AWD technique for irrigation scheduling was found effective for reduction in irrigation water supply by about 14-18% in Boro rice. Overall water productivity in traditional farmers practice varied from 0.69 to 0.73 kg/m3 and that of AWD varied from 0.81 to 0.83 kg/m3. AWD irrigation method reduces 160 kg CO2/ha emission and reduced 23-36% methane flux emission from rice field compared to continuous flooding. The yield of newly released high yielding varieties varied from 4.53 – 9.88 t/ha and the farmers' choice of the variety depends upon the yield, grain quality, growth duration and price of local market.	Mass adoption of water saving technology by the farmers will reduce significant amount of irrigation water pumping, fuel use and cost of irrigation in some areas. It will also reduce the greenhouse gas emission. The study recommends field level training and demonstration of Polythene pipe distribution system and AWD to motivate the farmer for wide-scale adoption of these technologies.

PLANT PHYSIOLOGY DIVISION

Research progress 2018-2019

Sl. No.	Research Progress	Expected output
	Program area/Project (Duration)	
Project 1: Salinity tolerance		
1.1	**Exploring new sources of salinity tolerance from BRRI Gene Bank collections at seedling stage**	Four hundred thirteen germplasm along with standard tolerant IR58443 and sensitive check IRRI154 were screened according to Gregario et. al., (1997) at the seedling stage, and out of tested germplasm, 17 (Acc. No. 2009, 2011,

		2037, 2046, 2833, 2834, 2838, 2845, 2846, 2862, 2863, 2865, 2924, 2961, 3003 and 3004) were found moderately tolerant (SES score and survivability ranged from 4.5 -5.0 and 60 - 100% respectively).
1.2	Screening of advanced breeding materials for salinity tolerance at seedling stage	**IRSSTN Materials (Plant Breeding Division):** Among eighty five (85) genotypes seven genotypes were found tolerant to moderately tolerant (SES 3-5 and survivability percentage 90-100%) **Advance line and Soma clonal line (Biotechnology Division):** Among fourteen (14) lines none of the genotypes found tolerant to salinity (SES 6.5-9, Survivability 0-66 %)
1.3	Re-mapping QTLs for salinity tolerance of Ashfal balam at reproductive stage	A total of 20 significant QTLs were identified for salinity at reproductive phase. But one cluster of QTL in chromosome 6 was found consistent for filled grain number, filled grain weight and spikelet fertility traits with R2 ranged from 47.89%-51.68%, which could be prime target for developing future reproductive phase salinity tolerance from Ashfal balam.
Project 2: Submergence tolerance		
2.1	Identification of rice germplasm for two weeks flash flood submergence tolerance	Out of 114 germplasm one germplasm (Acc. No. 1028) found tolerant (SES score 1) with 100 percent survivability. Seven germplasm (Acc. No. 1002, 1011, 1012, 1029, 1030, 1042, 1061) found moderately tolerant with SES score 5 and survivability ranges were 77-92%.
2.2	Identification of breeding lines for flash flood submergence tolerance	Out of 250 advance breeding lines two PVS (IR13F441, IR 92704-SUB-SUB-140-2-B) lines performed better compared to check (BINA dhan12, BRRI dhan51, BRRI dhan52 and BRRI dhan79).
2.3	Impact of Submergence duration on growth and yield of Submergence tolerant BRRI varieties.	There are no significant GD and yield differences found for 7 days submerged and normal environmental condition. Plant mortality rate also found minimum. BRRI dhan52 required 10 and 16 days more to mature at 14 and 18 days submerged condition respectively, than normal condition. Irrespective of variety the survivability and yield reduction was 90 to 70% and 20 to 50% at 14 and 18 days submerged condition respectively. BRRI dhan79 had more than 80%

		survivability at 18 days submerged condition but the yield reduction and growth were similar to BRRI dhan52.
2.4	Screening for stagnant flooding tolerance of advance breeding lines and germplasm at whole growth period during T. Aman season	Among the genotypes three (3) advance breeding line namely IR 13F458-5, IR 13F458-1 and IR 13F712-5 were found moderately tolerant. Among 27 varieties 5 varieties found moderately tolerant viz. BRRI dhan46, BRRI dhan33, BRRI dhan53, BR23 and BR10.
Project 3: Drought tolerance		
3.1	Screening germplasm for drought tolerance at reproductive phase	Out of 200 germplasm, 13 genotypes showed best performance in relation to yield under drought stress at reproductive phase.
3.2	Evaluation of previously selected germplasm under drought stress at reproductive phase in the rain-out shelter	Out of 33 germplasm BRRI Gene Bank Acc. no 1353 yielded highest followed by Acc. no 1434 and 1069 which have 1 to 5 tolerance score in previous year in the field that reveals a positive correlation with field performance.
3.3	Physiological and biochemical characterization of advance breeding lines under drought stress at reproductive phase	Out of 6 RYT materials IR96321-1099-402-B-4-1-2 performed better followed by IR96321-1447-428-B-1-1-1.
3.4	Evaluation of previously selected germplasm under drought stress at reproductive phase in the rain-out shelter	Out of 33 germplasm BRRI Gene Bank Acc. no 1353 yielded highest followed by Acc. no 1434 and 1069 which have 1 to 5 tolerance score in previous year in the field that reveals a positive correlation with field performance.
Project 4: Heat tolerance		
4.1	Generation advance and selection of progenies of spikelet fertility introgression lines at BC3F3 stage of BRRI dhan28 and BRRI dhan29 background	During T. aman season-2018 head to row of previously selected plants were grown and 41 plants (BRRI dhan28 x N22) and 50 plants (BRRI dhan29 x N22) were selected. During Boro-2019 season head to row of previously selected materials were grown and 17 plants (BRRI dhan28 x N22) and 24 plants (BRRI dhan29 x N22) were selected.
4.2	Screening rice germplasm and breeding lines for heat tolerance	Among the 50 germplasm 22 scored 5 and 3 scored 3. BRRI Acc. nos. 1206, 1214, 1216, 1280, 1281, 1282, 1285, 1289, 1291, 1293, 1294, 1469, 1471, 1475, 1478, 1320, 1322, 1524, 1526, 1551, 1553, 1567 showed 41 to

		60% spikelet fertility under heat stress condition and got score 5 and Acc. nos. 1522, 1523, 1527 showed more than 61% fertility and scored 3.
Project 5: Cold tolerance		
5.1	Exploring new sources of cold tolerance from BRRI Gene Bank collections at seedling stage	Among the tested rice genotypes, BRRI dhan67, an exotic rice genotype Koshihikari, 33 BRRI GeneBank Germplasm and 21 advanced rice genotypes showed moderate level of cold tolerant at seedling stage
5.2	Screening for seedling stage cold tolerance of advanced breeding lines	Out of six advanced rice genotypes BR8562-11-2-6-1-1-1 and BR(Bio)9777-124-1-1-2 showed moderate level of cold tolerance. Other advanced lines were susceptible.
5.3	Characterization and evaluation of some selected rice genotypes for cold tolerance	Only five genotypes TP7594, TP16199, BR8907-B-1-2-CS1-4-CS2-P3, BR8562-11-2-6-1-1-1 and BR(Bio)9777-124-1-1-2 out of 17 genotypes were found as moderately cold tolerant at reproductive phase
Project 6: Growth studies		
6.1	Response to photoperiod of some BRRI released modern T. Aman varieties and IRRI advance line	On the basis of relative photoperiod sensitivity (RSP) BRRI dhan78, BRRI dhan79, BRRI dhan80 and BRRI dhan87 are weakly photoperiod-sensitive. BRRI dhan51, BRRI dhan52 are moderately photoperiod-sensitive and BRRI dhan75 is photoperiod insensitive. Among the three breeding lines IR92704 is moderately photoperiod sensitive and rest two (IR92466, IR13F441) are weakly photoperiod sensitive.
Project 7: Yield potential		
7.1	Physiological characterization for morpho-physiological traits of rice for improving yield potential of current high-yielding ideotype	Two experiments conducted during Boro (2017-18) and T. Aman (2018) season considering 20 and 10 genotypes respectively. Results showed that panicle dry weight (PDW), Harvest index (HI) and total dry matter (TDM) showed significant and positive relationships to the yield revealing these traits could be important for considering yield improvement.

Project 8: Crop Weather Information		
8.1	Automatic weather station data recording, transfer, storage and maintenance	Data were recorded and storage accordingly.
8.2	Manual weather station data recording, transfer, storage and maintenance	Data were recorded and storage accordingly.

Soil Science Division

Research Progress 2018-19

Research Progress	Expected output
Program Area: Crop-Soil-Water Management	
Project 1: Fertility Assessment of Rice Soils and Nutrient use efficiency in rice	
Expt.1.1. Determination of N dose for ALART materials This study was aimed to assess optimum N doses by evolving N response curves for a group (premium quality rice/PQR, favorable Boro rice/FBR, and zinc enriched rice/ZER) ALART materials of Boro season. Three individual experiments (1. PQR, 2. FBR-Bitech. div., 3. FBR and ZER) were conducted at three sites of BRRI farm, Gazipur during Boro 2019 season. In all sites, the experiments were laid out in RCB design with five urea-N doses of 40, 80, 120, 160 and 200 kg N ha^{-1} or without (N_0) N fertilizer application. Grain yields responded diversely to applied N rates. . From the N response trial of PQR lines, it is postulated that BR89207-45-2-2 would be worth used as high yielding-N use efficient PQR line, next to recently developed PQR varieties, BRRI dhan81 and BRRI dhan50. Also BR8590-5-2-5-2-1 is possible to utilize as efficient N use PQR line. Out of the studied FBR lines, IR99056-B-B-15 and BR8938-30-2-4-2-1lines required lower N fertilizer and had higher potential to utilize native soil N than check varieties, BRRI dhan28 and BRRI dhan58. Lower optimum N application rate but greater yield of BR (Bio) 9777-118-6-4 is indicative of its potential as efficient N use FBR line. The study on ZER's N response trial demonstrates that BR8631-12-3-5-P2 may employ as efficient N use	Determination of appropriate N rates for some newly released BRRI varieties/ lines for optimum yield.

ZER line over two checks (BRRI dhan28 and BRRI dhan74) without sacrificing yield. The lower grain yield and optimum N rates of BR8631-12-3-6-P3 pointed out its appropriateness as low N input ZER line but with sacrificing yield.	
Expt.1.2. Determination of N dose for modern rice varieties This experiment was implemented in T. Aman, 2018 and Boro, 2018-19 seasons to find out the optimum N rate for modern rice variety. BRRI dhan75 was used under eight N levels with the application rates of 0, 25, 50, 75, 100, 125, 150 and 175 kg ha^{-1} in T. Aman while in Boro season, six N doses: 0, 40, 80, 120, 160 and 200 kg/ha were tested on BRRI dhan89. The experiment was conducted in a RCB design with three replications. From this experiment it is concluded that, the economically suitable nitrogen application rate for BRRI dhan75 in T. Aman season is 85 kg ha^{-1} and in Boro season for BRRI dhan89 it is 149 kg ha^{-1} under which it will give higher yield.	Determination of appropriate N rates for newly released BRRI varieties for optimum yield.
Expt.1.3. Performance of prilled urea and urea super granule applicators on nitrogen mineralization, grain yield and nitrogen uptake in Boro Rice A field experiment was conducted on validation of prilled urea (PU) and urea super granule (USG) by applicators on yield and nitrogen mineralization in Boro rice 2018-19 at BRRI farm Gazipur (AEZ 28). Four treatment combinations of different N doses and methods of N application were tested to compare urea-N application by PU and USG applicator for rice yield, N mineralization; N uptake and N use efficiency over urea broadcasting. Application of N as PU or USG by applicators has same effect on grain and straw yield. Statistically similar grain yield were observed with N application as PU or USG @ 78 kg N/ha by applicator which were significantly lower than with urea broadcasting @ 135 kg N/ha.	To compare urea-N application by PU and USG applicator for rice yield and N uptake

Expt.1.4. Fertilizer management for premium quality Boro Rice An experiment was conducted at the Soil Science research field at Bangladesh Rice Research Institute, Gazipur, to study the yield and quality of premium quality rice as affected by nutrient management during the period from January to May 2018. The experiment comprised two premium fine rice varieties viz. BRRI dhan50 and BRRI dhan63, four nutrient managements viz. control (no manures and fertilizers), 100% soil test based (STB) chemical fertilizers, cowdung at 2.5 t $ha^{-1}$with 50% of STB dose of chemical fertilizers and 5 t ha^{-1} cowdung. The experiment was laid out in a randomized complete block design with three replications. The two varieties performed similar in terms of yield and other parameters at same fertilizer management. The grain and straw yield were higher in 100% STB treatment followed by INM based treatment in both varieties although INM can save around 50% chemical fertilizer and less hazardous for environment.	Determination of appropriate fertilizer management for premium quality Boro Rice for optimum yield and quality.
Expt.1.5. Nutrient management for growing four crops in a year	
The experiment was initiated with three fertilizer treatments e.g. AEZ based fertilizer, crop residues (CR) + AEZ based fertilizer and native nutrients were tested with two cropping patterns like Mustard-Boro-T. Aus-T. Aman (CP1) and Mustard-Green gram-T. Aus-T. Aman (CP2). In the first, second and third crop cycle, AEZ based chemical fertilizer seems to be enough for obtaining potential yield of each crop in both patterns. In all cases, incorporation of crop residue performed better than chemical fertilizer alone.	Appropriate integrated nutrient management packages will be developed for triple and four crops based cropping patterns.
Expt.1.6. Influence of nitrogen and potassium rates on performance of modern rice A five years study was conducted from T. Aman 2014 to Boro 2019 at BRRI farm, Gazipur (AEZ 28). Five doses of K (0, 50, 100, 150 and 200 kg ha^{-1}) in the main plot and four doses of N (0, 50, 75 and 100 kg ha^{-1} in T. Aman and 0, 100, 120 and 140 kg ha^{-1} in Boro) in the subplots were tested	Suitable ratio of N and K for MV rice cultivation will be developed with N and K dynamics in soil and

for three years with BRRI dhan49 and BRRI dhan29, respectively. After that it was tested with BRRI dhan72 and BRRI dhan74 in T. Aman and Boro season respectively. Split-plot design was utilized with three replications. A combination of 50 kg K and 50 kg N in T.Aman seems to be suitable for desired grain (5.20tha^{-1}) and straw yield (8.68 tha^{-1}). A combination of 100 kg K ha^{-1} and 120 kg N ha^{-1} was enough for 6.03 t ha^{-1} rice grains, while highest grain (6.40 t ha^{-1}) and straw yield (4.73 t ha^{-1}) was recorded with a combination of 100 kg K ha^{-1} and 140 kg N ha^{-1}in Boro.	plant.
Expt.1.7.Performence of rice varieties under P deficit conditions An experiment was conducted at BRRI farm, Gazipur during Boro 2018-19 having different levels of soil available P. Soil available P were grouped into four where each level had three plots considered as three replications. The soil available P levels were considered as main plots. Soil available P groups were 1.70-2.30, 2.31-2.90, 2.91-3.50 and 3.51-4.10 mg kg^{-1} in dry season. In sub-plots, 0 and 20 kg ha^{-1}P fertilizer doses were arranged. In dry season, BRRI dhan89 was used as tested genotype. Imbalanced nutrient concentrations in grains and straw were observed due to P deficiency in soil. Soil P affected rice yield and plant nutrition more in dry season than wet season. Soil P deficit conditions largely influence grain and straw yields and other yield parameters of rice. However, despite the variations in soil P levels, application of recommended dose of P fertilizer might be useful to recover yield loss. Soil P affected rice yield and plant nutrition more in dry season than wet season.	The more P efficient varieties will be identified by investigating the performance of MV rice under different soil P levels
Expt.1.8. Micronutrient status of some selected paddy soils of Bangladesh This experiment was conducted to know the micronutrient status of some selected paddy soils of Bangladesh. Soil samples were collected from different location of Gazipur, Habiganj, Bhanga and Rangpur before Boro season. The soil samples were collect from 0-20 cm depth and rice based	Determination of micronutrient some selected paddy soils of Bangladesh

cropping pattern. Total 100 soil samples were collected from different locations. From each location 25 samples were collected. The results showed that Gazipur soils pH, organic carbon (OC) %, Iron(Fe), Manganese (Mn), Copper (Cu) and Zn were ranges from 5.7-6.7, 0.61-1.83%, 106.9-375.9 ppm, 7.90-83.41ppm, 4.40-6.52ppm and 4.81-51.27 ppm respectively; Rangpur soils pH, organic carbon (OC) %, Iron(Fe), Manganise (Mn), Copper (Cu) and Zn were ranges from 6.0-7.1, 0.41-1.67%, 145.3-425.7 ppm, 1.04-5.40ppm, 3.27-5.11ppm and 0.63-4.78 ppm respectively; soils pH, organic carbon (OC) %, Iron(Fe), Manganise (Mn), Copper (Cu) and Zn were ranges from 6.0-7.1, 0.41-1.67%, 145.3-425.7 ppm, 1.04-5.40ppm, 3.27-5.11ppm and 0.63-4.78 ppm respectively; Habigonj soils pH, organic carbon (OC) %, Iron(Fe), Manganise (Mn), Copper (Cu) and Zn were ranges from 4.9-5.8, 0.98-3.76%, 219.5-608.5ppm, 8.65-84.46ppm, 3.51-6.81ppm and 4.31-14.15 ppm respectively; Bhanga soils pH, organic carbon (OC) %, Iron(Fe), Manganise (Mn), Copper (Cu) and Zn were ranges from 6.7-7.2, 1.95-2.72%, 149.1-394.3ppm, 4.04-87.77ppm, 10.8-15.4ppm and 3.47-14.61 ppm respectively.	
Expt.1.9. Delineating of rice yield limiting soil factors for some selected paddy soils. The yield of rice varieties varied with different locations. The variation of yield offers a great opportunity to conduct research and find out indigenous soil nutrient ratios, yield limiting soil factors and the relationship of nutrient ratios with rice yield.Soil samples from 0-20 cm depth were collected from Gazipur (AEZ 28), Habiganj (AEZ 21), Rangpur (AEZ 3) and Bhanga (AEZ 12) using global positioning system (GPS) record along with plot history. Collected samples were analyzed for physical and chemical properties. Organic C and essential plant nutrients were high in these two soil samples compared to Gazipur and Rangpur. In Habiganj (AEZ 21), C:P, N:P and Ca:P ratios were the widest compared to Bhanga (AEZ 12) and Rangpur	Identify the yield limiting soil factors of rice

(AEZ 3). These clearly indicated that soils were deficient in P. Similar ratios of C:P, N:P and Ca:P were also found in Gazipur (AEZ 28) because of lower soil P levels. The C:N ratio ranged from 9.76 to 12.57. The C:K, N:K and P:K ratios were higher in AEZ 28 and AEZ 3 because of lower soil K levels. Our result indicated that grain yield was the lowest in AEZ 28 and AEZ 3 compared to other studied locations, might be because of unfavourable C:N and S:Zn ratios. The lower S:Zn ratio indicates higher soil Zn availability might have affected S uptake and thus reduced rice yield.	
Project 2: Nutritional Problems in Soils	
Expt.2. 1. Long term effect of organic and inorganic nutrients on yield and yield trend of lowland The experiment was initiated on a permanent layout at the BRRI farm, Gazipur since 1985 Boro season. Twelve treatments in RCB design with 4 replications were imposed .From Boro 2000, each plot was sub-divided to include a reverse treatment .Treatments were modified four times adding different organic manure with IPNS systems and splitting K doses. Long-term omission of N, P, K adversely affected rice yield though S and Zn omission had no negative effect on rice yield in Grey Terrace soil of BRRI farm, Gazipur. Long-term application of IPNS based fertilizers showed increasing trend of rice yield, while inorganic fertilizer alone showed yield plateau.	Increased yield and soil health maintenance through balanced fertilization
Expt.2. 2. Long-term missing element trial at BRRI regional station farm in Rangpur Long term nutrient omission trial is an effective tool for identifying the contribution of nutrients in crop production. In order to find the role of major macro and micronutrients a long term field experiment has been running in the BRRI farm, Rangpur since 2015. The experiment includes seven treatments [T_1= Control, T_2=NPKSZn,T_3=PKSZn(-N), T_4=NKSZn(-P), T_5=NPSZn(-K), T_6=NPKZn (-S),T_7=NPKS (-Zn)] whichwere designed in RCB. Rice has been growing in Boro-Fallow-T. Aman cropping pattern.	Identification of yield limiting nutrients of BRRI farm Rangpur by missing element trial

After four cropping year we found that N is the most limiting nutrient for rice growth and yield irrespective of season	
Expt.2. 2. Effect of intensive rice cropping on rice yield under continuous wetland condition Wetland puddled rice culture influences soil properties and yield in the long run. An experiment on continuous wetland rice culture was initiated in 1971 at BRRI, Gazipur and since then it is running. Six fertilizer treatments viz. control (native nutrient), reverse control (NPKSZnCu), NPK, NPKS, NPKSZn and NPKSZnCu has been testing on rice yield and soil health in a rice-rice-rice cropping system. The varieties tested in T. Aus, T. Aman and Boro seasons were BRRI dhan48, BRRIdhan46 and BRRI dhan50, respectively. This was a non-replicated trial. Grain yield in control plot was 1.10 -2 .92 t ha^{-1} irrespective of season in 2018 and annual production was 6.03 t ha^{-1}. Its reversed management i.e. addition of NPKSZnCu fertilizer, resulted in 14.35 t $ha^{-1}yr^{-1}$ grain production, which was slightly higher than complete fertilizer treatment (14.09 t $ha^{-1}yr^{-1}$).	Increased annual rice production in wet land condition and soil health maintenance through balanced fertilization.
Project 3: Integrated nutrient management for intensive rice cropping	
Expt. 3.1. Integrated nutrient management for double and triple rice cropping for maximizing productivity The experiment was initiated in Boro 2008-09 at BRRI HQ farm Gazipur in a clay loam soil. In Boro-Fallow-T.Aman pattern, BRRI dhan58 and BRRI dhan49 were used. In Boro-T.Aus-T.Aman pattern, BRRI dhan74, BRRI dhan48 and BRRI dhan46 were included as test variety. Fertilizers used were: T_1=control, T_2=STB dose (NPKS @ 160-25-60-20 kg ha^{-1} for Boro, 70-12-48-10 kg ha^{-1} for T. Aus and 84-15-54-14 kg ha^{-1} for T. Aman), T_3= STB (50%) + MM (CD @ 2 t ha^{-1} + ash @ 1 t ha^{-1} oven dried), T_4= FP (NPKS @ 80-10-20-10 kg ha^{-1} for Boro, 70-10-15-0 kg ha^{-1} for T. Aus and 70-10-15-0 kg ha^{-1} for T. Aman). The experiment was laid out in RCB design with three replications.	Sustainable soil health and productivity ensured by nutrient and cropping pattern management.

In Boro 2017-18 and T. Aman 2018 under double cropping pattern, 50% STB + MM fertilizer dose produced significant higher grain yield than 100% STB fertilizer dose. But under triple cropping pattern 100% STB and 50% STB + MM fertilizer dose produced statistically similar grain yield in Boro 2017-18, T.Aus 2018 and T.Aman 2018. However in double and triple rice cropping pattern, all treatments produced significantly higher grain yield than native nutrient. In T.Aman 2018 under double and triple cropping pattern insignificant yield difference were observed between 100% STB and FP fertilizer dose. But in Boro 2017-18 under double and triple cropping pattern, 100% STB fertilizer dose produced significant higher yield than FP fertilizer dose. Cumulative yield of triple cropping was always higher than double rice cropping pattern irrespective of treatments	
Expt. 3.2. Performance of vermicompost and poultry manure on rice yield and soil health The experiment was conducted at BRRI Farm, since Boro, 2015. Poultry manure and VC were used full doses of chemical fertilizer with @ 0.5, 1.0, 1.5, 2.0 and 2+IPNS fertilizer t ha^{-1} and compared with control. The recommendation rates of chemical fertilizers (N-P-K-S-Zn = 138-10-80-5-5kg ha^{-1}). Vermicompost (VC) or Poultry litter at 0.5 t ha^{-1} with full doses of chemical fertilizer could sustain rice productivity and soil health.	Sustainable soil health and productivity through nutrient management.
Project 4:Greenhouse Gas Emission from Rice Field	
Expt. 4.1. **Effects of fertilizer and water management on greenhouse gas emissions, rice yield and nitrogen use efficiency** Field experiments were conducted at BRRI farm, Gazipur (T. Aman 2018 and Boro 2018-19) and farmer's field at Bhaluka, Mymensingh (Boro 2018-19) under both AWD and CSW conditions. Eight treatments were tested for both seasons. Integrated plant nutrient system (IPNS) based organic fertilizers, i.e., poultry litter (PL), vermicompost (VC) was applied before transplanting. For deep placed treatments, urea briquettes (UB) were applied as a single application with first top dressing (TD) of PU (7-10 days	Quantification of CH_4 emissions and nitrogen use efficiency through fertilizer and water management.

after rice transplantation). UB were placed at 7-10 cm below the soil surface between four hills at alternate rows. For Bhaluka, Mymensingh site, conventional farmers practice and AWD conditions were tested for quantifying CH_4 emissions.A closed chamber technique was used to collect gas samples to measure CH_4 emissions. In T. Aman, grain yields recorded in control treatment were 3.5 t ha^{-1} in AWD and 3.4 t ha^{-1} in CSW condition, while in Boro season; it was 3.0 t ha^{-1} in AWD and 3.1 t ha^{-1} in CSW. N fertilizer treatments showed insignificant variation in yield during T. Aman season under both water management practices. Deep placement of UB significantly increased grain yield compared to broadcast PU at similar N rate in Boro season under both water management practices. No significant variations in rice yield were observed among the IPNS based organic amendments in Boro season. However, deep placement of UB remarkably increased total N uptake (TNU) and recovery efficiency of N (RE_N) than that of PU in both seasons. AWD condition significantly reduced cumulative CH_4 emission compared to CSW irrigation regimes in both locations.	
Expt. 4.2 Effect of different organic sources for amelioration of industrial polluted area of Sripur, Gazipur The rice soils of Sripur, Mirzapur and Pirojali were irrigated with contaminated industrial water. Moreover soils of Mirzapur and Pirojali remain under contaminated water for 5-7 months in a year. A benchmark survey was done with 30 rice soil samples of that area and found soils of Sripur, Pirojali and Mirzapur contained high organic matter (>2.5%), high level of Fe (87to 38ppm), Mn (7 to150 ppm), Cu (1 to 7 ppm), and Zn (3 to 65 ppm). Soils of Mirzapur and Pirujali were acidic in nature and pH ranged from 4.95 to 5.88 and 4.42 to 6.0, respectively. A number of 8 field experiments were conducted during Boro 2018-19 in those areas with different organic amendment. Rice grown nearest the contaminated irrigation sources (5-500 m) exhibited Fe toxicity symptom after 30-50 days of transplanting. High organic matter of the soils, exhibited more	Amelioration of industrial polluted area by different organic sources will be developed

amorphous and crystalline Fe^{3+} compounds which might be used as electron acceptors in the submerged condition and resulted more Fe^{2+} toxicity in plant. There were no significant effect of applied biochar and organic matter found on paddy yield. Plant uptake of heavy metals is in progress.	
Project 5: Soil Microbiology and Biofertilizer	
Expt. 5.1. Evaluation of bio-organic fertilizer in soil plant system To improve soil health, BRRI has developed "**Bio-organic fertilizer**" with combination of vegetable waste/ degradable kitchen waste (79.5%), rice husk biochar (15%), rock phosphate (5%) and consortium of (10) plant growth promoting bacteria (N_2 fixing bacteria, phosphate solubilizing bacteria (PSB) and indoleacetic acid (IAA) producing bacteria). Rock phosphate (5%) was incorporated, which acts as an alternate of TSP fertilizer. The beneficial bacteria added in biofertilizer are indigenous and isolated from favorable and unfavorable rice ecosystem (drought, saline and acid soil). The results proved that application of bio-organic fertilizer @ 1 t ha^{-1}in Aus and 2 t ha^{-1}during T. Aman and Boro season fulfilled 25-30% urea and 100% TSP fertilizer requirement for rice production and gave statistically similar or higher (0.5 to 1 ton ha^{-1}) grain yield compared to full (100%) chemical fertilizer. Bio-organic fertilizer improved rice yield in saline soil.	Bio-organic fertilizer as a nutrient source in soil plant system soil
Expt. 5.2. Carbon mineralization and global warming as influenced by elevated temperature under various fertilizer managements An experiment was set up in the growth chamber to evaluate the influence of temperature on C mineralization and global warming in organic and chemical fertilizers amended terrace paddy soil. The soil (0-15 cm) was collected from farmer's paddy field at least two seasons $year^{-1}$ for 30 years of Sreeepur, Gazipur. The soil is silt loam. Four treatments i.e. T_1(planted in untreated soil), T_2(planted in soil treated with NPKSZn chemical fertilizers @ 160-20-80-10-1 kg ha^{-1}), T_3(planted in soil treated with IPNS based fertilizers viz. bio-organic fertilizer @ 2 t ha^{-1} + chemical fertilizers)	The temperature effect on nutrient mineralization from INM and chemical fertilizer amended soil will determined

and T_4(unplanted soil) were tested. In each PVC pot, 1.01 kg soil was filled forming a soil core of 10.5 cm height matching the bulk density of 1.15 Mgm^{-3}. Per pot five 14 days old seedlings of BRRI dhan28 was transplanted in a single hill. Regularly monitoring of CO_2, CH_4 and N_2O emission, plant N-uptake and soil mineral N content till 46 days after transplantation (DAT) was done. All pots were continuously flooded by deionized water. During monitoring period, temperature and humidity in growth chamber ranged from 31 to 51ºC and 4 to 64%, respectively. However, the temperature is rapidly rising and the country is facing higher temperature of up to 38º C in recent years. Regardless of presence or absence of rice plant, total C emission was increasing linearly towards the experimental period in all treatments. Unexpectedly, the accumulative C emission did not significantly relate to the temperature (r = -0.54 to -0.67, p = 0.099 to 0.210) and humidity (r = 0.10 to 0.25, p = 0.593 to 0.824) in every treatment. Irrespective of fertilizer amendment, accumulative C emission in rice transplanted treatments i.e. in T_1, T_2 and T_3were strikingly greater than that in unplanted soil (T_4), predominantly between 31 to 46 DAT. During the entire 46 days, total C emission (in mg kg^{-1}) and global warming potential (GWP) (in CO_2 eq. kg ha^{-1}) were statistically identical between the planted treatments (i.e. amongst T_1:1756 ± 69 and 9182, resp., T_2:1662 ± 130 and 8771, resp., and T_3: 1494 ± 102 and 9050, resp.) which all were again significantly ($p<0.01$) greater than that in unplanted soil, T_4 (554 ± 46 and 3487, resp.).	

PEST MANAGEMNT PROGRAM AREA

Entomology Division

Research Progress 2018- 2019

Sl. No.	Research Progress Program area/project (duration)	Expected output

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1	**Project:**Pests and natural enemies' incidence at BRRI farm, Gazipur **Duration:** Long term	The overall insect pest incidence was found low in the reporting year. Comparatively higher incidences of insect pests were found in Aus and T. Aman seasons than the Boro season. Green leafhopper (GLH), white leafhopper (WLH) and grasshoppers (GH) were the most abundant pests and found in all the three seasons. Highest number of Rice bug was found in Aus 2018. Seed bed found higher pest population among all the habitat of Aus, T. Aman and Boro. Higher numbers of natural enemies were found in the Aus season than the Boro and T. Aman seasons. Spider (SPD), damsel fly (Dam. fly), ladybird beetle (LBB) and carabid beetle (CDB) were the dominant predators in all the habitats of the reporting seasons. Weekly counts, taken directly from 20 hills showed that the population and the damage done by insect pests were below the ETL in all the three rice seasons.
2	**Project:**Incidence of insect pests and natural enemies in light trap **Duration:** Long term	In the study period, highest number of insect pest and natural enemies was found in BRRI HQ followed by BRRI RS Rajshahi and Barishal. In contrast, incidence of both insect pest and natural enemies was lower in RS Rangpur, Cumilla and Sonagazi. For green leafhopper (GLH), two peaks were observed in the reporting months from July 2018 to June 2019**.** First peak was found on October for BRRI HQ Gazipur and RS Rajshahi while November for RS Barishal with greater number of GLH (more than 4,000 individuals). However, second peak was observed at the end of April for Gazipur and May for Rajshahi with less than 1,500 GLH individuals. Both BRRI HQ Gazipur and RS Rajshahi had two peaks in October and November with a BPH population around 10,000 and 2,000 respectively. These results indicate that October and November were favorable for BPH incidence in Gazipur and Rajshahi. Three minor peaks were also observed in Gazipur in April to June. For yellow stem borer (YSB), BRRI RS Rajshahi and Barishal showed two major peaks at different times for each location**.** It was found in October and May for Rajshahi with around 6,000 and 3,200 YSB individuals respectively. In case of Barishal, two

Sl. No.	Research Progress Program area/project (duration)	Expected output
		peaks were observed in November and March with 2,200 and 1,000 YSB individuals respectively. These results indicate that incidence of YSB occurred in Rajshahi and Barishal at different times with greater number of YSB population in Rajshahi. In Gazipur, two peaks were found in November and May with 900 and 400 carabid beetle (CDB) individuals respectively. However, Rajshahi had peaks for CDB in October for 400 individuals and April for 200 individuals while two peaks for Barishal in November and March with around 200 and 400 individuals respectively. Furthermore, Cumilla had one peak in February with few individuals compared with other locations. These results clearly indicate that CDB population was abundant at different times of the year in most locations.For green mirid bug (GMB),one major peak was observed in BRRI HQ Gazipur with more than 20,000 GMB individuals in November**.** Despite this, a minor peak was also found in RS Rajshahi at the same time with fewer individuals.
3	**Project:** Development of bioclimatic models to forecast the dynamics of rice insect pests **Duration:** Mid term	In order to quantify the projected changes in precipitation and temperature over the 10 selected areas in Bangladesh, daily values of *P*, T_{max} and T_{min} were extracted from the CMIP5 models grid point closest to the corresponding weather station coordinates. Summarizing the future change, under RCP4.5 scenario, in temperatures and rainfall on three time-slices, F_1 (2006-39), F_2 (2040-69) and F_3 (2070-2095), and comparing with the baseline of 1981-2005, this analysis shows increase in maximum temperatures by 0.76ºC, 1.56ºC and 2.04ºC and minimum temperatures by 0.78ºC, 1.55ºC and 2.01ºC during F_1, F_2 and F_3, respectively, in 10 locations. Relatively, Jashore region is predicted to be warmer than the other nine regions. On the other hand, under the same scenario, annual rainfall will likely increase by 228, 265 and 342 mm during F_1, F_2 and F_3, respectively, in the regions; the effect will be more experienced in Cox's Bazar and less in Jashore region. It is likely that such pattern of regional and seasonal variations in temperatures and rainfall will impact infestation of insect-pests and diseases on

Sl. No.	Research Progress Program area/project (duration)	Expected output
		crops.
4	**Project:** Impact of climate change on pest control services in rice field **Duration:** Short term	Comparatively higher number of insect pests and natural enemies were observed in Chattogram than Satkhira. Significant higher number natural enemies (spiders, lady bird beetles, carabid beetles, dragon flies, damsel flies, and green mirid bug and parasitoid wasps) observed in non-saline ecosystem than saline ecosystem. No brown planthoppers were observed in exposed area where eggs and adult BPH were released at the mid stage of rice growth. On the other hand, where BPH introduced area was covered by nylon mesh cage showed significant higher number of populations developed (180.89) and feed rice plant ($P < 0.001$). Statistically similar development trends were found in three locations as saline area ($P > 0.05$). Number of natural enemies in exposed and non-exposed area were also recorded. Among the natural enemies, lady bird beetle, staphylinid beetle, carabid beetle and spiders were largely found both in exposed and non-exposed areas. These indicate that natural enemies are available to destroy insect pests in rice field. Significant number of lady bird beetles (21), spiders (13), and staphylinid beetle (30) were recorded outside the cage in rice field. Higher number of lady bird beetle (31), spiders (18) and staphylinid beetle (46) were recorded in pest exposed area. Similarly, natural enemies were observed in non-saline area both in exposed and non-exposed pest area. Significant number of lady bird beetles (12), spiders (10), and staphylinid beetle (20) were recorded outside the cage in rice field. Higher number of lady bird beetle (18), spiders (14) and staphylinid beetle (26) were recorded in pest exposed area. In non-exposed pest area, natural enemies including lady bird beetle, spiders and staphylinid beetles densely prevail closed to cage where pest remained throughout the experimental period. More importantly, we quantified the yield reduction due to pest introduced in cage. Significant lower amount of rice yield observed in non-exposed area (total 9 hills/ cage, area: 0.36 m^2). Non-exposed area showed 206.52 g rice yield whereas exposed area showed 238.52 g yield. This result indicates that brown

Sl. No.	Research Progress Program area/project (duration)	Expected output
		planthopper can reduce 13.41% rice yield if natural enemies are absent in the field.
5	**Project:** Conservation of natural enemies in rice ecosystem **Duration:**Mid term	The results showed that highest number of short horned grasshopper (SHG), yellow stem borer (YSB)and green leafhopper (GLH) were found in T_3 (12.33, 10.67 and 5.83 respectively per 20 sweep) where neither flowering plants nor insecticide used. In case of natural enemies, highest number of spiders, lady bird beetle (LBB) and carabid beetle (CBB) were found in T_1 (6.33, 2.67 and 1.17 respectively) where sesame was grown as nectar rice flowering plants on bunds surrounding the rice crop. In T_2, (insecticide treated plot) carabid beetle (CBB), damsel fly and LBB population were found lower than T_1 and T_3. Significantly higher parasitim activity was found in T_1tretament both in YSB eggs and rice leaf folder larvae and in comparison, YSB egg prarsitism rate was higher than LF larval parasitism. Result of this study demonstrates that enhanced ecosystem may increase parasitim activity in the rice field. In T_2, where insecticide used three times but yield was similar to that of T_1(5.04 t/ha) and T_3 (5.05 t/ha). Moreover, from sesame crop additional 1.0 t/ha yield obtained in T_1 that added extra profit. Significantly lower yield obtained in T_3 (4.7 t/ha) where no flowering plant nor insecticide use.
6	**Project:** Test of different candidate insecticides against major insect pests of rice. **Duration:** Long term	A total of 47 commercial formulations of insecticides were evaluated against brown planthopper (BPH). The insecticides, their dose and mortality against BPH presented in Table 1. Forty-five (45) insecticides out of 47 were found effective against BPH (Tables 1) and two were found non-effective (mortality < 80%). Farmers can use these insecticides to control insect pests in field
7	**Project:** Fumigation action of botanical oils against stored grain insect pests **Duration:** Mid term	The results indicated that the 1st and 2nd exposure period (24 and 48 hrs respectively) of rice stored grain insects to mahogany oil fume caused significant mortality to rice weevil and angoumois grain moth compared to the control. Mortality ranges from 54 to 91.11% and from 84.20 to 92.12% in the rice weevil and angoumois grain moth respectively. The result of this study indicates that mahogany oil would be an effective product for controlling stored grain insect

Sl. No.	Research Progress Program area/project (duration)	Expected output
		pests. After fumigation exposure of grains, panel test was conducted in order to determine that bitter taste residue remains in the grain or not. Randomly more than 10 people were selected and approached to eat the grain after 48 hrs exposure of fumigation and no bitter taste was found by mahogany oil. However, more research is required for large scale control.
8	**Project:** Farmers' perception in pesticide usein Bangladesh **Duration:** Short term	To assess the farmers' perception of pesticide use in crop field, 917 farmers were interviewed using a structured questionnaire. All the respondents except three were male (n = 914; 99.67%) and the average age was 47.17 (±12.78) years. Most of them were not educated and had received an average of only 1.99 (±0.79) years of primary school education. The net family size of the sample households was 4.41 (±4.56) people and the daily per capita income was 459.90 (±174.42) BDT. Almost all farmers within the sample regions are using pesticides particularly insecticides in their crop fields. The respondents were not well informed that pesticides were very harmful to the quality of agricultural products, the environment, and human health. Their knowledge score varies from 3.1 to 3.5 indicating that they have little knowledge (score 1= completely know, 2= somewhat know, 50%; 3=little know, 25%; 4= very little know, 1%; 5= no knowledge). Only few respondents, however, reported that they knew about pesticide toxicity and how pesticides affect the body. An α value greater than 0.70 indicates good internal consistency. Somebody believed that they might be poisoned when spraying pesticides. Most of them lacked the ability to understand the instruction manuals and pesticide labels.
3	**Project:** Use of solar light trap for insect pests management in crop field **Duration:** Mid term	Insect pests catches in each light trap were collected and recorded. Significant number of insect pests that cause damage to rice were caught in each trap at every location. Rice insect pests including yellow stem borer (YSB), green leafhopper (GLH), white leafhopper (WLH), zigzag leafhopper (ZLH), field cricket (FC), mole cricket (MC), leafroller (LR), caseworm (CW), stink bug and rice bug (RB) were caught in solar light trap. Highest number of GLH and YSB were recorded from solar light trap in April

Sl. No.	Research Progress Program area/project (duration)	Expected output
		2019. The major rice insect pest, YSB decreased after April 2019 and showed lowest trap catches at June 2019. Field cricket showed highest peaks at May and lowest was found at March. Caseworms were trapped in solar light trap in all months. Among the insect pests, stem borer was the dominant pest that trapped in solar light trap. We also recorded damaged symptoms both from solar light trap installed plot and farmers plot (no solar light trap were installed). Significant lower damaged was found in solar light trap installed plot than control one (P = 0.05).
8	**Project:** Reaction of provitaminA enriched Golden Rice event GR2-E introgressed line of BRRI dhan29 to different insects under confined field trial (CFT) condition. **Duration:**Mid term	Stem borer (SB), leafroller (LF), rice bug, grasshoppers and natural enemies namely; carbid beetle, spider and parasitoids were found in all trial plots. Based on the fortnightly report, prophylactic measure was applied in field. Insect infestation was very low at the crop establishment stage due to regular application of insecticide. The yellow stem borer infestation was observed from vegetative stage to the reproductive stage. But that level did not cross ETL. No significant differences were observed between GR2-E introgressed line and BRRI dhan29 ($P>$ 0.05). Very few numbers of stem borer egg masses were observed both in GR2-E introgressed line and BRRI dhan29. The egg masses were removed from the experimental plot by hand picking. Higher amount of folded leaf and deadheart were observed in BRRI dhan29 than golden rice but statistically similar. However, significant difference was not found between golden rice and BRRI dhan29. Damaged symptoms including deadheart and whitehead were removed from the infested hill. Damaged by other insect pests such as leafroller, grasshopper was observed both in transgenic and non-transgenic lines. However, their damaged intensity was very low both in transgenic and non-transgenic plot. Moreover, abnormal insect pest infestation was not observed in transgenic lines. Unknown insect pests were not observed during the entire rice growing period. The prophylactic measure was used to control insect pests at the different crop growth stage. Outbreak of insect pests during the rice

Sl. No.	Research Progress Program area/project (duration)	Expected output
		growing season was not observed. So, the efficiency of pest management using prophylactic measure was satisfied.
9	**Project:** Use of sex pheromone to control rice leafroller, *Cnaphalocrosis medinalis*/ sustainalble management of climate associated outbreaking insect pests *Cnaphalocrosis medinalis* (BARC coordinated, MOA Project) **Duration:** One year	Currently pheromone lure is applied using plastic pot that requires the maintenance of water level in pot. Insect killing agents like detergent/shampoo or other chemical that kill the insects when they come in water contact. Moreover, watering is administered at every 4-5 days interval and maintain water level in the pots. To alleviate this problem, we designed a novel trap that does not require water or any other insect killing materials. In this trap, once insects entered into trap they never come out from the trap. In addition, we can collect live insect from field using this trap and used to taxonomic analysis. We collected pheromone lures from China and used them for field evaluation. The optimal blend of used pheromone was Z11□18:Ald, Z13□18:Ald, Z11□ 18:OH and Z13□18:OH at a ratio of 3:25:3:3. The significant highest number of leaffolder was trapped at 18 November 2018 in Gazipur BRRI farm. However, catches of leaffolder in trap varied and reached upto 571/trap within one week. This result indicates that pheromone trap is very effective to withdraw leaffolder from rice field. We also recorded damaged symptoms both from pheromone trap installed plot, control plot withholding insecticide and insecticide treated plot. Significant lower damaged was found in pheromone trap treated plot than control and insecticide treated plots. In insecticide treated plots where insecticides were applied three times, but sufficiently higher leaf damaged was observed than pheromone trap treated plot ($P < 0.01$). This finding indicates that pheromone trap is more effective than chemical insecticide for reducing larval population and damaged intensity. Use of this synthetic pheromone blend provides a promising alternative to the currently used for monitoring and controlling of *C. medinalis* in Bangladesh. Six hundred seventy-two (672) leaffolder larvae were collected from rice field and kept them in laboratory for checking the parasitized larvae and identify parasitoids (emerged

Sl. No.	Research Progress Program area/project (duration)	Expected output
		from killed larvae). Initially, we identified following five parasitoids that parasitize the larvae of leaffolder in field condition which caused 6-27% parasitized.
10	**Project:** Screening of advanced breeding lines (ZER) against major insect pests of Rice	Among ZER breeding lines, one Aman line (IR 97641-35-2-2-8-P2) and one Boro line (IR99285-1-1-1-P2) was found moderately susceptible (Score 5) against BPH and WBPH respectively, when screened at green house condition.
11	**Project:** Screening of advanced breeding lines (RLR) against major insect pests of Rice	One breeding line (IR11N202) was found moderately resistant (Score 3) to GLH, four lines (IR 11L433, Latabalam, IR96321-1099-402-B-4-1-2, IR96321-1447-428-B-1-1-1) were moderately susceptible (Score 5) to BPH, two lines were moderately susceptible against WBPH (BR8521-30-3-1, IR 11L433) and GLH (IR04A428, IR96321-1099-402-B-4-1-2) respectively.
12	**Project:** Screening of advanced breeding lines (ALART, PVT) against major insect pests of Rice.	One ALART (Kalizira type) breeding line (BR 8850-10-12-2-3) was found moderately resistant (Score 3) and another one ALART (Kalizira type) line (BR 8850-10-12-8-3-3) was moderately susceptible against WBPH in Aman 2018. One Boro ALART (favorable Boro) line, BR (Bio)9777-26-4-3 showed moderately susceptible reaction to WBPH.
13	**Project:** Screenings of FBR, CTR and PQR advanced breeding lines against major insect pests of Rice.	Among genotypes, only RYT (FBR) BR9675-68-5-1 showed moderately resistance (score 3) reaction against BPH. Genotypes, RYT (FBR) BR9675-68-5-1, RYT (CTR) BR8562-11-2-6-1-1-1, BR8562-11-2-6-2-5-2 and BRRI dhan29-SC3-2816-10-6-HR6(Com)-HR1-(Gaz)-P8 (Hbj), and PQR line BR8862-29-1-5-1-3, were found moderately susceptible (score 5) against WBPH.
14	**Project:** Evaluation of INGER IRBPHN 2018-19 rice varieties.	Two IRBPHN genotypes showed moderately resistance (Score 3) to moderately susceptible reaction (score 5) in Aman season 2018 season. No promising materials were found in Boro 2018-19 IRBPHN.
15	**Project:** Exploration of BRRI germplasm to identify brown planthopper (BPH) resistance rice accession.	Overall, all tested rice accessions showed wider variation for higher resistant scores only with an average 7.8. The scores of resistant check T27A and susceptible check BR3 were 4.8 and 8.8 respectively. More importantly, only one rice accession (Accession 489) showed lower resistant score than

Sl. No.	Research Progress Program area/project (duration)	Expected output
		resistant check T27A which indicate presence of resistance genes in that rice accession. The identified rice accession from this study could be used in further genetic analysis or selected as a donor in resistance breeding program.

Plant Pathology Division

Research Progress 2018-19

Sl No.	Research Progress	Expected output
1	Survey and monitoring of rice diseases in selected areas	Survey will be done during maximum tillering and onward in T. aman and Boro season.
2	Pathotypic and genetic diversity of *Rhizoctoniasolani* AG1-IA	40 diseased samples have already collected from different locations and isolation is going on.
3	Molecular characterization of bakanae causing fungi in Bangladesh	60 isolates have already purified and DNA extraction is going on.
4	Development of differential system of*Xanthomonasoryzae*pv. *oryzae* and study on its molecular diversity	180 isolate were purified and preserved for long term. Pathogenicity tests of 150 isolates against NILs have completed.
5	Isolation and identification of rice kernel bunt pathogens and their pathogenicity test– another emerging disease of rice.	Disease samples were collected and morphologically identified of the pathogen.
6	Effect of drought tolerant microbes (*Pseudomonas* spp. and *Trichoderma*spp.) on drought response of rice.	Three *Trichoderma* isolates were performed well for drought tolerance.
9	Development of an effective inoculation technique for Sheath rot disease screening	Seedlings were grown and pathogen will be inoculated in booting stage.
11	Factors affecting recent outbreak of rice tungro disease	GLH population data were collected from Aus seedbed of tungro prone area (Nagalkot, Cumilla). Weather data (temperature, rainfall, humidity) and others rice cultivation data (variety, planting time) were also collected from the respective areas.
12	Identification of the source of infection of rice false smut disease	To identify seed and soil source, experiments have already set up in Gazipur and Cumilla
13	Improvement of differential system for rice blast disease in Bangladesh	Blast infected samples have already collected from blast outbreak areas of

		Bangladesh. Isolation, preservation and pathogenicity tests against differential system of 40 isolates completed.
14	Isolation of potential fungi for controlling major weeds of rice	Fungal infected weed samples have already collected from Gazipur and Sirajganj. Isolation will be started soon.
15	Regional Yield Trial of blast resistant materials	10 blast resistant materials were tested in 6 blast prone areas.
16	Exploring new sources of resistance and pyramiding blast resistant gene in Boro rice	100 germplasm were collected and introgression of *Pi9* was done in the background of BRRI dhan28
17	Screening of advanced rice breeding lines and land races against Blast and Sheath Blight diseases	Around 100 lines have already received from Breeding Division and seeded all those lines for sheath blight screening
18	Introgression of Blast resistant genes into BRRI dhan47	BC3F4 population were developed
19	Identification of major blast resistant genes in jhum rice.	Two blast resistant genes were identified using molecular marker.
20	Improvement of BRRI varieties for resistance to blast and bacterial blight diseases using marker assisted backcross breeding	BC1F1 generation were developed and seeded in T. aman, 2019 for generation advancing.
21	Identification of resistant sources and gene pyramiding for bacterial blight resistance	Out of 237 germplasm, 23 were found resistant.
22	Pyramiding of major BB resistant gene (s) in susceptible rice varieties/lines	BC2F1, BC3F1 population were developed and seeded in T. aman, 2019 for generation advancing.
23	BB resistance and yield performance of selected breeding lines	Seeded for SYT
24	Gene detection of bacterial blight (BB) resistance in local rice cultivars using phenotypic and molecular studies	Seeding of the resistant germplasm were done in T. aman, 2019
25	Detection of major resistant genes and pyramiding of bacterial blight resistance into parental lines of hybrid rice using MABC	PhD student work is going smoothly
26	Screening of LST against BB	Around 15000 lines will be screened in T. Aman season
27	Screening of rice germplasm against bakanae disease	Germplasm were collected and seeded in T. aman,2019
28	Linkage and QTL mapping of tungro resistance in rice	Mapping population BC2F2 developed. Genotyping as well as phenotyping will be started soon.
29	Developmentof prebreeding materials for tungro resistance	Tungro resistant BC5F2 and BC3F3 population already developed

30	Development of blast resistant varieties using differential system and molecular markers	6000 progenies of BC2F5 generation of 15 combinations are now in field. Modified Field RGA is practicing for advancing materials
31	Studies on the genetic mechanism of rice blast and gall midge resistance in BRRI dhan33	Seeds of 300 family lines of BC1F2 have already harvested. Polymorphism studies of 600 SSRs between BRRI dhan33 and US2 have already done and found 205 polymorphic SSRs. Phenotyping of segregating population against neck blast have already done.
32	Linkage and QTL mapping of blast resistance in BR16	Seeding of recipient and donor parents have done
33	Detection and confirmation of blast resistance genes in land races using differential system	Screening of 331 germplasms have already done using 5 differential blast isolates.
34	Development of inoculation technique for false smut disease	Staggered planting has done
35	Identification of the primary source of natural infection of rice false smut disease	Seeding for the experiment was done
36	Effects of RFSm contaminated seeds on quality	Healthy and contaminated seed will be collected in this T. aman season
37	Investigation of grain quality and nutritional status of rice infected by major diseases	Healthy and infected seed will be collected in T. aman season
38	Developing an algorithm between the severity of sheath rot disease and yield reduction in rice	Data already taken in T. aman, 2018 and will be verified in T. aman, 2019
39	Crop loss assessment at different stages of rice caused by bacterial blight	Seeding already done
40	Factors affecting recent outbreak of rice blast disease in Bangladesh	Weather factors and pathogen races have already calculated. Now data processing is going on. Interesting data will be presented soon in Thursday seminar.
41	Up-scaling of the management of rice seedling blight disease in farmers seed bed during boro	Experiment will be conducted in Boro, 2019
42	Evaluation of commercial biopesticides against major rice diseases	Routine work
43	Isolation of effective bacterial isolate for management of sheath blight disease	Soils were collected from sheath blight infected field of Gazipur
44	Management of Sheath blight disease using *Trichodermaharzianum*	Seeding were done in T. aman, 2019
45	Bakanae disease control with integrated approach	Seeding were raised in T. aman, 2019
46	Identification of potential bio-control agents	40 bacteria, 13 fungi, 4 plant extracts

	and formulation of biopesticides against Bakanae disease of rice	were found effective against bakanae. Seeding were done in T. aman, 2019
47	Development of nano particle mediated fungicide for rice blast disease management in Bangladesh	*In vitro* condition, silver nano particle was found effective against rice blast pathogen. Seeding for *in vivo* test also done.
48	Integrated management of rice tungro disease	Two chemical sprayed on seedbed and another one after transplanting were done with managing proper sanitation.
49	Evaluation of new chemicals against Blast, Sheath blight, False smut, Sheath rot and Bakanae diseases of rice	Experiment already set up in T. aman, 2019

FARM MACHINERY AND MECHNIZATION PROGRAM AREA

Farm Machinery and Postharvest Technology Division

Research Progress 2018-2019

Sl. No.	Research Progress	Expected output
1.	**Programme area /Project title: Development of Agricultural Machineries**	
1.1	**Experiment :** ***Design and development of a head feed mini combine harvester*** **Progress:** ❖ A study was conducted to modify, fabricate and test the performance of the BRRI developed prototype (version-1) of head feed mini combine harvester with locally available materials in Janata Engineering Workshop, Chuadanga under Public Private Partnership (PPP). BRRI provided engineering design, drawing, technical and financial support to improve and fabricate the machine. ❖ The second prototype of combine harvester was redesigned and fabricated according to the identified faults in the 1st prototype. ❖ The field test of 2nd prototype was conducted to find out the performance, efficiency, operation fault, etc. ❖ It was found that harvesting capacity and fuel consumption were 1.25~1.50 bigha/h and 3.84~3.96 l/h respectively. ❖ The improved combine harvester becomes appropriate in both dry and muddy fields with a plough pan up to 15-20 cm. ❖ The average harvest loss was 2.46% and off them the cutter bar, scattering and threshing losses were found to be 0.648, 0.373 and 1.327% respectively.	Prototype of head feed mini combine harvester will be available for Bangladesh condition
1.2	**Experiment :** ***Design and development of a whole feed combine harvester*** ***Progress:*** ❖ A second prototype of whole feed mini combine harvester was fabricated using locally available materials in the Janata Engineering workshop, Chuadanga under public private partnership (PPP). ❖ BRRI provides design, drawing, technical and financial support to develop and fabricate the machine. ❖ The faults of first prototype were taken into consideration to fabricate the second prototype. The field test revealed a functional problem in gear system and cleaning mechanism. The harvesting capacity and fuel consumption were found 0.15~0.20ha/h and 2.75~3.25 l/h respectively. ❖ The success of this machine may create a new era in Bangladesh agriculture for harvesting and also mitigate the labour shortage	Prototype of whole feed mini combine harvester will be available for Bangladesh condition.

Sl. No.	Research Progress	Expected output
1.3	**Experiment : Design and development of fertilizer deep placement mechanism for existing rice transplanter** **Progress:** ❖ Mixed fertilizer deep placement mechanism was incorporated in the existing walking (ARP-4UM) type rice transplanter under the NATP sub-project. ❖ In the transplanter, spiral type mechanism was incorporated as metering device to receive and dispense desired amount of mixed fertilizer. ❖ Engine power 1800 rpm was reduced and transmitted to the applicator main shaft at 22 rpm with the arrangement of a belt-pulley, worm gearing, shaft-bearing, chain-sprocket and bevel gear with engage-disengage facility. ❖ A control lever was also used to calibrate fertilizer dose based on variety and seasons. Walking type rice transplanter, that we developed was evaluated in the laboratory, soil bin, research field and farmer's field. ❖ In the laboratory and soil bin test, it was observed that fertilizer control lever can control fertilizer dispensing rate and dispensed uniformly in the furrow and covered effectively. ❖ It was also observed that agitator rotated smoothly to prevent the bonding of fertilizer mixture	Fertilizer deep placement mechanism in the mechanical rice transplanter will be validated for Bangladesh condition.

Sl. No.	Research Progress	Expected output
1.4	**Experiment : Development, validation and adoption of power weeder for wet land rice cultivation** **Progress:** ❖ A research was conducted to design, develop and validate a multi-row power weeder to control weeds in line transplanted wet rice field. ❖ Engine power 6500 rpm was reduced and transmitted to the rotors of the weeder at 185 rpm with the arrangement of a coupling, spline shaft-bearing, worm gearing and rotary shaft with engage-disengage facility. ❖ Spike angle and arrangement were designed critically considering the effective depth of weeding and total area of coverage in between two lines. ❖ A total of six spike plates comprising three spikes in each plate were attached in each side rotor whereas six spike plates comprising one spike in each plate were attached in each middle rotor. ❖ The developed power weeder were tested in both research laboratory and farmers' field at sadar and Sreepur areas of Gazipur; Bhaluka, Mymensingh; Netrakona sadar, Habiganj sadar, BRRI RS Cumilla and Rangpur sadar under different soil conditions. ❖ The treatments were: One weeding by power weeder (BPW) followed by (fb) one hand weeding (HW), one weeding by BRRI manual weeder (BW) fb one HW, Weedy check, Weed free and Mulching fb by two HW (Farmers' practice). ❖ Average of seven locations and three replications, actual and theoretical field capacity of the multi-row power weeder was found 0.229 and 0.290 hahr-1 whereas average field efficiency was found 78.74%. ❖ In all cases, significantly lower weeding efficiency was observed for BRRI manual weeder (69.28%) whereas weeding efficiency of BRRI multi-row power weeder was 78.93%. ❖ Finally, weed control efficiency of the developed weeder was 73.18%.	BRRI developed power weeders will be validated for Bangladesh condition.

Sl. No.	Research Progress	Expected output
1.5	**Experiment :** ***Performance evaluation of power operated automatic seed sower machine*** **Progress:** ❖ The uniform seedling density 2-3 seedling per square centimeter is a prerequisite condition for smooth operation of mechanical rice transplanter. ❖ Seed sowing in a uniform density by hand broadcasting is difficult, time consuming and laborious work. Thereby a power mechanical seed sower machine was collected and calibrated to perform seed sowing mechanically. ❖ The uniformity of seed dispensing rate and depth of soil in the tray were measured in different position of the lever. ❖ The recommended depth of bed soil and depth of cover-up soil was found in the middle position of 3-4 and 2-3 of the adjusting lever, respectively. ❖ The desired seed rate was found in the middle position of 3-4 of the adjusting lever for long and short grain varieties (120~150gm germinated seeds per tray) and uniformity of seedling (3-4 seedling per cm2). ❖ About 440 trays per hour can be prepared at desired condition. Therefore, it is an appropriate and time saving technology to prepare seedling trays for mechanical rice transplanter.	Performance of power operated seed sower machine will be evaluated
2	***Project Title: Milling and Processing Technology***	

Sl. No.	Research Progress	Expected output
2.1	**Experiment :** ***Test, evaluation and modification of rubber roll de-husker*** **Progress:** ❖ A de-husking machine was developed to improve the milling performance of rice processing and husking brown rice was polished in MNMP polisher. ❖ Capacity of the de-husker was 675 kg/ and the husking efficiency was found 92.3% for BRRI dhan80. ❖ The milling recovery was 64% when it was polished in friction type polisher. ❖ The average head rice recovery based on input paddy was 55.8%, which was found promising for processing of premiere quality rice. Old steel engelberg huller can be replaced with the combination of de-husker and polisher. ❖ Besides, this combination gives similar milling recovery of the semi and automatic rice mill. ❖ In addition, separately collected husk and bran can be used for making briquette and extracting edible oil respectively.	A suitable rubber roll de-husker will be introduced for Bangladesh condition

Sl. No.	Research Progress	Expected output
2.2	**Experiment :** ***Effect of degrees of milling (DoM) on rice quality*** **Progress:** ❖ Farm Machinery and Postharvest Technology (FMPHT) division, BRRI and HarvestPlus jointly conducted research on "Processing of Rice for Zn Efficacy Study". ❖ The aims of this study were to determine the percentage of milling effect on weight loss, head rice recovery, Zn and Fe loss of rice. Two rice varieties such as BRRI dhan28 (no Zn enrich) and BRRI dhan42 (bio-fortification) were used in this study. ❖ Grain zinc and iron content were estimated in the brown rice (dehusked unpolished grain) and different degree of polished rice (7.5, 10, 12, 13.75 and 15%). The zinc content was calculated by using X-ray fluorescence (XRF) at HarvestPlus laboratory in Bogura. It was observed that the zinc content of both varieties decreased with the increase of the degree of milling (passing number 1 to 5). ❖ Zinc content of two varieties was varied up to 12 DoM and after 13.75 DoM there have no difference in Zn content, both bio-fortification and no Zn enrich verities. ❖ A similar trend was found in iron content in the parboiled grain of these two varieties. ❖ During the milling process, the broken percentage increases with increasing of DoM, due to low surface hardness which leads to low quality and recovery of milled rice. It was also observed that there had negative relationship between DoM and head rice yield. ❖ DoM affects not only the quality but also the appearance of rice kernels. ❖ This study showed that the DoM and whiteness are positive correlated. ❖ It was clearly shown that more food loss occurred due to more degree of milling, which is great, hampered the food security of a nation. ❖ It can be concluded from these results that, over DoM affect the losses of Zn and Fe content as well as lower head rice recovery.	Optimum degree of milling will be introduced for Bangladesh condition
3	***Project Title: Renewable Energy Technology***	

Sl. No.	Research Progress	Expected output
3.1	**Experiment :** ***Feasibility of rice straw for biomass briquette production*** **Progress:** ❖ An initiative was taken to produce briquette mixing rice husk along with dry rice straw at different ration to increase calorific value of rice straw and alternate use as well. ❖ Five treatments (T1: 10% straw + 90% husk; T2: 20% straw + 80% husk; T3: 30% straw + 70% husk; T4: 40% straw + 60% husk and T5: 50% straw + 50% husk) were used for this experiment. ❖ The percentage productions of briquette were decreased with the increased percentage of straw. ❖ The average density of husk and straw are 0.032gm/cc and .022gm/cc. ❖ The density of produced briquette decreased with the increase of rice straw.	Better ratio of rice husk straw to produce biomass briquette will be identified

Workshop Machinery and Maintenance Division

Research Progress 2018-19

Sl. No.	Research progress	Expected output
	Programme area/ project duration	
1	Design and development of manually operated mini reaper **Progress:** ✓ Design and drawing of manually operated reaper has been done. ✓ Its fabrication is going on.	Harvesting time, cost, human drudgery and yield loss will be minimized.
2	Modification of reaper travelling wheel for wet-land condition **Progress** ✓ It has been tested in the semi-wet land and it performed well. ✓ The wide of the reaper travelling wheel has been increased to increase the soil resistive force. ✓ It will be tested.	Wet land suited travelling wheel of reaper will be developed.
3	Determination of tilling efficiency of power tiller at selected areas in Bangladesh **Progress** ✓ Experiment was conducted in Aman 2018 and Boro 2019 seasons in R/S Rajshahi and Rangpur. ✓ It will be continued in other satations.	Optimum tillage depth for maximum paddy yield will be determined.
4	Potentiality of engineering workshop for enhancing farm mechanization in selected areas of Bangladesh **Progress** ✓ Data was collected from Arafat Engineering Workshop, Dinajpur. ✓ It will be continued.	Potentiality of engineering workshop has been determined.
5	Survey on status and constraint of farm machinery used in farmer's field at selected areas **Progress** ✓ Data was collected from the farmers' field of Dharabazar, Netrokona district and Krishnapur village, Magura district. ✓ It will be continued.	Problems and demand of the machinery in the farmers' field will be identified.

Sl. No.	Programme area/ Project duration	Objectives
6	Feasibility study of solar energy use in Agricultural Machinery **Progress** ✓ 850 Watt solar panels were installed on the roof of BRRI automobile workshop. ✓ Solar energy was used winnowing and threshing paddy at BRRI threshing yard. ✓ It will be evaluated for different machinery.	Solar energy useable thresher and winnower were be developed.

RICE FARMING SYSTEMS PROGRAM AREA

Rice Farming Systems Division

Research Progress 2018-2019

Sl. No.	Research Activities	Progress
	Programme area: Rice Farming Systems	
1.	Development of four-crop cropping patterns for favorable irrigated ecosystem in medium highland	Potato\Pumpkin (Relay)-T. Aus-T. Aman cropping pattern gave the highest REY (23.86 t ha^{-1}) among the tested 6 cropping patterns. Aus-2019 was harvested. T. Aman is in the field.
2.	Determination of fertilizer dose for Mustard-Boro-T. Aman cropping pattern	Cropping systems-based (CSB) fertilizer requirement was relatively lower than the individual crop-based (ICB) fertilizer. For Mustard-Boro-T. Aman cropping pattern CSB fertilizer N, P, K (kg ha^{-1}) was 256.86, 34.51 and 86.2 respectively which can save around 20-50% nutrient than ICB fertilizer.
3.	Evaluation of establishment method of Mustard-Boro-T. Aman cropping pattern in medium highland ecosystem	Single pass unpuddled Boro rice-Conventional Aman rice-Mustard (T_1) gave higher rice equivalent yield (REY), 12.64 t ha^{-1} that other methods.
4.	Identification of rice variety in Boro-Fallow-T. Aman cropping system for sustainable productivity	BRRI dhan71-BRRI dhan63 cropping pattern performed better among the tested 10 cropping pattern (CP), where BRRI dhan71 yielded 5.91 t ha^{-1}.
5.	Crop intensification in deepwater rice ecosystem	BRRI dhan29-Digha CP yielded 9.82 t ha^{-1}, which was 23.20% higher than the control, 8.07 t ha^{-1} (BRRI dhan29-

Sl. No.	Research Activities Programme area: Rice Farming Systems	Progress
		Fallow-Fallow).
6.	Improvement of Aus-based cropping pattern through introduction of premium quality Aus rice varieties in Mujibnagar karmasuchi area.	In Maize -Aus-Fallow the average Aus yield was 5.31 t ha^{-1} , followed by Boro-Aus-Fallow 5.11 t ha^{-1}.
7.	Development of Vegetables, Fish and Fruit System for shallow Mini Pond.	The gross margin of T_1 (Aroid+Fish with stocking density: 02 piece/m^2) was 595%, 503% and 405% higher over T_4 (Only fish - Stocking density: 01 piece/m^2), T_3 (Only aroid in the pond), T_2 (Aroid+Fish (Stocking density: 01 piece/m^2) treatment, respectively. The lowest gross margin was found in T_4 treatment where only fish was cultivated.
8.	Performance of HYV Aus rice under Jhum Cultivation.	Average yield of BRRI dhan48, BRRI dhan43, BRRI dhan65, was 3.49, 2.97, 3.06, 3.48 and 3.22 t ha^{-1} respectively.
9.	Intensification of Single T. Aman area through the inclusion of modern Aus rice in piedmont plain land in hilly areas	BRRI dhan48- BRRI dhan71 and BRRI dhan48-BHD6 gave relatively higher yield (9.0 t ha^{-1}) among the evaluated CP in hilly area.
10.	Fertilizer management in HYV Aus rice in Jhum cultivation	T_3 (Row placement in between dibbling lines) and T_4 (Basal broadcasting+ half urea top dressing at tiller initiation stage and maximum tillering stage in two splits) gave comparative better yield (3.17-3.55 t ha^{-1}) than other methods.

SOCIO-ECONOMICS AND POLICY PROGRAM AREA

Agricultural Economics Division

Research Progress 2018 – 2019

Sl. No.	Research Progress	Expected output
01	**Farm level adoption and evaluation of modern rice cultivation in Bangladesh** **Objectives:** • To determine the region-wise adoption rate of different MVs in Aus, T. Aman and Boro seasons; • To estimate the yield of different modern and local rice varieties in different seasons; and	Variety wise adoption rate and yield be delineated; and constraints of MVs be identified.

Sl. No.	Research Progress	Expected output
	• To determine the socio-economic and varietal constraints to the adoption of MV rice in different regions. **Duration:** Routine work **Research site/ Location:** Fourteen Agricultural Regions of Bangladesh **Status: Completed**	
02	**Estimation of Costs and Return of MV Rice Cultivation at the Farm Level** **Objectives:** i) Delineate input use pattern in modern Aus, T. Aman and Boro rice cultivation; ii) Estimate the profitability and risk of modern Aus, T. Aman and Boro rice cultivation at farm level. **Duration:** Routine work **Research site/ location:** Fourteen Agricultural Regions of Bangladesh **Status: Completed**	Profitability, factor and income share of MV rice cultivation be estimated.
03	**Value Chain Analysis of Aromatic Rice (*Tulshimala*) in Bangladesh** **Objectives:** • Map the value chain networks of aromatic rice and the process of value additions along the chain; • Determine cost, margin, price spread and efficiency of supply chain of aromatic rice; and • Identify constraints and opportunities of value chain of aromatic rice and recommend policy measures. **Duration:** July, 2018 - June, 2019 **Locations:** Mymensingh, Sherpur and Netrakona **Status: Completed**	Efficient and emerging value chain for aromatic rice be identified.
04	**Farmers' perceptions of and adaptation strategies to climate and environmental changes in drought prone north-west Bangladesh** **Objective:** ➢ Delineate farmers' perception of and responses to climate and environmental changes in relation to rice production; ➢ Identify the factors affecting the adaptation strategies; ➢ Estimate economic viability of the dominant cropping pattern; and ➢ Understand farmers' observation along with their suggestions of the impact of climate change on farming; **Duration:** July, 2017 - June, 2020 **Locations:** Rajshahi and Naogaon **Status: Yearly Report Completed**	Farmers' preference about T. Aman rice varieties with their most and least preferred traits be identified.
05	**Assessing the Impact of BRRI Released Modern *T. Aman* Rice Technology Adoption on Farmers' Welfare in Bangladesh** **Specific objective:** 1) to investigate the impact of BRRI released modern *T. Aman* rice technology adoption on farmers' welfare.	• Level of changes in farmers' income due to adoption of BRRI released *T. Aman* rice

Sl. No.	Research Progress	Expected output
	Duration: 2018-2019 **Location: All over Bangladesh** **Status: Completed**	varieties will be identified. • Changes in poverty status/situations of the farmers those adopted BRRI released *T. Aman* rice varieties will be assessed.
06	**Adoption and Profitability of Modern Rice Cultivation including Nerica in the Hilly areas of Bangladesh** **Objectives** ➢ To find out the adoption of different rice varieties in different seasons , input use level, yield, profit, and causes of cultivating existing rice varieties; ➢ To explore the reasons of not using recommended inputs, if any; ➢ To find out the existing input –output marketing system in the hilly areas and ➢ To identify problems faced in rice production and suggest probable solution. **Duration: 2017-2020** **Study Locations:** Total 10 Upazila (4 from Rangamati, 3 from Banderban and 3 from Khagrachari) from 3 Hilly districts **Status: Yearly Report Completed**	Rice cultivation status in the hilly area and problems and opportunities of modern technology adoption will be identified.
07	**Propensity of Adoption Indian varieties in Boro season in North-west Bangladesh** **Objectives:** ➢ Determine area coverage and yield of Indian rice varieties in the study areas; and ➢ Find out the specific reason for cultivating those varieties. **Duration:** July, 2017- June, 2020 **Research site/ location:** Rajshahi, Naogaon, and Bogura **Status: Yearly Report Completed**	Adoption status of Indian rice varieties and the reasons for adoption will be identified.
08	**Preference of T. Aman rice varieties in south-west coastal Bangladesh** **Objectives** ▪ To identify the most preferred T. Aman rice varieties in the coastal ecosystem. **Duration: 2018-19**	Reasons of popularity of the preferred T. Aman variety in the coastal region will be identified

Sl. No.	Research Progress	Expected output
	Locations: Khulna and Borguna **Status: Completed**	

Agricultural Statistics Division

Research Progress 2018-19

S. N.	Research Progress	Expected output
IV: Program Area: Socio-economics and Policy		
1.	**Project: Stability Analysis of BRRI varieties** ***1.1 Experiment/Study*** Stability and Adaptability of BRRI Released Aus Varieties in Different Locations of Bangladesh (In collaboration with Agronomy Div. and BRRI R/S Satkhira, Rajshahi, Rangpur, Kustia & Barisal) ***Research Progress:*** T. Aman : Data processing and analysis complete. Boro : Data collection from BRRI HQ & R/S is going on.	Stability index of BRRI varieties according to seasons
	1.2 Experiment/Study: Study on G X E interaction of BRRI varieties (In collaboration with Pl. Breeding Div., ARD Regional Stations ***Research Progress:*** Computer programming for analysis has completed. T. Aman data processing and analysis are going on and data collection of Boro season from BRRI HQ & R/S is going on.	Genotype x Environment Interaction effect of BRRI varieties
	1.3 Experiment/Study: Region specific BRRI variety adoption: A simple way of increasing national rice production ***Research Progress:*** Secondary data already collected from yearbook of Agricultural Statistics-2017, Published by BBS, April-2018 and data	Projection of the national rice production of Bangladesh

	analysis has done. Primary data collection of T.Aus and T. Aman data processing and analysis are going on and data collection of Boro season from BRRI HQ & R/S is going on.	
2.	***2.1 Experiment/Study:*** Maintenance of rice database ***Research Progress:*** Data is updating continuously & introducing important related data**.**	1. Database on rice and related crops. 2. Year wise GR of Rice Production in Bangladesh 3. Database on climatic factors 4. Various climatic maps
3	**Project: Crop Modeling** ***3.1 Experiment/Study:*** Minimizing Agro Micro climatological Risk Factors for Maximizing Sustainable Rice Production in Bangladesh ***Research Progress:*** Daily weather forecasting and validation of the model is going on. Generating agro meteorological advisories based on weather forecasting is running	1. Forecast and validate daily crop weather for sustainable rice production. 2. Technical capacity enriches for crop management and smartly disseminates information of daily weather forecasting and advisories to the farmers.
	3.2 Experiment/Study: Simulating of Climate Change Impact on Rice Growth and Yield in Bangladesh using DSSAT Model *(In collaboration with Entomology Div., Plant Physiology Div., Soil Science, IWM Div., Plant Pathology Div., and Agril. Econ. Div.)* ***Research Progress:*** Daily weather forecasting and validation of the model is going on. Generating agro meteorological advisories based on weather forecasting is running	1. DSSAT model validation for the assessment of climate change impacts on rice varieties released by BRRI. 2. Genetic coefficient of eight BRRI released rice varieties will be estimated. 3. Impact of climate change on rice growth and yield will be identified. 4. Yield of rice varieties will be forecasted. 5. Adaptation options for regional rice farmers will be analyzed.

4	**Project: Geographical Information System (GIS)** ***4.1 Experiment/Study:*** Suitability Mapping of BRRI dhan80-86 and BRRI hybrid dhan6 (In collaboration with Plant Breeding Div., Soil Science Div. and ARD) ***Research Progress****:* Suitability Mapping (Edaphic) of BRRI dhan80-86 and BRRI hybrid dhan6 has been completed.	Suitable and not suitable areas for particular rice varieties
	4.2 Experiment/Study: Climate Mapping of Temperature and Rainfall in Bangladesh ***Research Progress****:* Maps of maximum temperature, minimum temperature and total rainfall 2016and 2017 has been completed**.**	Different climatic factors maps of Bangladesh.
	4.3 Experiment/Study: Zoning of BRRI rice varieties (In collaboration with Plant Breeding Div., Soil Science Div. and ARD) ***Research Progress****:* Zoning maps of BRRI dhan50, BRRI dhan70 and BRRI dhan50 have been completed**.**	Zoning maps and suitable areas for particular rice varieties .
5.	**Project**: Capacity Building Through Training ***5.1 Experiment/Study:*** Training Program on Experimental Data Analysis ***Research Progress****:* A day long training program conducted with titled "Estimation of genetic gain of Breeding Lines Using R" with 15 participants funded by TRB-BRRI project	Skills of BRRI scientists on experimental data analysis will be enriched.

6	**Project: Information and Communication Technology (ICT)** **6.1 Activity: "Rice Doctor" Apps for BRRI.** **Research Progress:** • We have conducted two in house trainings. A total number of 20 scientists/officers were trained. • Tender process of Rice Doctor Apps has been completed. • Work order has been issued to apps developing company MCCL.	Manage and maintain rice doctor.
	6.2 Activity: Mobile Apps of "RKB" (Rice Knowledge Bank). **Research Progress:** • Mobile apps "Rice Knowledge Bank (RKB)" has been hosted at Google play store. It is available at android-base smart phone. So anybody can download it from Google Play Store of any android-base mobile. Otherwise, this mobile app can share from other smart phone by 'SHAREit' software. RKB is regularly updating with including all varietal information (include total 94 varieties as well as BRRI dhan89, BRRI dhan88 and BRRI dhan87). It has also included Rice cultivation methods, rice production methods, soil and fertilizer management, insects and their management, diseases and their management and irrigation & water management. • RKB has awarded world summit award-2018 on government & citizen engagement category at Bangladesh computer council, ICT Division.	1. Manage and maintain RKB. 2. Extend and update regularly as routine work.

	6.3 Activity: BRKB Website Management. **Research Progress:** • Updated with latest information of Aman, Aus and Boro rice varieties included latest variety of BRRI dhan89 and BRRI hybrid dhan6. • All types of information like Soil and fertilizer management, insects and pest management, Rice diseases management and preservation methods has been updated.	1. Provide more benefit to all users specially farmers, extension workers, researchers etc. 2. Include more information as well as national issues associated with rice production and training.
	6.4 Activity: Dynamic view connectivity system, Bangla searching system and inner banner system for BRKB Website. *(In collaboration with training, breeding and others research divisions)* **Research Progress:** • We have developed dynamic view connectivity system in BRKB.	1. Dynamic view connectivity system in BRKB. 2. Bangla searching system in BRKB. 3. Inner banner system in BRKB.
	6.5 Activity: BRRI Web Mail and Group Mail. **Research Progress:** • We have created individual e-mail id into BRRI domain for all scientists and all officers as per requirement of the Ministry of Agriculture (MoA). • We have created group mail for all scientists, officers and regional stations as per requirement of BRRI scientists. • We provided 120 webmail solution in this reporting year. • BRRI Web mail & Group mail has been hosted at BCC (Bangladesh Computer Council) server.	1. Create web mail ID and group mail as per requirement of BRRI scientists and officer's usage. 2. Manage, maintain and update regularly web mail ID, password and group mail for security purpose.

	6.6 Activity: Developing secure system for BRRI **Web Mail and Group Mail.** **Research Progress:** • Automatic active & close system (AACS) has been developed in BRRI web mail. • In the reporting year we incorporated secure sockets layer system in BRRI web mail, now our web mail is more secure.	1. Spamming filtering system (SFS) in BRRI web mail and group mail. 2. Automatic active & close system (AACS) in BRRI web mail and group mail. 3. Secure Sockets Layer system in BRRI web mail and group mail.
	6.7 Activity: Online Application System of BRRI. *(In collaboration with Administration of BRRI and Teletalk Mobile Company Ltd.)* **Research Progress:** • Agreement was completed between BRRI and Teletalk Bangladesh Limited, on 8 March' 2017 for Web & SMS based online application system software.	1. Digital and paperless recruitment system for BRRI. 2. Manage and maintain online application system of BRRI.
	6.8 Activity: e-File Management System of BRRI. **(In collaboration with Administration of BRRI)** **Research Progress:** • e-File (Nothi) Management System was introduced at BRRI with help of A2i, Prime Minister's Office (PMO) on 24 September' 2017. • At present (February, 2018), BRRI obtained 22nd position among all govt. organizations and departments for using e-File (Nothi) System. • Started and issued various file, official letter, various notice etc through e-Filing (Nothi) system at all research division, section and administration of BRRI HQ. • Started various file through e-Filing (Nothi) system initially at Rajshahi and Rangpur Regional Station.	1. Establishing uninerrupt and Paper-less office system. 2. Manage and maintain e-File (Nothi) system of BRRI.

	6.9 Activity: e-Tender System of BRRI. **Research Progress:** • BRRI has introduced e-GP on 1st July of 2016 and also incorporated with it as a first organization among the NARS institute as well as a first organization under Ministry of Agriculture (MoA). • BRRI has been submitted 102 (One hundred and Two) tenders into e-GP Portal in collaboration with procurement cell, building & construction division and others research divisions. • Tender submission process is being continued.	1. Establishing e-Governance. 2. Manage and maintain e-Tender system of BRRI.
	6.10 Activity: Digitalized Labour Salary Management System of BRRI. (In collaboration with FM Div.) **Research Progress:** • ICT Cell of Agricultural Statistics division has been digitalized LSMS for BRRI including labors information, two types of attendance (General attendance and additional attendance), pay slips, allowances, deductions, leave, savings and net pays etc. • Salary management system is easier than previous system for digitization.	1. Maintain the salary related information as well as labour information 2. Easy to access, accurate and consistent results will be obtained in the form of documents whenever the user needs. 3. To inherit all the properties with high security, fast, robust, flexible, reliable and scalable.
	6.11 Activity: Online Labour wages Management System of BRRI *(In collaboration with FM Div.)* **Research Progress:** • Software design has been completed. • Architecture of database has been completed.	1. Maintain the salary related information as well as labour information 2. Easy to access, accurate and consistent results will be obtained in the form of documents whenever the user needs. 3. To inherit all the properties with high security, fast, robust, flexible, reliable and scalable.

	6.12 Activity: LAN and internet connectivity of BRRI regional station(R/S). **Research Progress:** • Established Local Area Network (LAN) connectivity at five regional stations i.e. Sonagazi, Comilla, Rangpur, Barisal, and Habigonj. • Increased 2 Mbps full duplex, dedicated and 3.5G (3.5 Generation) internet bandwidth at four regional stations i.e. Rangpur, Sonagazi, Comilla and Habigonj.	1. Manage and maintain Internet connectivity of BRRI regional station 2. Manage and maintain local Area Network of BRRI regional station.
	6.13 Activity: BRRI Web Portal Management. **Research Progress:** • BRRI has made the web portal with both Bengali and English languages. It is the largest web portal (www.portal.gov.bd) in the world and BRRI is incorporated with it as a first organization among the NARS institute. • The static website of BRRI is converted into dynamic website (Web Portal) which is made by our ICT skill manpower of ICT Cell, Agricultural Statistics Division as per requirement of the Ministry of Agriculture (MoA) and Access to Information (A2i) under Prime Minister Office (PMO). It is hosted into Bangladesh Computer Council (BCC) server. • We have included rice database, climate database etc at BRRI dynamic website and updated regularly. • To make more updated and informative, we developed individual web page including picture of Headquarter and all regional stations of BRRI.	1. New features for BRRI web portal. 2. To increase hosting spaces gradually.

	6.14 Activity: Management of BRRI HQ Local Area Network and Internet Connectivity. **Research Progress:** • Increased Digital Data Network (DDN) bandwidth connectivity from 51 Mbps to 60 Mbps. Now our internet speed is faster than previous once. Hence, we are providing sufficient speed among all scientist and officer of BRRI.	1. Bandwidth speed would be increased and distributed the bandwidth among client PCs. 2. BRRI Local Area Network would be increased.
	6.15 Activity: BRRI Networks Update, Maintenance and Extension. **Research Progress:** • Introduced Facebook at BRRI for noble purpose as per instruction from Ministry of MoA. • Already 340 (Three hundred and Forty) members have been joined this BRRI Networks group. It is increasing gradually. • Stored at least 3000 various and more research activities photos of head quarter and all regional stations, uploaded around 170 necessary pdf and word file document for all members. • More than 900 various member's request has been pending because they are not BRRI employee. But it proves that BRRI networks are popular for all classe users of facebook. • BRRI Networks group is regular updated by ICT Cell employee and to protect from all types of unwanted post, photo and other's spam, there have worked a ICT Cell employee as a moderator and administrator. So it is always safe and secured.	1. Store more research related activities post and necessary documents. 2. Extend the group with adding more members and introducing more new feature for noble purpose.

	6.16 Activity: Personal Data Sheet of BRRI. **Research Progress:** • Created Personal Data Sheet (PDS) database including various information field for all scientists, officers, staffs as per requirement of the Ministry of Agriculture (MoA). • We have distributed 355 user ID and password to all scientists, officers & stuffs personal mail and published user id list into BRRI website. • It is a routine work and updated regularly.	1. Creating Personal Data Sheet (PDS) database including various information fields for all scientists, officers, stuffs as per requirement of the Ministry of Agriculture (MoA).
	6.17 Activity: Video Conference System of BRRI **Research Progress:** • Already we have created Skype account for all divisional head and regional stations head. The communications between BRRI headquarter and other's regional station has been conducted by Video Conference System in every monthly co-ordination meeting now.	1. Creating Skype account for all scientists.
	6.18 Activity: Heritage of BRRI. **Research Progress:** • We have created Heritage for all retired scientists, officers, staffs and labours of BRRI as per requirement of the BRRI authority. • Heritage is updated regularly as per availability of information. It is a routine work.	1. Managing and maintaining BRRI heritage. 2. Adding all ex. Scientists, ex. officers and ex. Stuffs in BRRI heritage.

Farm Management Division

Research Progress 2018-2019

Sl. No.	*Research Progress*	**Expected output**

	Program area/Project (Duration)	
Program area: Socio-economic and Policy		
03. Farm Management Division		
	3.1. Project: Rice Production Management	
	Expt. 1. Effect of spacing and seedling number per hill on the yield and yield components of different short duration rice varities in T.Aman and Boro seasons **<u>Factor A: Variety (Main Plot)</u>** **(For T.Aman)** 1. BRRI dhan71 2. BRRI dhan75 3. BINA dhan-17 **(For Boro)** 1. BRRI dhan84 2. BRRI dhan86 3. BRRI dhan28 **<u>Factor B: Spacing (Sub Plot)</u>** 1. 20 cm X 15 cm (33 hills/m^2) 2. 25cm X 15cm (16 hills/m^2) 3. 20cm X 20cm (25 hills/m^2) **Progress:** Report writing of both T.Aman and Boro season experiment has been completed.	**In T.Aman season:** BRRI dhan75 gave the highest grain yield with single seedling and (20 cm X 15 cm) spacing. **In Boro season:** BRRI dhan84 gave the highest grain yield with single seedling and (25 cm X 15 cm) spacing.

<table>
<tr>
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<td>Expt. 2. Effect of organic matter on soil properties and yield of rice
Treatments:
<table>
<tr><th>Expt.1</th><th>Expt.2</th></tr>
<tr><td>T_1= Control</td><td>T_1= Control</td></tr>
<tr><td>T_2= Chemical fertilizer as BRRI recom.</td><td>T_2= Chemical fertilizer as BRRI recom.</td></tr>
<tr><td>T_3= Kitchen waste 6.0t/ha</td><td>T_3= Kitchen waste 3.0 t/ha +1/2 T_2</td></tr>
<tr><td>T_4= Bio-slurry 6.0 t/ha</td><td>T_4= Bio-slurry 3.0 t/ha + 1/2 T_2</td></tr>
<tr><td>T_5= Poultry litter 6.0 t/ha</td><td>T_5= Poultry litter 3.0 t/ha + 1/2 T_2</td></tr>
</table>
Progress: Report writing of both T.Aman and Boro season experiment has been completed.</td>
<td>In both experiment, Poultry litter used plot gave better yield of rice.</td>
</tr>
<tr>
<td></td>
<td>Expt. 3. Rice seed production</td>
<td>In different seasons, this division produced 14189 Kg TLS and 12419 Kg breeder seed.</td>
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<td>3.2. Project: Survey and development of data base for labor management</td>
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<td></td>
<td>Expt. 1. Monitoring the laborers’ wages rate For rice cultivation around BRRI Farms.</td>
<td>The average laborers' wage rate day^{-1} varies from Tk. 488-540 in different region of the year.</td>
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<tr>
<td></td>
<td>3.3. Project: Management and utilization of land and other resources.
• Ten activities were done on seed production, irrigation, drainage, beautification etc.
These are the continuous routine activities</td>
<td>These are for the better outcome from farm land and researches.</td>
</tr>
</table>

Technology Transfer Program Area

Adaptive Research Division

Research Progress 2018-2019

A. TECHNOLOGY VALIDATION

1. Title: Advanced Lines Adaptive Research Trial (ALART)

Sl. No.	Research Progress	Expected output/Output
1.1	**T. Aus 2018**: Four advanced line i.e., BR9011-48-4-3, BR9011-64-1-2, BR9011-67-4-1from breeding division and BR(Bio)9787-BC2-63-2-4 from Biotechnology division along with BR26 and BRRI dhan48 as checks were tested at farmers' field in eight locations during T. Aus 2018. Both BR9011-67-4-1 and BR9011-64-1-2 gave higher grain yield than the check BRRI dhan48. Besides the line showed uniform flowering and maturity with almost similar grain size (thousand grain weights is similar). Although plant height of the line was slightly taller than BRRI dhan48, it showed lodging tolerance.	Considering grain yield, growth duration and other attributes BR9011-67-4-1 and BR9011-64-1-2 were recommended for Proposed Variety Trial (PVT).
1.2	**ALART, Rainfed lowland rice (RLR), T. Aman 2018:** Three advanced lines BR8841-22-2-4-2, BR8841-38-1-2-1 and IR10F102along with BRRIdhan39and BRRI dhan49 as checks were tested at farmers' field in eight locations during T. Aman 2018. The trial site of Barishal (Sadar) was damaged due to 4 times tidal submergence. All the tested entries gave statistical similar grain yield (4.76-4.86 tha^{-1}) to the check variety BRRI dhan49 (4.75 tha^{-1}), but statistically higher than the check variety BRRIdhan39.	Due to poor yield, slightly longer growth duration, high disease infection compared to check, none of the tested entries was found suitable for PVT.
1.3	**ALART, (RLR), Biotechnology, T. Aman 2018:** Two advanced lines developed by Biotechnology Division for rainfed lowland rice: BR(Bio)8961-AC22-14 and BR(Bio)8961-AC26-16 along with BRRI dhan49 (Ck) were evaluated in eight locations during T. Aman 2018. On an average of seven locations, the tested advanced lines gave little higher yield (4.69 and 4.67 tha^{-1}) compared to check (4.58 tha^{-1}) though the yield was statistically similar. Plant height and grain weight of BR(Bio)8961-AC26-16	Considering all attributes, both the genotypes BR(Bio)8961-AC22-14 and BR(Bio)8961-AC26-16 was recommended for proposed variety trial (PVT) if the irregular flowering is corrected by the concern division for the respective genotype.

	was little bit higher than the check and the line BR(Bio)8961-AC22-14. It is noticeable here that both the tested lines were less infected by false smut disease.	
1.4	**ALART, (RLR Rangpur) T. Aman 2018:** Three advanced lines (BR8189-10-2-3-1-5-RAN7, BR9392-6-2-IB-RAN5 and BR10238-5-1-RAN6) were evaluated against two check varieties (BR11 and BRRI dhan52) in seven locations of Rangpur region and in BRRI farm, Gazipur during T. Aman 2018. The tested three lines yielded more or less similar compared to the checks. Grains of the tested lines were bold type like check varieties	Considering all attributes, none of the genotypes was recommended for proposed variety trial (PVT).
1.5	**ALART, Insect Resistant Rice (IRR), T. Aman 2018:** Two advanced lines:BR8693-8-4-2-1 and BR8693-17-6-2-2, along with BRRI dhan49 (S. Ck) and BRRI dhan33 (R. Ck)as checks were tested at farmers' field in eight locations during T. Aman 2018. Both the advanced lines gave statistically higher yield than the check varieties i.e., BRRIdhan49 and BRRIdhan33, grain type of both the advanced lines was medium bold type, whereas grain type of the check variety of BRRI dhan49 was medium fine type. The flowering and maturity of the BR8693-8-4-2-1 was regular, but the flowering and maturity of the BR8693-17-6-2-2 was irregular. The main purpose of this ALART (Insect resistant rice) is to recommend insect resistant rice genotype which would be more resistant compared to other existing rice varieties.	Considering all the necessary characteristics and farmers' opinion, the advanced line BR8693-8-4-2-1 was found to be suitable for PVT.
1.6	**ALART Zinc enriched rice (ZER), Aman 2018:** Two zinc enriched advanced rice genotypes BR8442-12-1-3-1-B5 and BR8442-12-1-3-1-B1along with BRRI dhan72 and BRRI dhan49 as checks were tested at farmers' field in eight locations during T. Aman 2018.	Based on overall performance, BR8442-12-1-3-1-B5 was recommended for PVT.
1.7	**ALART Premium quality rice (PQR), Aman 2018:** Three advanced lines for premium quality rice: BR8493-12-7-4 (Com), BR8493-3-5-1 (Com) and BR8846-38-2-4-3 along with BRRI dhan37, BINA dhan-3 as standard checks;Katerivog and Kalizira as local check were tested at farmers' field in six locations during T.Aman 2018. Genotypes and environments interaction had significant effect on grain yield, growth duration, plant height and yield components. The highest yielder genotype BR8846-38-2-4-3 and the check varieties were almost disease	Considering overall performances and feedback of farmers and DAE personnel, the genotype BR8846-38-2-4-3 may be recommended for proposed variety trial (PVT).

	free.	
1.8	**ALART, Favorable Boro Rice (Biotechnology) Boro, 2019:** Two advanced lines developed by Biotechnology Division for favorable Boro condition (BR(Bio)9777-26-4-3 and BR(Bio)9777-118-6-4)along with BRRI dhan58 as check were evaluated in in eight locations during Boro 2019. All the tested entries failed to give significantly higher than the check variety and they don't have any special characters for which they could be considered for further progress.	Considering all attributes, none of the genotypes was recommended for proposed variety trial (PVT)
1.9	**ALART, PQR Boro, 2019:** Three advanced lines (BR8590-5-2-5-2-1, BR8590-5-2-5-2-2 and BR9207-45-2-2) developed by Plant Breeding Divisionfor premium quality Boro rice were evaluated in eight locations during Boro 2019 against the check variety of BRRI dhan50 and BRRI dhan81. The advanced lines have no yield advantage over the checks, high shattering at 80% maturity (10-15%) and longer growth duration. Initially, farmers and extension personnel choose BR8590-5-2-5-2-2 and BR8590-5-2-5-2-1 at vegetative and flowering stage due to attractive phenotypic appearance and long panicle size. But at maturity stage they dislike the entries due to shattering problem, delayed maturity of the lower portion of the panicle, blast incidence etc.	Considering all attributes, none of the genotypes may be recommended for proposed variety trial (PVT).
1.10	**ALART, ZER Boro, 2019:** Two advanced lines (BR8631-12-3-5-P2and BR8631-12-3-6-P3) developed by Plant Breeding Division for Zinc enriched Boro rice were evaluated in eight locations during Boro 2019 against the check variety BRRI dhan28 and BRRI dhan74. On an average,the first entry (BR8631-12-3-5-P2) yielded (6.85 tha-1) significantly higher than all other entries including checks.All the entries showed excellent plant growth with uniform flowering and maturity.	Farmers and extension personnel chooseBR8631-12-3-5-P2 due to attractive phenotypic appearance, higher yield, long panicle size and good grain size. Considering all attributes, the line BR8631-12-3-5-P2wasrecommended for proposed variety trial (PVT).
1.11	**ALART (FBR), Boro 2019:** Two advanced line i.e., BR8335-10-6-3-10 and BR8938-30-2-4-2-1 along with BRRI dhan28 and BRRI dhan58 as checks were tested at farmers' field in eight locations during Boro 2019. Grain yield of 2 tested lines and check variety BRRI dhan58 was almost similar ranged from 6.80 tha^{-1} to 6.96 tha^{-1} which were significantly higher than BRRI dhan28 (6.16 tha^{-1}) and growth duration of BRRI dhan28 was about one week earlier than other	Considering the above characteristics of the tested genotypes with check varieties, none of the genotypes could be recommended for proposed variety Trial.

	three genotypes . In terms of grain type, phenotypic acceptance and farmers' reaction, no significant difference was observed.	
1.12	**ALART, Bacterial Blight Rice (BBR-Bio), Boro 2019:** Three bacterial blight resistant advanced rice genotypes BR(Bio)8333-BC5-1-20, BR(Bio)8333-BC5-2-16, BR(Bio)8333-BC5-2-22 developed by Biotechnology division were tested along with Resistant check IRBB60 and standard check BRRI dhan29 during Boro 2019 at farmers' field in eight locations. Irrespective of genotypes and locations, the genotype BR(Bio)8333-BC5-1-20 gave the highest mean grain yield (7.26 t ha^{-1}) which was statistically similar with the check varieties BRRI dhan29 and BRRI dhan72. Yield performances of all the advanced lines were better in compare with resistant check IRBB60. Though none of the lines gave significantly higher yield comparing standard check BRRI dhan29, the advanced line (Bio)8333-BC5-1-20 was preferred by farmers and DAE personnel for its grain type (medium fine) and less disease incidence. There was no occurrence of BB in any of the experimental sites.	As we have no BB resistant variety, BR(Bio)8333-BC5-1-20 was recommended PVT if somehow the irregularity of flowering is corrected.
1.13	**ALART, Insect Resistant Rice (IRR), Boro 2019:** Two advanced lines: BR8335-10-6-3-10 and BR8340-5-6-1, along with BRRI dhan58 (S. Ck) and T27A (R. Ck) as checks were tested at farmers' field in eight locations during Boro 2019. None of the tested advanced line could give higher yield than the check variety BRRI dhan58 7.19 tha-1. The flowering and maturity of the BR8340-5-6-1 was uniform and had less insect infestation. AS the main purpose of this ALART is to recommend insect resistant rice genotype which would be more resistant compared to other existing rice varieties.	Considering overall performance, BR8340-5-6-1 line was found to be suitable for PVT.

B. TECHNOLOGY DISSEMINATION

2. Title: Seed Production and Dissemination Program (SPDP) of BRRI varieties with other technologies under GOB and Projects (SPIRA, ASRS, TRB, URSP (NATP2**)).**

	Research Progress		**Expected Output/Output**			
SN	**Expt. Title: Seed Production**	**Locations and varieties/technologies**	Total production	Seeds retained	Farmers gained	Motivated Farmer

	and Dissemination Program (SPDP)		through demo (ton)	by farmers (ton)	awareness through demo (no.)	(no.)
2.1	SPDP using drum-seeder during Aus, 2018 using BRRI dhan48 & BRRI dhan82	Locations: Nakla, Sherpur Varieties: BRRI dhan48 & BRRI dhan82 Technologies: drum-seeder	17.4	3.9	360	170
2.2	SPDP of HYV under TRB program during Aus, 2018	Locations: eight upazilas of six districts (Mymensingh, Chattogram, Moulvibazar, Jashore , Chuadanga, Khulna Varieties: BRRI dhan48 & BRRI dhan82	24	1.6	825	120
2.3	SPDP in Jhum, 2018	Locations: 7 upazila in three hilly districts (Bandarban, Rangamati & Khagrachari) Varieties BRRI dhan48 and BRRI dhan65	4.0	.7	633	265
2.4	SPDP in valley of Hills during T. Aus, 2018	Locations: 7 upazila in three hilly districts (Bandarban, Rangamati & Khagrachari) Varieties BRRI dhan27, BRRI dhan48, BRRI 65 and BRRI dhan82.	7.2	2.3	705	314
2.5	SPDP, T. Aman 2018 under GoB and URSP, SPIRA, TRB and URSP (NATP 2)	Locations: 37 upazila of 24 districts (Sherpur, Netrakona, Mymensingh, Narayanganj, Chattogram Tangail, Gaibandha, Chapai Nawabganj, Jashore, Bagerhat and Patuakhali, Netrakona, Mymensingh, Khulna, Naogaon,	122.8	14.4	12500	5000

		Bagura, Joypurhat, Bandarban and Cox'sbazar, Comilla, Mymensingh, Barisal & Jhalokathi) Varieties: BRRI dhan34, BRRI dhan49, BRRI dhan70, BRRI dhan71, BRRI dhan72, BRRI dhan75, BRRI dhan79 and BRRI dhan87				
2.6	SPDP in valley of Hills during T . Aman 2018	Locations: 7 upazila in three hilly districts (Bandarban, Rangamati & Khagrachari) Varieties: BRRI dhan27, BRRI dhan48, BRRI 65 and BRRI dhan82.	11.00	1.8	875	466
Adaptive Trial Aman 2018						
2.7	Head to Head Adaptive Trial Aman 2018 under TRB project	A total of 200 Head to Head Adaptive Trials (HHAT) were conducted in Aman (wet season) 2018 throughout the country under TRB project. BRRI released 12 varieties BRRI dhan49, 51, 52, 66, 70, 71, 72, 73, 75, 79, 80 and 87 were used in the HHATs along with check varieties Swarna, Guti Swarna, Suman Swarna, Sada Mota, Khato Babu, BINA dhan7, BINA dhan11 and BINA dhan17. Among the varieties, 5 to 6 varieties were used in a HHAT based on rice environments like Rainfed Lowland Rice (RLR), Salinity (Khulna Region), Salinity (Barishal Region), Flash Flood Submergence (FFS) and Drought. Area of each HHAT was 1 bigha (0.13 ha) and total area of HHAT was 200 bigha (26.8 ha).	Genotypes by environments interaction had significant effect on the overall performances of the varieties. Performances of the variety varied from location to location due to environmental effect. Among the varieties, BRRI dhan87 gave the highest mean grain yield (6.36 t ha^{-1}) and the lowest mean grain yield was found in BRRI dhan66 (4.42 t ha^{-1}). Farmers preferred BRRI dhan75 for its higher yield with shorter growth duration, long slender grain having bit aroma, Rabi crop easily can be grown after harvesting. BRRI dhan76 gave higher yield than local varieties like DudKalam, Sadamota etc. BRRI dhan80 produced higher yield, it could be popularize in high and medium high land. BRRI dhan87 performed excellent throughout the country. Farmer preferred this variety for its higher grain and straw yield and long slender grain.			
2.8	Adaptive trial (AT) in Jhum	Experiments were carried out in 10 upazilas	Considering all the situations, BRRI dhan48 and BRRI dhan82 might be suitable for hilly			

	during Aus 2018	in three hilly districts (Bandarban, Rangamati & Khagrachari) using four high yielding modern rice varieties (BRRI dhan27, BRRI dhan48, BRRI dhan65 and BRRI dhan82) and one local check were planted side by side in one bigha of land.	areas. Some newly released varieties might be included in the program in next season.
2.9	Adaptive trial (AT) in Hill during T.Aman 2018:	Experiments were carried out in 10 upazila in three hilly districts (Bandarban, Rangamati & Khagrachari) using five high yielding modern T. Aman rice varieties (BRRI dhan49, BRRI dhan70, BRRI dhan71, BRRI dhan72 and BRRI dhan75) and one local check were planted side by side in one bigha of land.	BRRI dhan49 yielded the highest (5.2 t ha^{-1}) followed by BRRI dhan72 (5.1 t ha^{-1}), BRRI dhan71 (4.9 t ha^{-1}) and BRRI dhan75 (4.8 t ha^{-1}) and these varieties might be suitable for hill areas in T. Aman season.
2.10	Head to Head Adaptive Trial Boro 2019 under TRB project	A total of 200 Head to Head Adaptive Trials (HHAT) were conducted in Boro (dry season) 2019 throughout the country under TRB project following similar protocol of HHAT Aman 2018. BRRI released 9 varieties (BRRI dhan28, BRRI dhan67, BRRI dhan74, BRRI dhan81, BRRI dhan84 & BRRI dhan86, BRRI dhan29, BRRI dhan58 and BRRI dhan89) were evaluated in the HHATs throughout the country. The varieties	BRRI dhan28 gave the lowest yield having highest pest incidence especially neck blast infection that should be replaced immediately. BRRI dhan29 produced competitive yield along with BRRI dhan89, however it was infected by neck blast disease in some locations. BRRI dhan67 showed potentiality throughout the country although it was released for coastal saline environment. BRRI dhan58 and BRRI dhan81 would be suggested to grow in southwest to north region that means Jashore to Panchagarh as these varieties highly infected by neck blast disease in other regions of the country. BRRI dhan74 would be disseminated only those places where farmers like bold grain. BRRI dhan84 performed well with shorter growth duration even 2 days earlier than BRRI dhan28; however it was lodged in some locations. This will be suitable in high and medium high land. Performance of BRRI dhan86 was not at par level as it was highly infested by disease (sheath blight, bacterial blight and neck blast) and insect (stem borer, leaf folder).

		were tested under two groups: the first 5 varieties were under BRRI dhan28 group and rest of 3 varieties (BRRI dhan29, BRRI dhan58 and BRRI dhan89) was in BRRI dhan29 group based on growth duration. Similar protocol was followed regarding crop management and data collection.	Flowering and maturity of BRRI dhan86 were uneven in some locations indicated that heterogeneity is still existed. Consequently, most of the farmers are disappointed with this variety. BRRI dhan89 produced better yield than BRRI dhan29. Most of the farmers liked for its competitive yield; however some farmers disliked for its longer growth duration.			
2.11	SPDP, Boro 2019 under URSP (NATP 2) project in Boro 2019. Under GoB, SPIRA, ASRS, TRB and NATP 2	64 upazila of 38districts (Tangail, Kishoreganj, Narayanganj, Sherpur, Netrakona, Mymensingh, Khulna, Joypurhat, Chattogram, Cox'sbazar and Bagerhat , Gaibandha, Dinajpur, Thakurgaon, Panchagarh, Naogaon, C.Nawabganj, Jessore, Jhinaidah, Patuakhali, Chittagong, Cox's Bazar, Moulvibazar, Netrakona, Kishoreganj, Khulna, Bagerhat, Netrakona, Mymensingh, Sherpur, Khulna, Jashore, Chuadanga, Naogaon, Bagura, Bandarban and Cox'sbazar, Mymensingh, Jamalpur. Varieties: BRRI dhan47, 50, 58, 60, 63, 67, 68, 69, 74 & 81, 84, 89	180.6	22.1	13010	2458

2.12	SPDP in valley of Hills in Boro 2019	**Locations:** Three hilly districts of Bangladesh (Bandarban, Rangamati, Khagrachari) Varieties: BRRI dhan58 and BRRI	6.3	.9	597	270
2.13	Adaptive trial in hills during Boro 2019	Experiments were carried out in 12 upazila in three hilly districts (Bandarban, Rangamati & Khagrachari) using five high yielding modern T. Aman rice varieties (BRRI dhan58, BRRI dhan63, BRRI dhan67, BRRI dhan81 and BRRI dhan86) and one local check were planted side by side in one bigha of land.	BRRI dhan58 and BRRI dhan67might be suitable for the hilly areas during Boro season. BRRI dhan63, BRRI dhan81 and BRRI dhan86 was affected by blast disease.			
2.14	Production of quality seeds at BRRI farm	Seeds of recent and promising rice varieties were produced in T. Aman and Boro seasons during the reporting period under the close supervision of Adaptive Research Division	A total of 7.8 tons quality seeds of different BRRI varieties were produced. The seeds were distributed to the farmers and stakeholders through Head to Head Adaptive Trial (HHAT), Seed production and dissemination program (SPDP) and seed support program in Aman and Boro 2019.			
Grand Total			373.3	**47.7**	**29505**	**9063**

NB:
SPIRA=Strengthening Physical Infrastructure and Research Activities of BRRI
ASRS=Adaptation and out-scaling of some selected rice varieties in stress prone environments
TRB= Transforming Rice Breeding Project
URSP= Up-scaling of BRRI Released New Promising Rice Varieties through Quality Seed Production at Farmers' Level

C. PROMOTIONAL ACTIVITIES

Farmers' training and field Day

SN	Farmers' training and promotional activities	Expected Output/Output
3.1	**Farmers training during 2018-19 under GoB, TRB, ASRS and SPIRA** During the reporting period, ARD 49 farmers' train at different locations under GOB and different projects d a total of 62 Farmers' training at different locations of the country.	A total of 1520 trainees (1410 farmers and 110 SAAOs of DAE) participated SAAOs of DAE) participated.
3.2	**Field Day/ Farmer's Rally under GoB, TRB, ASRS and SPIRA** ARD conducted 60 field days at different locations of the country under GoB and different projects (SPIRA, TRB, ASRS and URSP (NATP2) during Aus 2018, Aman 2018 and Boro 2019.	About 8000 participants including farmers, local leaders and DAE personnel were participated in the field days.
3.3	**Seed support to stakeholders under TRB project.**	ARD distributed 5.16 and 4.6 ton truthfully labeled seeds (TLS) of modern rice varieties in Aman 2018 and Boro 2019 respectively were distributed to 1435 farmers and stakeholders with free of cost through seed support program in Aman 2019 and Boro 2019. Around 5000 farmers will be benefitted through getting seed and technologies directly and indirectly.
3.4	**Establishment of Farmers seed center under TRB project and ASRS program under MoA** A total of 26 farmers' seed centers were established at Netrakona, Kishoreganj, Jashore, Khulna, Bagerhat and Bandarban providing	ARD provided 78 plastic drum under TRB project and ASRS program. Six plastic drums were provided in each seed center and around 80 kg seeds can be preserved in each drum. Farmers will preserve good quality seed of promising rice varieties for rapid dissemination through seed exchange or selling among the farmers.

Training Division

Research Progress 2018-2019

Sl. No.	Research Progress	Expected output
	Program Area: Technology transfer Program Performing Unit: Training Division	
	1.Capacity Building and Technology Transfer	

	1.1. Training on rice physiological development through trait discovery. Duration: 1 week Batch: 1 No. of Participants:30 Progress: Completed	Knowledge of the trainees on different traits related to rice physiology will be increased.
	1.2. Training on modern rice production technologies (Regular). Duration: 1 week Batch: 20 No. of Participants:395 Progress: Completed	Knowledge of the participants on modern rice production will be enriched.
	1.3.Two-month rice production technologies training for DAE officers Duration: 2 months Batch: 2 No. of Participants: 60 Progress: Completed	Trained personnel will be able to identify field problems of rice cultivation and solve the problem.
	1.4. Training on basic molecular biology and disease resistance Duration: 1 week Batch: 2 No. of Participants: 49 Progress: Completed	Knowledge of the participants on molecular biology will be enriched.
	1.5. Training on modern rice production and ecofriendly insect management training Duration: 1 week Batch: 2 No. of Participants: 35 Progress: Completed	Knowledge about modern rice production and ecofriendly insect management of the trainees will be enriched.
	1.6. Farmers training Duration: 1 day Batch: 20 No. of participants:600 Farmers, 40 SAAO Progress: Completed	Knowledge of farmers in haor areas about modern rice production technologies will be enriched.
	1.7.Training on dissemination of BRRI released aman varieties in northern region of Bangladesh Duration: 1 day Batch:3 No. of participants:62 Progress: Completed	Dissemination of BRRI released varieties in Northern region will be increased instead of Indian varieties.
	1.8 Evaluation of imparted training program	All the training programs on modern rice production will be very much helpful for the trainees to build up their capacity for modern rice

		production activities.

REGIONAL STATION PROGRAM AREA

Regional Station, Bhanga, Faridpur.

Research Progress 2018-2019

Sl, No.	Program area/Project (Duration)	Expected Output
	Program Area: Varietal development , Farming Systems Research, Crop-soil-water management, Socio economics, Technology transfer **Program Performing Unit:** BRRI Regional Station, Bhanga, Faridpur	
1	Experiment 1. Field Rapid generation advance (FRGA)	In Boro 2018-19, 22675 plants were grown in F_2 generation followed Field RGA technique with single seed descent (SSD) targeting to develop high yielding Boro varieties and 10395 F_3 progenies were maintained by collecting single panicle from each plant
2	Experiment 2. Proposed Variety Trial (PVT) of DWR, B. Aman, 2018	Two advanced breeding lines such as BR10230-15-27-7B (BR11 Sub1 / BRRI dhan40), BR10260-7-19-2B (Tilakkachari / BRRI dhan41) and a check variety Fulkori were evaluated as PVT in two locations, Muksudpur upazila in Gopalganj and Bhanga upazila of Faridpur district. BR10230-15-27-7B was recommended for release as BRRI dhan91 which is country's first deep water rice high yielding variety.
3	Experiment 3. Proposed Variety Trial (PVT) for PVT-RLR and ZER of T.Aman, 2018	BR7528-2R-HR16-2-24-1 (ZER) and BR8492-9-5-3-2 (RLR) gave 0.9 tha^{-1} and 1.0 tha^{-1} higher yield than check variety BRRI dhan39 at Akanbaria village of Bhanga upazila in Faridpur district. The growth duration of BR7528-2R-HR16-2-24-1 (ZER) was six days earlier than the check variety. The growth duration of BR8492-9-5-3-2 (RLR) was similar to check variety BRRI dhan39
4	Experiment 4. Proposed Variety Trial (PVT) for Faourable Boro (Bio), Boro, 2018-19	BR (Bio)9787-BC2-63-2-2 produced 0.96 tha^{-1} higher yield than check variety BRRI dhan28. The growth duration of BR(Bio)9787-BC2-63-2-2 was four days shorter than check variety

Sl, No.	Program area/Project (Duration)	Expected Output
5	Experiment 5. Regional Yield Trial (RYT), B.Aman, 2018	In Kendua village of Muksudpur upazila in Gopalganj district, all line produced higher grain yield than the check variety Hizal-digha. Among all, Lal-mohon produced higher yield (1.4 tha^{-1}). In Talma village of Nagarkanda upazila in Faridpur district, there is no significant differences in yield among these lines. The growth duration of sorsoria, dudlaki, laxmidigha was almost similar to check variety. The other four lines Bashiraj, Biladigha, Kipho-digha, Lal-Mohon has higher growth duration than check variety in both locations.
6	Experiment 6. Multi-location Yield Trial in B.Aman, 2018	The advance breeding line like BR7930-20-2-2-2-2-1produced similar grain yield(3.9 tha^{-1})to the check varietyBRRI dhan52 with almost 21 days higher growth duration. The other advance breeding lines produced lower yield with the check variety BRRI dhan52. There were no advanced lines that produced higher yield than check variety BRRI dhan44. The growth duration of BR8748-19-1 was eight and fifteen days earlier than that of check varieties BRRI dhan52 and BRRI dhan44 respectively
7	Experiment 7. Advanced yield trial (AYT-1 & AYT-2) in Boro Season, 2018-19	The advance breeding lines like BR8899-17-1-1-1-1-1 (7.76 tha^{-1}), IR100008-40-B-3 (7.34 tha^{-1}), IR100740-89-B-2 (7.2 tha^{-1}), IR100722-B-B-B-B-16 (6.89 tha^{-1}), TP30433 (6.77 tha^{-1}), IR99982-B-B-B-B1(6.74tha^{-1})produced higher grain yield than the both check varieties (BRRI dhan81 and BRRI dhan28) with longer growth duration and The advance breeding lines like IR99982-B-B-B-B-18 (6.69 tha^{-1}), BR10296-55-4 (6.66 tha^{-1}), TP30015 (6.65 tha^{-1}), IR99982-B-B-B-B-8 (6.61 tha^{-1}), IR100121-B-B-B-B-67 (6.46 tha^{-1}), IR100004-19-B-1 (6.3 tha^{-1}) produced higher grain yield than the check variety BRRI dhan28 with longer growth duration
8	Experiment 8. Preliminary yield trial in Boro Season, 2018-19	The advance breeding line like BR10296-27-3-1-1 (8.08 tha^{-1}), TP 30754 (7.79 tha^{-1}), TP 30596 (7.73 tha^{-1}), TP 30606 (7.58 tha^{-1}), TP 30610

Sl, No.	Program area/Project (Duration)	Expected Output
		(7.56 tha^{-1}), TP 30598 (7.19 tha^{-1}), TP 30597 (6.96 tha^{-1}) produced higher grain yield than the check varieties (BRRI dhan81 and BRRI dhan28) with longer growth duration and two breeding lines BR9600-22-5-2-1-P3 (6.79 tha^{-1}), TP 21654 (6.71 tha^{-1}) produced higher grain yield than the check variety BRRI dhan28 with longer growth duration
9	Experiment 9. Regional Yield Trial in Boro Season, 2018-19	**RYT (Boro) Favorable:** Among five advanced breeding lines, none of them out-yielded the check BRRI dhan58. **RYT (Boro) Bacterial Blight Resistance:** Among six advanced breeding lines, none of them out-yielded the susceptible check BRRI dhan29 with shorter growth duration. But BR9651-15-2-1-4 produced slight higher yield with similar growth duration than check variety BRRI dhan58. Compared with resistant check IRBB60, BR9651-15-2-1-4 produced higher yield at about 0.24 tha^{-1} with similar growth duration followed by BR9651-15-2-1-5, BR9651-15-2-1-3, BR9651-15-4-3-2 at about 0.2 tha^{-1}, 0.19 tha^{-1} and 0.06 tha^{-1}respectively. **RYT (Boro) PQR:** All four advance breeding line like BR8862-29-1-5-1-3, BR8862-8-3-4-4-1, BR8995-2-5-5-2-1, BR9205-10-1-5-3 produced higher grain yield at about 1.07 tha^{-1}, 1.5 tha^{-1}, 0.8 tha^{-1}, 0.32 tha^{-1} respectively than the check varieties BRRI dhan50 withlonger growth duration but lower yield comparing other check variety BRRI dhan63 with longer growth duration also. **RYT (Boro) ZER:** The advance breeding line IR99285-1-1-1-P2 produced higher yield at about 2.26 tha^{-1}, 0.89 tha^{-1}, 0.32 tha^{-1} over Check varieties BRRI dhan84, BRRI dhan74 and BRRI dhan29 respectively. But IR99285-1-1-1-P2 produced higher grain yield at about 1.73 tha^{-1}, 0.36 tha^{-1} than the check varieties BRRI dhan84 and BRRI dhan74 respectively with longer growth duration but lower yield comparing other check variety BRRI dhan29 with 12 days shorter growth duration. **RYT (Boro) Cold tolerant-Bio:** The advanced

Sl, No.	Program area/Project (Duration)	Expected Output
		breeding line BR(Bio)9777-124-1-1-2 produced lower yield than the check BRRI dhan28 and BRRI dhan36 with similar growth duration **RYT (Boro) Favorable-Bio:** Among three advance breeding lines, BR(Bio)9777-116-12-2-5 and BR(Bio)9777-116-12-2-4 produced about 0.27tha^{-1} and 0.13tha^{-1} higher grain yield respectively with similar growth duration than the check variety BRRI dhan58 **RYT (Boro)Bacterial Blight Resistance-Bio:** Among the five advance breeding lines, none of them out-yielded the resistant check IRBB60 with almost similar growth duration. But BR(Bio)11447-1-28-14-3 produced higher yield at about 0.09 tha^{-1} over standard check variety BRRI dhan28
10	Experiment 10. Estimation of Rice Elite Breeding Pool for Irrigated Ecosystem of Bangladesh, 2018-19	148 genotypes were evaluated for breeding value estimation. Initially, 10 (ten) genotypes were selected based on yield performance which will be used as parent in crossing and further evaluation.
11	Experiment 11. Preliminary Yield Trial (PYT-BZT) in Boro 2018-19	The genotype IR 106236-B-B-B-PRN B-PRN B-PRN-62 produced higher yield 5.84 tha^{-1} followed by IR 106239-B-B RGA-B RGA-138 (5.51 t/ha), IR16A2203 (5.08 tha^{-1}), IR 106236-B-B-B-PRN B-PRN B-PRN 246 (5.05 tha^{-1}), IR16A2287 (5.02 tha^{-1}), IR15A3248 (4.94 tha^{-1}), IR16A1135 (4.78 tha^{-1}), IR16A1996 (4.60 tha^{-1}), IR15A3466 (4.59 tha^{-1}), IR 106236- B-B-B-PRN B-PRN B-PRN 11 (4.56 tha^{-1}), IR 103314-B-B RGA-B RGA-143-1 (4.54 tha^{-1})
12	Experiment 11. INGER-IIRON Trial in Boro 2018-19	Out of 67 lines, 11 lines such as SVIN055, SVIN63, SVIN64, SVIN65, SVIN66, SVIN69, SVIN74, SVIN76, SVIN77, SVIN109 and SVIN117 were selected for using as parent in cross and advanced yield testing.
13	Experiment 1. Stability of yield of BRRI released Aman varieties	In long duration Aman varieties, BR22, BRRI dhan41 and BRRI dhan46 gave the highest grain yield (4.1 tha^{-1}) followed by BRRI dhan44 (3.9 tha^{-1}) and BR23 (3.6 tha^{-1}). In short duration Aman varieties, BRRI hybrid dhan4 produced higher yield (4.2 tha^{-1}) followed by BRRI dhan71 (3.7 tha^{-1}) and BRRI dhan56 (3.6 tha^{-1}). BRRI hybrid dhan6 gave the highest grain yield

Sl, No.	Program area/Project (Duration)	Expected Output
		(4.4 tha^{-1}) in medium duration Aman varieties followed by BRRI dhan70 (4.3 tha^{-1}) and BRRI dhan73 (4.1 tha^{-1}), BRRI dhan53 (4.1 tha^{-1}), BRRI dhan49 (4.1 tha^{-1}). In Boro season, long duration varieties,BRRI dhan89 gave the highest grain yield (6.8 tha^{-1}) followed by BRRI dhan29 (6.4 tha^{-1}) and BRRI dhan35 (6.1 tha^{-1}). In short duration Boro varieties BRRI Hybrid dhan3 yielded higher yield (6.1 tha^{-1}) followed by BR74 (5.7 tha^{-1}) and BRRI dhan68 (5.5 tha^{-1}).
14	Experiment. 14. **:** Identification of potential rice variety in Wheat/Onion-Jute-Relay Aman cropping pattern under shallow deep water rice ecosystem	For identification of potential rice variety in Wheat/Onion-Jute-Relay Aman cropping Pattern under shallow deep-water rice ecosystem, highest yield of rice (3.9 tha^{-1}) was obtained from BRRI dhan39 that was relayed with jute. Highest REY (Rice equivalent yield) was found from T_5 (24.74 tha^{-1}) cropping pattern followed by T_2 (24.17 tha^{-1}) and T_4 (22.74 tha^{-1})
15	Experiment. 15: Validation of improved fertilizer management option in *Aman* rice relayed with jute at farmers field in shallow flooded area	In validation of improved fertilizer management option in *Aman* rice relayed with jute at farmers field in shallow flooded area, highest yield (4.4 tha^{-1}) was obtained from researcher fertilizer management practice (Fertilizer rate (Urea-TSP-MP-Gypsum-Zinc): 225-105-90-135-7.5 kg/ha through top dressing at weeding time than farmer practice
16	Experiment. 16**:** Multilocation testing of Boro-DWR cropping pattern in flood prone areas	In multi-location testing of Boro-DWR cropping pattern in flood prone areas, existing cropping pattern was replaced by improved cropping pattern Boro-DWR (Laldigha) and REY was increased at about 1.3 tha^{-1}
17	Experiment. 17**:** Nitrogen management of newly released short duration modern T. Aman rice varieties	In effect of nitrogen and potassium management on growth and yield of short duration T. Aman rice, yield of BRRI dhan71 was significantly higher in T_4 (4.6 tha^{-1}) followed by T_2 (4.3 tha^{-1}). In respect of yield of BRRI dhan75, there was no significant difference among treatments. In context of plant height there was no significant differences in two varieties among four treatments.
18	Experiment. 18: Stability of yield of BRRI released Aman & Boro varieties	In long duration Aman varieties, BR22, BRRI dhan41 and BRRI dhan46 gave the highest grain yield (4.1 tha^{-1}) followed by BRRI dhan44 (3.9 tha^{-1}) and BR23 (3.6 tha^{-1}). In short duration

Sl, No.	Program area/Project (Duration)	Expected Output
		Aman varieties, BRRI hybrid dhan4 produced higher yield (4.2 tha^{-1}) followed by BRRI dhan71 (3.7 tha^{-1}) and BRRI dhan56 (3.6 tha^{-1}). BRRI hybrid dhan6 gave the highest grain yield (4.4 tha^{-1}) in medium duration Aman varieties followed by BRRI dhan70 (4.3 tha^{-1}) and BRRI dhan73 (4.1 tha^{-1}), BRRI dhan53 (4.1 tha^{-1}), BRRI dhan49 (4.1 tha^{-1}). In Boro season, long duration varieties,BRRI dhan89 gave the highest grain yield (6.8 tha^{-1}) followed by BRRI dhan29 (6.4 tha^{-1}) and BRRI dhan35 (6.1 tha^{-1}). In short duration Boro varieties BRRI Hybrid dhan3 yielded higher yield (6.1 tha^{-1}) followed by BR74 (5.7 tha^{-1}) and BRRI dhan68 (5.5 tha^{-1}).
19	Activity 1: Demonstration of modern rice varieties in Aman and Boro seasons in greater Faridpur region	Mean grain yields with growth duration of demonstrated Aman varieties were: 5.5 tha^{-1} with 128 days for BRRI dhan71, 5.8tha^{-1} with 121 days for BRRI hybrid dhan4 and 5.7 tha^{-1} with 120 days for BRRI hybrid dhan6. In Boro 2018-19, mean grain yield of BRRI dhan58 was 6.9tha^{-1} with growth duration of 155 days, 5.8 tha^{-1} with 148 days for BRRI dhan74, 6.3 tha^{-1} with 148 days for BRRI dhan81, 8.2 tha^{-1} with 162 days for BRRI dhan91. Under TRB-BRRI project, The highest grain yield with growth duration in different locations were as follows: 8.18 tha^{-1} in BRRI dhan28 at Goalando, Rajbari; 10.08 tha^{-1}in BRRI dhan67 at Bhanga, Faridpur; 8.03 tha^{-1} in BRRI dhan74 at Mukshudpur, Gopalganj; 8.65 tha^{-1} in BRRI dhan81 at Kalkini, Madaripur; 9.83 tha-1 in BRRI dhan84 at par ShariatpurSadar, Shariatpur; 9.83 tha^{-1} in BRRI dhan86 at ShariatpurSadar, Shariatpur.
20	Activity 2. Seed production and dissemination in BRRI Farm	BRRI Regional Station, Bhanga farm produced about 25.0 tons of seeds of which about 10 tons of breeder seed of BRRI dhan28 and BRRI dhan29 and the rest about 15.0 were TLS of short duration Aman varieties e.g. BRRI dhan39, BRRI dhan71, BRRI dhan75, BRRI dhan79 and BRRI dhan87 as well as Boro varieties of BRRI dhan28, BRRI dhan29, BRRI dhan50, BRRI dhan58, BRRI dhan63, BRRI dhan67, BRRI dhan81, BRRI dhan88, BRRI dhan89 during

Sl, No.	Program area/Project (Duration)	Expected Output
		Boro 2018 -19 season.
21	Activity 3. Training /Agricultural Fair	Three hundred farmers of greater Faridpur region at production technologies through 10 training programs organized by BRRI Regional Station, Bhanga were trained on modern rice with the cooperation of DAE under the financial assistance of GOB and BRRI -SPIRA project.

Regional Station, Rangpur

Research Progress 2018-2019

Sl. No.	Research Progress Program area/Project (Duration)	Expected output
Varietal Development program		
1.0	**Development of rice varieties suitable for Rangpur region**	
1.1	Field RGA (F3 and F4)	In Boro and T. Aman season, approximately 4, 000 plants were selected for generation advanced
1.2	Observational Yield Trial (OYT)	80 genotypes in Boro and 125 genotypes in T. Aman season were selected, and new suitable Boro varieties will be developed for Rangpur region
1.3	Secondary Yield Trial (SYT) of BRRI dhan49 NILS	16 genotypes were selected for further evaluation
1.4	Advanced line adaptive Trial (ALART)	Two genotypes (BR8189-10-2-3-1-5 and BR10238-5-1) were selected for ALART in RLR ecosystem for Rangpur region
2.0	**Development of rice varieties suitable for Rangpur region**	
2.1	Secondary Yield Trial (SYT)	16 genotypes were selected and suitable T. Aman varieties will be developed for Rangpur region
2.2	Maintenance and seed increase of parents/lines/land races	To maintain local and modern rice variety as germplasm for

		breeding
CROP-SOIL-WATER MANAGEMENT		
1.1	**Effect of Crop Establishment Methods and Nutrient Management on the Performance of BRRI newly develop Boro, T. Aus and T. Aman varieties at Rangpur region** **Materials and methods:** **Design:** Randomized complete block design (RCBD) with 3 replications. **Treatments:** Three nutrient management and four crop establishment methods. A: Nutrient Management; N_1: AEZ based BRRI recommended nutrient, N_2: Soil test based BRAC fertilizer recommended guide 2012 based and N_3: Control. B: Crop Establishment Methods; M_1: BRRI recommended management (40-day old seedling, 2 seedling per hill, 20 cm × 20 cm spacing), M_2: SRI Management (12-day old one seedling per hill, 30 cm × 30 cm spacing with SRI water management, M_3: Sprouted seed at 20 cm apart by line sowing, M_4: Spouted seed by broadcasting. Tested varieties were in T. Aus, T. Aman and Boro season BRRI dhan48, BRRI Dhan71 and BRRI dhan63 respectively.	BRRI recommended methods or SRI methods and BRRI recommended or soil test based BARC 2012 nutrient management could be established for higher and sustainable yield at Rangpur region in Boro, T. Aus and T. Aman season.
1.2	**Effect of Organic (Vermi compost) and Inorganic fertilizer on fine rice yield and quality at Rangpur region in T. Aman season** **Materials and methods:** **Design: RCBD with 3 replications.** **Treatments:** T_1 = Control, T_2 = BRRI Recommended fertilizer, T_3 = Soil test based BARC 2012 fertilizer recommendation, T_4 = ½ T_2 + 1 t/ha varmi compost, T_5 = ½ T_3 + 1 t/ha varmi compost, T_6 = Only 1 t/ha varmi compost, T_7 = Only 2 t/ha varmi compost, T_8 = Only 3 t/ha varmy compost, T_9 = Only 4 t/ha varmy compost and T10 = T_2 + 75 kg mustard oil cake. BRRI dhan50 and BRRI dhan70 used during Boro and T Aman season	The highest grain yield was found from treatment T_3, T_2 than $T_{10.}$ T_2 and T3 produced similar higher grain yield but there is no significance effect use of mastered oil cake with BRRI recommended fertilizer. The highest yield of BRRI dhan50 (5.37 t/ha) and BRRI dhan70 (3.73 t/ha) was found by applying Soil test based BARC 2012 Fertilizer Recommendation dose. In terms of grain quality of BRRI dhan50 and BRRI dhan70, comparative better grain quality was observed for T10 of BRRI dhan70 which highest at T3. Only the application of vermi compost is negatively correlated with grain yield and grain quality.

Regional Station, Satkhira-9400

Research Progress 2018-2019

Sl. No.	Research Progress	Expected output
1.	**Variety Development Program (VDP)** In Boro season 2018-19, proposed breeding line HHZ5-DT20-DT2-DT1, HHZ12-SAL2-Y3-Y2 and IR83484-3-B-7-1-1-1 yielded higher than all check varieties. BR(Bio)9787-BC_2-63-2-2 produced higher yield with 1 days earlier growth advantage against the check variety BRRI dhan28. In T.Aman 2018, all 5 advanced lines BR-RS(Raj)-PL4-B, BR-SF(Rang)-PL1-B, BR8535-2-1-2, BR8210-10-3-1-2 and BR8492-9-5-3-2 yielded higher than the check varieties i.e BRRI dhan49, BRRI dhan39 & BRRI dhan34. A total of 83 breeding lines were evaluated in RYT during T. Aman 2018 of which 37 entries appeared promising for further advancement. Ten breeding lines appeared promising for further advancement among the tested 34 entries during Boro 2018-19.	Selected lines could be used for further advancement
2.	**Transforming Rice Breeding/STRASA/Green Super Rice Program/ Golden Rice Program** A total of 188 progenies were selected from 42 crossing populations from F_3 to F_5 in T. Aman 2018 season. In rapid generation advance (RGA), a total of 857 and 120 panicles were collected from $14F_3$, and $3F_5$ populations, respectively. In LST, a total of 1750 entries were collected from 27 crossing populations in Boro season. Fifty-six and twelve lines were selected from 78 and 88 lines in T. Aman and Boro season, respectively. Under breeding zone trial, around 432 lines were tested through each advance yield trial (AYT) and Observational yield trial (OYT), where 10-15 promising lines were identified. Under GSR project in Boro 2018-19, In OYT, 64 lines were evaluated with 4 standard check varieties and nine local landraces. Only 3 lines i.e. 7 FBR-404, 7 FBR-340 & 7 FBR-102 yielded significantly higher than all check varieties and landraces. In **PYT-1**, 24 lines were evaluated and most of the entries were damaged by insect infestation and salinity. In **PYT-2**, 22 lines were evaluated and 5 of them performed better than BRRI dhan28, BRRI dhan67 & BRRI dhan58. In **PYT-3**, 20 lines were	Better genotypes could be used for further advancement

	evaluated and only '7 FBR-222'line showed better than check variety. In **SYT**, 7 entries were evaluated and yield performance of all entries including check varieties was very poor. In **AYT-1,** 9 entries were evaluated and most of the entries showed better performance compared to check, i.e. BRRI dhan28 and BRRI dhan58. However, AYT-2 completely damaged by early stage salinity. During Boro 2018-19, a confined field trial was conducted to BRRI Regional Station, Satkhira for development and validation of beta-carotene enriched rice known as golden rice. The yield performance of golden rice (6.6 t/ha) was significantly lower than BRRI dhan29 (7.3 t/ha) although the growth duration was similar.	
3.	**Effect of missing nutrient in T.Aman and Boro rice production** Application of N, P, K, S and Zn significantly increased rice yield compared to N omitted plot only. Omission of N, P, K, S and Zn (control plot) significantly reduced rice yield over the missing of P, K, S and Zn plot. However, insignificant variation in rice yield was observed between the missing of N solely and control treatment. Therefore, balanced fertilization might be a good option for obtaining optimum rice yield.	Productivity and profitability of the farmers will be increased
4.	**Yield maximization of Boro rice in saline coastal area through nutrient management.** Higher grain yield was found in 25% dose of N (155 kg ha^{-1}). In case of K, the result is not consistent as previous result. Therefore, it should be repeated for another year.	Productivity and profitability of the farmers will be increased
5.	**Technology Transfer** In integrated rice-fish culture, BRRI dhan49, BRRI dhan79 and BRRI dhan52 yielded better than BR10, BRRI dgan23 and BRRI dhan30 in Koyra, Khulna. **Hybrid rice trial**. Nine hybrid varieties were evaluated against three inbreed varieties BRRI dhan28, BRRI dhan67 and Binadhan-10 at two sites in Kaliganj, Satkhira for comparing salinity tolerance label among them during Boro 2018-19. In Raghurampur, Kaliganj all varieties were damaged due to high salinity. But in Faridpur, Kaliganj IT hybrid (5.1 t ha^{-1}) variety yielded higher yield than other varieties. **Head to head trial**. BRRI dhan73 and BRRI dhan49 might be suitable for Southern Bangladesh and can be recommended for	Dissemination and popularization of BRRI varieties and rice production technologies

	this area, but more trial should be done for few years for a concrete recommendation. A total of 101 demonstration (Aus: 28, Aman: 42, Boro: 31) was conducted during 2018-19 under SPDP program. Twelve farmer's training on rice production technology, quality seed production & preservation was conducted to train up 390 farmers of Satkhira, Khulna and Jashore districts. A total of fourteen field days were arranged during the reporting year.	
6.	**Breeder and Truthfully labeled seed production** A total of 6.81 ton breeder seed of BR10, BRRI dhan30 and BRRI dhan49; 1.65 ton TLS of BRRI dhan49, BRRI dhan71, BRRI dhan75 and BRRI dhan87 was produced in T. Aman 2018. In Aus 2018, 1.12 ton TLS of BRRI dhan48, BRRI dhan82 and BRRI dhan85 was produced. During Boro 2018-19, 21.59 ton breeder seed of BRRI dhan28, BRRI dhan50 and BRRI dhan67; 17.1 ton TLS of BRRI dhan28, BRRI dhan50, BRRI dhan58, BRRI dhan63, BRRI dhan81, BRRI dhan84, BRRI dhan86, BRRI dhan88 and BRRI dhan89 were produced.	Production of breeder seed to fulfill the requirement of BRRI HQ and ensure quality seed as well as disseminate the varieties to the farmers seeing that their demand
7.	**Climate Resilient Farming Systems Research and Development for the Coastal Ecosystem.** In this area, most of the farmers followed BRRI dhan28-Fallow-BRRI dhan49 cropping pattern which was successfully replaced by Mustard-BRRI dhan81-BRRI dhan75 and Mustard-BRRI dhan86-BRRI dhan75 cropping pattern. The existing cropping pattern had a REY of 10.42 t/ha, which was exceeded by 15.24 t/ha and 13.94 t/ha of the above improved patterns, respectively. In poultry system Sonali chicken, Khaki Campbell duck and Turkey rearing under scavenging system seems to be a good option to increase farmers' income.	Productivity and profitability of the farmers will be increased

BRRI Regional Station, Sonagazi, Feni

Research Progress 2018-2019

Sl. No	Research Progress	Expected output
1.	**Regional yield trial (RYT):** Regional Yield trials (RYT) were conducted at experimental field of BRRI, Sonagazi to test the	Selection of region based suitable advanced

	yield performance of superior breeding lines. A total of 85 breeding lines were tested under this trial during the reporting period from which 23 were found better than checks regarding grain yield and yield contributing characters. Breeding lines were supplied from Plant breeding and Biotechnology divisions. Twenty four lines along with standard checks BR26, BRRI dhan28, BRRI dhan43, BRRI dhan48, BRRI dhan65, BRRI dhan82 and BRRI dhan83 were tested during Aus from which eleven genotypes were recommended for advanced trial. During T. Aman season two Rainfed Lowland Rice (RLR), three Zinc Enriched Rice (ZER), one high yielding Rice (HYV) were evaluated under on-station condition. The RLR lines BR8521-30-3-1, IR13F352, were selected for advance. On the basis of growth duration, yield and yield contributing characters the ZER advanced lines BR8427-2-3-2-P1-2 , BR8436-21-3-3-3-1 , BR8436-7-4-2-3-1 , BR8444-37-2-3-1-1-B3 , IR99269-33-1-3, IR99269-33-4-1 , BR8143-4-3-3-6-2-4 , BR8442-9-5-8-1-1 , IR84725-191-2-6-2-1-P2 , IR99641-115-2-3, and BR8436-21-3-1-1-1 were found better than check variety. During Boro season 2018-19 no advanced lines were found performing better than checks.	breeding lines and could be used as Advanced Lines Adaptive Research Trial (ALART).
2.	**Advanced Lines Adaptive Research Trial (ALART):** ALARTs were conducted during T. Aus, 2018 in two locations of Feni & Chattagram districts which had four lines BR9011-48-4-3, BR9011-64-1-2 , BR9011-67-4-1 and BR(Bio)9787-BC2-63-2-4 with two checks BR26 (ck.) and BRRI dhan48 (ck.). Four categories of ALARTs were conducted during T. Aman, 2018 such as, RLR, ZER , IRR and RLR-Bio. The trials were conducted at two locations such as Sonagazi, Feni & Mirsorai, Chattagram. The ALARTs were also conducted during Boro 2018-19 season such as BBR-Bio, FBR, FBR-Bio, IRR, PQR and ZER at Sonagazi, Feni and Hathazari, Chattagram. Data were collected on yield and yield contributing characters, phenotypic acceptance at vegetative and reproductive stage, insect and disease reaction and lodging records. Collected results with reports were submitted to adaptive research division of BRRI, head quarter which were analyzed and reported.	Well performed lines could be used as PVT.
3.	**Proposed variety trials:** Proposed Variety Trial trials were conducted at farmers' fields by the participation of researchers, extension people, BADC worker and employees of Seed Certification Agency (SCA) just prior to variety release. The proposed lines BR8492-9-5-3-2 (RLR) and BR7528-2R-HR16-2-24-1 (ZER) along with standard check BRRI dhan39 were	Depending on the recommendation of field evaluation committee non of the tested lines were suggested as new

	evaluated under on-farm condition during T. Aman season of 2018. The grain yield of the tested lines BR8492-9-5-3-2 (RLR) and BR7528-2R-HR16-2-24-1 (ZER) were 3.73 t/ha and 3.61 t/ha respectively whereas the check variety produced 3.56 t/ha and no significant yield increase. The standard check was nearly 13 earlier than BR8492-9-5-3-2 (RLR).	variety.
4.	**Survey and monitoring of rice diseases:** Survey was carried out at farmers' fields of Laxmipur, Noakhali, Feni and Chattogram districts both in T. Aman, 2018 and Boro, 2018-19. Bacterial Leaf Streak (BLS), Sheath rot, BLB, and Sheath blight infestation were observed in different scores during T. Aman season. BRRI dhan28 and BRRI dhan29 were affected severely by neck blast during Boro season. Others were also affected in different degrees such as BRRI dhan58 and BRRI dhan67. The farmers were suggested for preventive measures using fungicide	A precautionary measures against neck blast disease will possible.
5.	**Monitoring of insect pests and natural enemies by using light trap:** Rice insect pests and their natural enemies were monitored throughout the reporting period by Pennsylvanian light traps from July 2018 to June 2019 at the experimental field of BRRI regional station, Sonagazi. The abundance of leaf roller (LR), Stem borer (SB), Rice bug (RB), green leafhopper (GLH), grasshopper (GH), Mole cricket (MC), Field cricket (FC), and stink bug (SB) were found in the light trap during the reporting period. Leaf roller (LR) populations were the highest of all among the insect pests.	A data base of insect population may be produced.
5.	**Breeder seed production:** Nucleus seeds were supplied from Genetic Resources and Seed (GRS) Division for breeder seed production during Aman and Boro seasons. BR11, BRRI dhan34, BRRI dhan41 and BRRI dhan80 were cultivated during Aman season whereas BRRI dhan28 and BRRI dhan29 during Boro season. A total of Breeder seed during Aman and Boro were 10.60 tons and 9.67 tons respectively All produced seeds were sent to GRS division of BRRI, Gazipur.	Enrichment of breeder seed stock.
6.	**Truthfully labeled seeds (TLS) production:** Truthfully labeled Seed (TLS) production activities were undertaken at BRRI research field during Aus, 2018, Aman 2018 and Boro 2018-19. This seed production category was an easy way without any supervision of SCA but quality was maintained providing our own facilities and declared truthfully. Seeds were produced as per physical and technical capacity, opportunity and local need of BRRI, Sonagazi. As a result, farmers purchased the seeds of BRRI released varieties. Seeds were also purchased by different organizations. Total production of TLS during Aus, Aman and Boro were 870 kg,	Increasing the availability of seed for farmers use.

	8563 kg and 421 kg respectively.	
7.	**Seed Production and Dissemination Program (SPDP):** The demonstrations were conducted in 6 upazilas of five districts (Noakhali, Feni, Chattagram, Laxmipur Cox's bazaar and Khagrasori) during T. Aus 2018. BRRI dhan48 and BRRI dhan27 were used as cultivar. Data on growth duration, grain yield, total production, retained seeds, knowledge sharing and motivated farmers were recorded. The highest yield (4.25 t/ha) was found in Mirsori upazila of Chattogram district followed by Companiganj upazila of Noakhali district. A total of 8922 kg seeds produced in demonstrated areas from which 2452 kg seeds were retained by the farmers for next year cultivation. The knowledge gained farmers were 1612 and motivated farmers were 1876 who decided for next year cultivation. During T. Aman season under core program. BRRI dhan41, BRRI dhan46, BRRI dhan49, BRRI dhan76 and BRRI dhan77 were used as cultivar in different upazilas. A total of 45 demonstrations were conducted in 55 farmers' fields having two bighas of each variety. The total seed production of BRRI dhan41, BRRI dhan44, BRRI dhan46, BRRI dhan49, BRRI dhan76 and BRRI dhan77 were 4217 kg, 4236 kg, 4125 kg, 4587 kg, 2547 kg and 1247 kg whereas retained seeds were 1478 kg, 1270 kg, 2145 kg, 2587 kg, 225 kg and 325 kg of those varieties respectively. SPDP were conducted in 3 Upazilas of 3 districts under SPIRA project. BRRI dhan71 and BRRI dhan87 were used as cultivar in those upazilas. The total seed production of BRRI dhan71 and BRRI dhan87 were 5478 kg and 7854 kg whereas retained seeds were 3287 kg and 4256 kg of those varieties respectively. During Boro season under core program. BRRI dhan29, BRRI dhan58 and BRRI dhan67 were used as cultivar in different upazilas. The total seed production of different varieties were 45236 kg and farmers retained 21257 kg of seeds for next year cultivation and distribution to other interested farmers. The knowledge gained farmers were 14256 and motivated farmers were 8569 for different varieties demonstrated in farmers fields. Demonstrations on SPDP were conducted in 4 Upazilas of 3 districts such as Feni, Laxmipur and Noakhali. BRRI dhan67 and BRRI dhan69 were used as cultivar in those upazilas. The total seed production of BRRI dhan67 and BRRI dhan69 were 20136 kg and motivated farmers were 2337 for those varieties demonstrated in farmers fields.	Rapid dissemination of BRRI released varieties among the farmers.

8.	**Farmers' training:** Farmers' trainings were arranged in Noakhali, Feni, Chattagram, Coxes bazar and Rangamati districts. A total number of 20 farmers trainings on "Modern Rice production technology" were conducted in five different districts during the reporting period. In every batch of farmers training 30 farmers and 5 DAE field stuffs participated in which they were trained up with rice production technology in different ecosystem especially on tidal submergence, salinity and favorable environment. A total of 700 farmers and DAE staffs were trained during the reporting period.	Capacity building of farmers about modern rice production technologies.
9.	**Field day:** Field days were arranged for awareness building and create interest among the farmers and concerned extension agents about the modern rice production technologies. These aided in wide publicity and familiarity of the institute, our technologies and BRRI's contribution towards national economy. About 150-200 persons (farmers, researchers, extension service providers, local leaders, public representatives and administrative people etc.) were invited in a field day. A total of 15 field days were arranged during Aus, T. Aman & Boro season. Nearly 3000 progressive farmers, local leaders, DAE field stuff, public representatives & NGO workers participated in those occasions.	Rapid dissemination of newly released rice varieties and other technologies throughout the country.

Regional Station, Sagardi, Barishal

Research Progress 2018-19

Sl#	Research Progress	Expected output
Programme area/Project with duration: Regional Station, 2018-19		
1	**Varietal development**	
	i) **Development of Tidal Submergence Tolerant Rice:** In objective to develop improved varieties for tidal submergence ecosystem, 71 plants were selected from 21 F_2 population and 755 plant progenies were selected from 8 F_4 generations during T. Aman 2018. During Boro 2018-19, a total of 66 F_3 plant progenies of 21 crosses were grown and 263 Plant progenies were selected for further generation advance as F_4.A total of 693 F_5 plant progenies of eight crosses were grown and 1960 plant progenies were selected for further generation advance as F_6.	Develop better genotypes

Sl#	Research Progress	Expected output
	ii) **Introgression of dense and erect panicle gene in indica rice:** A total of 146 F_1 seeds were obtained from 12crosses which were targeted to develop high yielding boro varieties Table 4. Out of 38 crosses, 22 crosses were confirmed and registered in BRRI Barishal station code BRBa051 to BRBa072 during Boro 2018-19.A total of 120 plant progenies were selected from F_3 generation with the objective to develop high yielding varieties with dense & erect panicles during T. Aman 2018. A total of 39 F_3 plant progenies of four crosses were grown during and 211 plant progenies were selected for further generation advance as F_4.A total of 111 F_4 plant progenies of four crosses were grown and 280 plant progenies were selected for further generation advance as F_5during Boro 2018-19 season.	Develop better genotypes with dense and erect panicle
	iii) **Observational trial (OT):** Based on yield performance sixteen (16) entries were selected from one hundred and forty (140) entries for further process (Table 10). Rest one hundred and twenty four (124) entries are recommended for re-observational trial.	Develop better genotypes
	iv) **Preliminary Yield Trial (PYT):** Preliminary yield trial (PYT) consisting of thirteen genotypes along with the BB resistant check IRBB60 and the susceptible check BRRI dhan29 and BRRI dhan58 was evaluated. Growth duration was ranged from 148-157 days where as grain yield was ranged from 6.82-8.79 t/ha. The five genotypes BR9943-16-2-2-2, BR9650-108-2-1, BR9943-35-2-1-2-B2, BR9943-4-2-3-1 and BR9943-24-3-3 produced above 8.0 t/ha grain yield that was the higher than all the check varieties and growth duration was similar with the checks BRRI dhan58 and BRRI dhan29. The other five genotypes BR9942-1-2-1-2-B2, BR9943-4-2-3-2, BR9943-26-2-3-6, BR9943-26-3-2-1 and BR9650-108-2-3(7.57-7.95 t/ha) gave the similar grain yield with the check BRRI dhan29 (7.56 t/ha) but produced the higher grain yield than the checks BRRI dhan58 and IRBB60. The genotype BR9943-7-2-3-1 produced the higher grain yield than the check IRBB60. There was no presence of BB symptom in this trial.	Develop better genotypes
	v) **Regional Yield Trial (RYT):** Six RYT in T. Aman 2018 and seven RYTs during Boro 2018-19 were conducted. The six genotypes IR84725-191-2-6-2-1-P2, BR7528-2R-19-16-RIL-14, BR9140-5-22-5-1, BR(Bio)9777-123-4-6-11, BR(Bio)9786-BC2-80-1-1 and BR(Bio)9786-BC2-161-1-2 performed better grain yield than check varieties during T. Aman 2018. In Boro 2017-18, The six genotypes BR8904-28-1-2-2-2, BR8995-2-5-5-2-,1BR9943-40-3-2, BR9651-15-2-1-4, BR(Bio)9777-116-12-2-5 and BR(Bio)9777-116-12-2-4 produced above 7.50 t/ha grain yield during Boro 2018-19.	Better genotypes wouldbe used for further advancement

Sl#	Research Progress	Expected output
	vi) Advanced Yield Trial (AYT): One AYT in T. Aman 2018 and six AYTs during Boro 2018-19 were conducted. Two hundred and eighty three advance breeding lines along with three check varieties were evaluated at Charbadna farm, BRRI Barishal during T. Aman 2018. Thirty six genotypes were selected on the basis of phenotypic acceptability, growth duration and grain yield for further generation advanced. The eight genotypes BRBa 2-5-3, BRBa 2-9-4, BRBa 2-2-1, BRBa 3-2-6, BRBa 1-4-9-2, BRBa 2-5-3, BRBa 2-1-3 and BRBa 3-3-3produced above 6.50 t/ha grain yield during Boro 2018-19. The trial AYT#5 and AYT#6 was not up to the mark due to late transplanting and pest infestation especially leaf roller & stem borer attack. That's why, the trials would be repeated in the next boro season.	Identify better genotypes
	vii) **Proposed Variety Trial (PVT):** Only one PVT were conducted during Aman2018 from where the proposed RLR genotype BR8492-9-5-3-2 (5.14 t/ha and 128 days) produced higher grain yield and similar growth duration than the check variety BRRI dhan39 (4.40 t/ha and 129 days). The proposed ZER genotype BR7528-2R-HR16-2-24-1 (4.80 t/ha and 125 days) produced higher grain yield and 4 days earlier growth duration than the check variety BRRI dhan39 (4.40 t/ha and 129 days). Two PVT were evaluated during Boro2017-18. The advanced breeding line BR(Bio)9787-BC2-63-2-2 along with the check variety BRRI dhan28 was grown at on-farm condition Sreerampur, Nalcity. The proposed genotype BR(Bio)9787-BC2-63-2-2 (6.60 t/ha and 140 days) produced higher grain yield and two days earlier growth duration than the check variety BRRI dhan28 (5.83 t/ha and 142 days) (Table 7). The highest fertility (93.6%) and 1000-grain weight (22.6 gm) also found in the proposed genotype BR(Bio)9787-BC2-63-2-2.	New variety would be released
	viii) Golden rice evaluation trial: One transgenic line IR112060 GR2-E:2-7-63-2-96 and one non-transgenic control as standard check variety BRRI dhan29 were evaluated. The transgenic line IR112060 GR2-E:2-7-63-2-96 performed little bit lower than the control check variety BRRI dhan29 in respect of tiller number, panicle number and grain yield. There were no indications of altered disease susceptibility of GR2E rice compared to control BRRI dhan29, were there no indications that GR2E rice was a preferred host for pest insects.	Transgenic rice would be developed
2	**Pest Management**	
	i) **Screening of chemicals against blast disease of rice:** Among the fifteen chemicals tested two viz. Brio and Iso-R40EC significantly reduced neck blast (NB) disease and showed reaction similar to Trooper and Nativo. Reduction of neck blast disease incidence by those chemicals was ranged from 90.0% to 92% over untreated control (plain water). Other chemicals viz. KGT2 CARE 75 WDG, BRAVO, Adtivo, Tabia, Trycyclazole 75WP also reduced neck blast and this reduction was ranged from 84 to 88%. Rest of the chemicals was not effective in reducing the blast disease.	Effective chemical (s) against blast disease would be identified
	ii) **Survey and monitoring of rice diseases in selected areas:** During T.Aman 2018, Bacterial Leaf Blight and Brown spot was recorded as major	Database would be

Sl#	Research Progress	Expected output
	diseases. Sheath blight, blast and false smut were also observed as a promising disease. High yielding variety BRRI dhan34, BRRI dhan52and local variety Chinigura, Montessormota, Sakkhorkhora, Kumragoir, Kalijira, Vushiara, Lalchikon, Sadamota, Moulata were infected by blast disease during the survey period. The incidence of rice blast disease was less in this season (T. Aman 2018) compared to last T. Aman 2017. Out of 27 fields visited during Boro 2018-19 season, blast was found in 20 fields. Rice blast incidence was comparatively lower in this season compared to 2017-18. Among the other diseases BLB was higher during Boro followed by sheath blight and brown spot. Leaf scald, Sheath Rot and Karnel Smut diseases were also recorded in a limited scale.	created in order to develop forecastin g models.
	iii) Demonstration on the management options of blast disease at farmers' field of Barishal region: The demonstration was conducted during Aman 2018 farmers' field of Babuganj, Barishal under natural field condition using blast susceptible rice variety BRRI dhan34. Yield of BRRI dhan34 was significantly higher in recommended practices (4.32 tha^{-1}) over farmers' practices (3.41 tha^{-1}). The amount of yield increase of BRRI dhan34 in recommended or research practice over farmers' practice was 20.6%. Disease incidence (%) was 13.6% in RP treatment while it was 73% in control treatment having a reduction of 81.4% over FP.	Farmers would be familiarize d with effective Blast manageme nt practices
	iv) **Pest and natural enemy incidence in BRRI R/S Barishal light trap:** Incidence of insect pests was lower than previous reporting year. Green leafhopper (GLH), Yellow stem borer (YSB), Brown Planthopper (BPH), Zigzag leafhopper (ZLH) and Long horned cricket (LHC) were found comparatively higher number than other rice insect pest. First peak of insect pest was observed at Barishal in the month of November, 2018 and 2^{nd} peak in March, 2019 of throughout the reporting year, July 2018 to June 2019. Among (GLH, BPH, YSB and RH) rice insect pest population highest number was found in the month of September, October and November, 2018 and another highest population was observed in the month of March and April, 2019. The highest catch of natural enemies in light trap was Staphylinid beetle (STPD), Green mired bug (GMB) and Carabid beetle (CDB) at Sagordhi farm, Barishal. The GMB was observed higher in November, 2018 and February, 2019. STPD was observed highest in November 2018 and January to March, 2019. CDB was found higher in November 2018 and April 2019. SPD was found higher throughout the year except November, 2018.	Database would be created in order to develop forecastin g models.
	v) Rice production using no or minimum use of insecticides: Two treatment, researcher practice (Logo, Perching, Sweeping, No insecticide upto 30 days of transplanting and need based application of pesticide) and farmers practice were used in this experiment. Comparable higher yield was recorded in researcher practice than farmers practice in both seasons of T.Aman 2018 and Boro 2018-19. During T. Aman 2018, higher yield (5.03 t/ha) wasfound in researcher practice than farmers practice (4.92 t/ha) plot. Average number	To keep environme nt from hazardous insecticide s and to reduce

Sl#	Research Progress	Expected output
	of insect pest was higher (6.3)in farmers plot than researcher plot (5.5) and average number of natural enemies was lower (2.2) in farmers plot than researcher plot (3.7). Similar trends were observedduring Boro 2018-19.	production cost of rice.
3	**Crop-Soil-water management**	
	i) **Long-term missing element trial:** The highest grain yield (5.17 tha^{-1}) was found in complete treatment (NPKSZn). Grain yield was significantly lower than the complete treatment due to the omission of N, K, S and Zn. The lowest yield was recorded in –N plot followed by –S plot. Thus the study reveals that N is the most limiting nutrient in tidal flooded soil.Overall findings suggest that all the nutrients (N, P, K, S, Zn) should be applied for getting the higher yield and obviously, N application must be assured for optimum rice yield.	Yield limiting factor (fertilizer) would be identified
	ii) **Effect of planting time on different rice varieties:** In T.Aman 2018 experiment was conducted having four sowing dates and four varieties. Irrespective of varieties rice transplanted in 5 August (seeding 1 July, yield 4.7 t/ha) and 21 August (seeding 16 July, yield 4.7 t/ha) with 35 days old seedling gave higher yield than the later two time of planting (Table 25). Average growth duration was 145 and 149 days at those transplanting time, respectively. Growth duration reduced by 7-11 days at later tow transplanting dates.	Suitable planting time for rice would be identified for better yield
	iii) Use of less saline water resources for increasing cropping intensity in Barishal region: This experiment was conducted at Bakerganj, Barisal,Nolcity and Sadarupazila of Jhalokathi district during Boro 2018-19. The water salinity was measured in both locations throughout the period of time and was less than 0.5dS/m, which is very suitable for irrigation. In Nolcity, Jhalokati, BRRI dhan 74 gave the highest yield of 6.3 t/ha while BRRI dhan67 produced the minimum 5.7 t/ha.InJhalokathisadar, BRRI dhan74 gave the higher yield of 6.1t/ha followed by BRRI dhan67 (5.6 t/ha). In Bakergonj BRRI dhan 74 performed the best among the four varieties. It gave the highest 6.1 t/ha grain yield followed by 6.0 t/ha and 5.7 t/ha for BRRI dhan67 and BRRI dhan58, respectively. BRRI dhan47 produced the lowest 5.3 t/ha. In both sites yield of each variety was lower than their average yield. This is because of transplanting of aged seedlings.	Cropping intensity would be increased
	iv) **Water resources assessment for dry season crop cultivation in selected polders of coastal region:** Total 151 km long primary and secondary canals were surveyed in polder 43/1. Total stored volume of water was 7414503 m3 in April. Among the surveyed canal 11.1 km long canal was affected by salinity ranges from 1-2.2 dS m-1. It shows that 4878 ha sunflower field can be successfully irrigated with the 7414503 m3 water. On the other hand, irrigation is possible for 1800 ha and 634 ha land of Maize and Boro rice, respectively.	Potential Irrigation Water Source for Boro Cultivation in Barisal Region would be identified

Sl#	Research Progress	Expected output
4	**Socio-Economics and Policy**	
	Stability analysis of BRRI released HYVs of rice: During Aus 2018, the highest yield was observed in BRRI dhan82 (5.1 t ha^{-1}) followed by BRRI dhan83 (4.9tha^{-1}) and BRRI dhan48 (4.9tha^{-1}). The lowest yield was found in BR21 (2.6 tha^{-1}) due to bird attack. During T. Aman 2018, among the tested 08 nos of SDV, the highest yield was observed in BRRI Hybrid dhan40 (5.8 t ha^{-1}) followed by BRRI dhan71 (5.3tha^{-1}). The lowest yield was found in BRRI dhan57 (3.8 tha^{-1}).In medium duration varieties, the highest yield was found in BRRI dhan87 (5.8t/ha) followed by BRRI Hybrid dhan6 (5.66t/ha). The lowest yield was observed in BR3 (3.83t/ha).Finally, in the long duration varieties, the highest yield was in BRRI dhan77 (5.4t/ha) followed by BRRI dhan76 (5.3t/ha) and the lowest yield was in BR5 (2.9t/ha). During Boro 2018-19,grain yield was ranged from 4.93-8.40 t/ha. The three varieties BRRI dhan29,BRRI dhan89 and BRRI hybrid dhan5 produced above 8.0 t/ha grain yield. The lowest grain yield was observed in the variety BR6 (4.93 t/ha) followed by BRRI dhan60 (5.04 t/ha).	Region basis suitable rice varieties would be identified
5	**Technology transfer**	
	i) Demonstration, seed production and scaling up of MV rice in Barisal region: During the reporting year, BRRI Barishal has conducted 21 demonstrations in Aus2018, the highest yield (4.97 t/ha) was recorded from BRRI dhan82 followed by BRRI dhan48 (4.55 t/ha) while the lowest yield (3.2 t/ha) was observed in BRRI dhan65. A total 28demonstrationsinAman, 2018 and the highest yield was recorded from BRRI dhan52 (5.4 t/ha) followed by BRRI Hybrid dhan4 (5.3 t/ha). A total of1114demonstrations were conducted in Boro season. Among the Boro varieties average yield of three hybrid varieties was 8.18 t/ha (ranged from 8.01-8.28 t/ha) which was higher than the seven inbreed varieties (average 6.66 t/ha, ranged from 6.05-7.3 t/ha). BRRI dhan74, BRRI dhan69 and BRRI dhan58 were liked by the farmers in this region.	Farmers would be motivated to cultivate HYVs of rice
	ii) Varietal replacement through Head to Head Trial: Varietal replacement through Head to Head Trial with five T. Aman varieties at 06 locations in Barishal region. BRRI dhan72 (4.78 tha^{-1}) and BRRI dhan77 (4.72 tha^{-1}) gave higher yield followed by BRRI dhan76 (4.70 tha^{-1}), BRRI dhan79 (4.66 tha^{-1}), BRRI dhan52 (4.56 tha^{-1}) and Sadamota (3.5 tha^{-1}). During Boro 2018-19 trials were conducted under BRRI dhan28 and BRRI dhan29 groups in 8 locations. BRRI dhan67 (7.45 tha^{-1}) and BRRI dhan74 (7.33 tha^{-1}) provided the higher yield followed by BRRI dhan81 (6.75 tha^{-1}), BRRI dhan28 (6.42 tha^{-1}), BRRI dhan86 (6.41 tha^{-1}) and BRRI dhan84 (6.25 tha^{-1}). In the BRRI dhan29 group, BRRI dhan29 (7.63 tha^{-1}) provided the highest yield followed by BRRI dhan58 (7.1 tha^{-1}), BRRI dhan89 (7.05 $tha^{-1)}$.	maximizing rice yield by adopting BRRI release latest varieties
	iii) **Farmer's training under different projects:** BRRI Barishal Regional Station conducted 10 farmers' training (male 251 and female 59,	Awarenes s for

Sl#	Research Progress	Expected output
	NGO 10 and Imam 10) and 9 field day (418 male and 482 female) in different locations of Barishal region during the reporting period.	adopting improved rice cultivation technologies would be grown
	iv) **Farmers' Field Day under different projects:** Nine field days were conducted of which one under Ecofriendly pest management programme (at Ujirpur, Barishal), one under Irrigation division (at Bakerganj, Barishal) and seven under SPIRA projects (3 during T. Aman and 4 during Boro season). About 1350 (643male and 707 female) farmers, extension personnel, administrative peoples, public leaders were targeted to participate on these programs (Table 61). Farmers liked BRRI dhan52 for its higher grain yield (5.4 tha^{-1} at Kolapara, Patuakhali) and the ability to survive under flash flood upto 14 days. They also liked BRRI Hybrid dhan4 for higher yield (5.3 tha^{-1} at Babuganj, Barishal), shorter growth duration (124 days). They were embraced with the newly developed submergence tolerant varieties BRRI dhan76 (5.2 tha^{-1} at Babuganj, Barishal) and BRRI dhan77 (5.1 tha^{-1} at Kawkhali, Jhalikathi) as it can replace locally cultivated rice varieties. Farmers were willing to store this seed for next season and agreed to cultivate along with surrounding farmers. Farmers were motivated with the varieties BRRI Hybrid dhan5 during Boro due to satisfactory grain yield (8.28 tha^{-1})	Awarenes s for adopting improved rice cultivation technologies would be grown
6	**Seed production**	
	i) Breeder seed production: In T. Aman 2018, a total of 17,070 kg and in Boro 2018-19, a total of 27,205 kg breeder seed were produced.	BRRI released HYVs of rice would be disseminated
	ii) **TLS production:** In T. Aman 2018, a total of 10823 kg TLS and in Boro 2018-19, a total of 28,759 kg BRRI released varieties were produced.	

BRRI Regional Station, Cumilla

Table-2
Research progress, 2018-19

Sl. No.	Research Progress Program area/Project (Duration)	Expected output
Development of improved genotypes with high		

yield potential along with earliness, photoperiod sensitivity, acceptable grain quality and resistance to diseases and insect pests.		
1.0	**T. Aman 2018**	
1.1	Hybridization	Forty crosses were made using 60 parents.
1.2	F_1 Confirmation	Twenty three were confirmed and registered in BRRI cross list with station code BRC674 to BRC696.
1.3	Growing of F_2 population	Sixty two progenies were selected from population of 21 crosses.
1.4	Pedigree Nursery (F_3, F_4, F_5 and F_6 generations)	Fifty six (56), 37 and 13 plant were selected from F_3, F_4, & F_5 generation, respectively and 23 breeding lines were bulked from F_4 to F_7 generation.
1.5	Observational trial (OT)	Twelve genotypes were selected from 92 genotypes based on high yield performance, shorter growth duration and other good agronomic characters.
1.6	Evaluation of Multi-Parent Advanced Generation Intercross Lines	Eight (8), 3, 4, 4, 2, 4, 3, 3, 8, 2 and 3 genotypes were selected from MAGIC INDICA 2014 (M1), MAGIC INDICA 2014 (M2), MAGIC PLUS 2014 (M1), MAGIC PLUS 2014 (M2), MAGIC GLOBAL 2015 (M1), MAGIC GLOBAL 2015 (M2), MAGIC INDICA 2015 (M1), MAGIC INDICA 2015 (M2), GSR (OYT), GSR (MST) and GSR (MST) respectively based on agronomic characters and better phenotypic performance as compared with standard checks.
1.7	Preliminary Yield Trial (PYT)	One (1), 0, 0, 5, 4 and 1 genotypes were selected from PYT#1 (Com), PYT#2 (Com), PYT#3 (Com), PYT#4 (Com), PYT (IRLON) and PYT (Com) respectively
1.8	Secondary Yield Trial (SYT)	Two (2) and 0 genotypes were selected in SYT#1 (Drought) (Com) and SYT#2 (Com) respectively
1.9	Regional Yield Trial (RYT)	In RYT#1 (RLR), RYT#2 (RLR), RYT#1 (ZER), RYT#2 (ZER), RYT#3 (ZER), RYT#1 (PQR), RYT#2 (PQR), RYT#3 (PQR), RYT (BB), RYT (Insect), RYT#1 (Bio) and RYT#2 (Bio), 3, 1, 4, 2, 0, 2, 1, 2, 1, 1, 0 and 0 genotypes were selected respectively

1.10	Advanced Yield Trial (AYT)	In AYT#2 (Com), 1 genotype was selected respectively
1.11	Advanced Yield Trial (AYT) Farmer (Water Stagnation)	In AYT#3 (Water Stagnation), 3 genotypes were selected
1.12	Advanced Yield Trial (AYT) Farmer (RLR & PQR)	In AYT#1 (RLR), AYT#4 (RLR), AYT#5 (RLR) and AYT#6 (PQR), 0, 1, 2 and 1 genotypes were selected respectively
1.13	Proposed Variety Trial (PVT)	In PVT#1 proposed line BR 8210-10-1-2 gave 0.08 t/ha higher yield with 8 days shorter growth than BRRI dhan49. On the other hand, in PVT#2 proposed line BR-7528-2R-HR16-2-24-1 produced 0.22 t/ha higher yield than BRRI dhan39 with 4 days shorter growth duration. In PVT#3 proposed line BR8535-2-1-1 produced 1.31 t/ha higher yield than BRRI dhan34 with 15 days shorter growth duration. In PVT#4 proposed line BR10230-15-27-7B and BR10260-7-19-2B produced 1.10 t/ha and 2.07 t/ha higher yield than Fulkori with 16 and 26 days shorter growth duration respectively.
	Boro 2018-19	
1.14	Hybridization	Seventeen crosses were made using 47 parents
1.15	F_1 Confirmation	All crosses (16) were confirmed and registered in BRRI cross list with station code BRC697 to BRC712.
1.16	Growing of F_2 population	Six hundred and ninety six (696) plant progenies were selected from population of 26
1.17	Pedigree Nursery (F_3, F_4, F_5 F_6 and F_7)	Two hundred and fifty (250), 49, 11 and 3 plant progenies were selected from F_3, F_4, F_5 and F_6 generations, respectively and 36 breeding lines were bulked from F_4, F_5 and F_6 generation.
1.18	Observational Trial (OT)	Twenty two genotypes were selected among 38 genotypes from OT based on high yield (5.23-8.67 t/ha) performance, lower growth duration (142-158 days) and other good agronomic characters than their checks.
1.19	Preliminary Yield Trial (PYT)	Twenty lines were selected from PYT (SD) for higher yield (5.02-6.51 t/ha) as compared with standard checks. In PYT (LD), based on high yield

		performance (6.19-6.99 t/ha) and growth duration (143-149 days) seven test lines were selected as compared with checks (6.53-7.62 t/ha) with lower growth duration.
1.20	Secondary Yield Trial (SYT)	In SYT (SD), BRC333-2-2-1-1-2, Four genotypes were selected for higher or similar yield (4.70-6.68 t/ha) and growth duration (143-145 days) than the checks. In SYT (MD), seven genotypes were selected for higher or similar yield (4.64-5.52 t/ha) and growth duration (142-153 days) than the checks. From SYT (LD), three genotypes were selected for higher or similar yield (5.49-6.22 t/ha) and growth duration (139-147 days) than the checks.
1.21	Regional Yield Trial (RYT)	In RYT (PQR), 3 lines were selected due to higher yield and similar growth duration with checks. From RYT (ZER), RYT (BB), RYT (BIO) BB all the lines were selected due to higher yield and similar growth duration with checks. From RYT (FBR), 3 lines were selected due to higher yield (7.20-7.69 t/ha) and similar growth duration with checks. In RYT (HAOR), BRRI dhan29-SC3-28-16-10-6-HR6(Com)-HR1(Gaz)-P4(Hbj) was selected due to higher yield (5.24 t/ha) and shorter growth duration with checks. In RYT (BIO) FBR, 2 lines were selected due to higher yield (7.39-7.42 t/ha) and similar growth duration with checks. But from RYT (BIO) CT, no promising lines were selected due to their lack of performance.
1.22	Advanced Yield Trial	In AYT (Com), all the 6 genotypes were selected for higher yield (5.86-6.67 t/ha) with almost similar growth duration (139-148 days) as compared with the checks yield (4.98-5.57 t/ha) and growth duration (137-144 days)
1.23	Proposed Variety Trial (PVT)	In PVT (Com) proposed line BR(Bio)9787-BC2-63-2-2 gave 7.43 t/ha higher yield and showed 3 days earlier growth than BRRI dhan28 (4.88 t/ha and

		148 days).
2.0	Crop-Soil-Water Management	
2.1	Long-term effects of some macro and micronutrients on yield and nutrition of upland rice	BRRI dhan84, BRRI dhan86 and BRRI dhan88 produced 6.79, 8.53 and 8.64 t/ha grain yield respectively with NPKZnS fertilizers. In case of BRRI dhan58, grain yield was drastically reduced due to omission of Potassium.
2.2	Effects of N rates on the yield of BRRI dhan87	N_{100} produced highest grain yield and straw yield
		Among the treatments, T_5 = NPKZnS (100%) gave highest grain yield in T. Aman season. Among the treatments, T_3 = N (70%) + KS (100%) + Bio fertilizer (2 t/ha) gave highest grain and straw yield BRRI dhan58
2.3	Long-term effects of some macro and micronutrients on yield and nutrition of upland rice	Among the treatments, T_5 (BRRI recom. fertilizer dose + 3 ton/ha organic manure (CD)) produced the significant highest grain yield in BRRI dhan75 (4.95 t/ha) and BRRI dhan71 (4.30 t/ha) compared to control treatment T_6.
2.4	Effect of N rates on the yield of BRRI dhan89	N_{160} produced highest grain and straw yield.
2.5	Evaluation of bio-organic fertilizer in the soil plant system	Among the treatments, T_5 = NPKZnS (100%) gave highest grain yield in T. Aman season. Among the treatments, T_3 = N (70%) + KS (100%) + Bio fertilizer (2 t/ha) gave highest grain and straw yield BRRI dhan58
2.6	Yield maximization of Aman rice through nutrient management	Among the treatments, T_5 (BRRI recom. fertilizer dose + 3 ton/ha organic manure (CD)) produced the significant highest grain yield in BRRI dhan75 (4.95 t/ha) and BRRI dhan71 (4.30 t/ha) compared to control treatment T_6.

2.7	Effect of time of seeding on yield of vatieties in Aman season.	BRRI dhan75 gave significant highest grain yield up to 15 July seeding time with lower growth duration than check variety BRRI dhan32.
2.8	Yield maximization of Boro rice through nutrient management	Among the treatments, T_5 (BRRI recom. fertilizer dose + 3 ton/ha organic manure (CD)) produced the significant highest grain yield in BRRI dhan81 (5.66 t/ha) and BRRI dhan86 (5.64 t/ha) compared to control treatment T_6.
2.9	Effect of time of seeding on yield of varieties in Boro season.	In Cumilla, BRRI dhan58 gave significant highest grain yield in 15 Nov. seeding time with shorter growth duration. BRRI dhan81 gave significant highest grain yield in 15 Nov. seeding time with shorter growth duration. BRRI dhan86 gave significant highest grain yield in 30 Nov. with shorter growth duration.
3.0	Pest management	
3.1	Survey and monitoring of rice diseases in selected areas in 2018-19 Survey and monitoring of rice diseases in selected areas in 2018-19	On an average, disease incidence of bacterial blight, sheath blight, neck blast, false smut and brown spot were 5-70, 5-80, 2-90, 1-20 and 5-90 % respectively during T. Aman 2018 season. In Boro 2018-19 season, the disease incidence of neck blast, bacterial blight, sheath blight and brown spot were 2-100, 2-80, 5-70 and 5-80 % respectively. This year neck

		blast disease was found so devastating in BRRI dhan28.
3.2	Validation of neck blast disease management in the farmers levels for enhancing rice production in Cumilla region**.**	During T. Aman 2018, Neck blast disease was obtained severe 44-82% in BRRI dhan34 at farmers practice compared to BRRI practices (1-7 %) in the demonstration areas and yield was saved upto 57 % by managing neck blast disease. During Boro 2018-19 season, highest neck blast disease (80 %) was recorded in Barura and Sadar, Cumilla in the farmers practice but lowest neck blast incidence was obtained in the BRRI practice ranged 0.1-5 % and yield was saved upto 63% by BRRI technology.
3.3	Regional Yield Trial for blast disease resistant lines during Boro 2018-19.	Three genotypes HR (path)-2, HR (path)-10, HR (path)-11 showed no neck blast incidence and yield ranged from 6.79 to 7.39 t/ha whereas, BRRI dhan28 showed about 81.3 % neck blast with 4.61 t/ha yield.
3.4	Screening of Blast, BB and Tungro resistant monogenic lines in disease hot spot in Cumilla during Boro 2018-19	Ten genotypes including BRRI dhan74 showed more than 6 t/ha yield.
3.5	Varietal reaction and recovering ability of BRRI released T. Aman varieties	Twelve rice varieties showed 20-60 % yield loss. Some BRRI varieties BR3, 10, 11, BRRI dhan51, 57, 62 showed 100 % yield loss due to high severity of rice tungro disease.
4.0	**Rice Farming Systems**	
	Multilocation trial of different BRRI varieties in major cropping patterns	Mean yield of BRRI dhan85 and BRRI

		dhan75 was 4.79 and 4.85 t/ha with the growth duration of 109 and 116 days in T Aus and T. aman season respectively under multilocation trial.
5.0	**Technology Tramsfer**	
5.1	Varietal replacement through Head to Head (HTH) Trial during T. Aman & Boro 2018-19.	BRRI dhan87 yielded highest 7.12 t/ha compared to BRRI dhan71, 72, 75 and 80 varieties. Farmers' preferred BRRI dhan87 than other varieties. BRRI dhan74 (upto 8.61 t/ha) yielded highest than BRRI dhan67, BRRI dhan86, BRRI dhan84 and BRRI dhan81. The yield of BRRI dhan89 (upto 8.62 t/ha) significantly higher than BRRI dhan29 followed by BRRI dhan58 (upto 7.70 t/ha).
5.2	Block demonstration, dissemination and quality seed production of rice varieties during Aman 2018 and Boro 2018-19 (SPIRA project).	In T. Aman 2018, the average yield of BRRI dhan75, BRRI dhan79 and BRRI dhan87 was about 5.4, 5.78 and 6.5 t/ha respectively. In all the blocks, highest yield was obtained from BRRI dhan87 ranged from 5.83 to 7.16 t/ha. During Boro 2018-19, the average yield of BRRI dhan74, BRRI dhan81, BRRI dhan88 and BRRI dhan89 were 8.12, 4.84, 6.27 and 7.86 t/ha respectively. Demo farmers as well as neighbor farmers also showed interest to cultivate BRRI dhan87 in T. Aman and BRRI dhan74 and BRRI dhan89 in Boro season.
5.3	Farmers Training	A total of 393 farmers and 27 SAAOs

		were trained up and build up their knowledge about modern newly released rice varieties from these trainings.
5.4	**Field days**	Eight field days were conducted in the block demonstration areas Cumilla, Chandpur and B Baria districts due to demonstrate the newly released BRRI varieties during Aman and Boro 2018-19 seasons along integrated blast disease management.
5.6	**Breeder and TLS seed production.**	In T. Aman and Boro 2018-19 seasons 33.35 tons breeder seeds of different BRRI varieties were produced and sent to GRS division, BRRI Gazipur. However, 36.75 tons of TLS of BRRI rice varieties were produced and sold to the farmers.