Research Progress 2021-2022

Sl. No.	Research Progress 2021-22	Expected Output
	Plant Breeding Division	
Program Area: Varietal Development program (VDP)		
1. Rice Breeding		
1.1	**Development of Upland Rice (B. Aus and Jhum rice)** During 2021-22, seven crosses were made using 11 parents. Out of 20, eight crosses were confirmed as true F_1. A total of 9,360 progenies obtained from 14 crosses of F_5 generation were advanced through field RGA (Rapid generation advance). Out of 2,830 lines, a total of 207 breeding lines comprising 21 crosses were selected from LST lines based on identical flowering, grain type traits and phenotypic acceptability under field condition. Twenty-nine entries were selected considering growth duration, yield, uniformity of morpho-agronomic traits and superiority in one or more traits over the standard checks from 176 advance breeding lines in OYT. Three genotypes such as BR11274-B-35-1-36, BR11274-B-11-1-16 and BR11262-B-109-3-47 were selected from five tested entries on the basis of yield and short growth duration in PYT. Five genotypes viz. BR10756-2B-8-72, BR10759-2B-11-3, BR10418-32-1-58, BR10417-15-2-11 and BR10409-15-2-8 were selected from eight tested entries in SYT. Improvement of jhum rice under upland rice program was implemented to develop high yielding rice variety with low (10-19%) to high (>25%) grain amylose content and drought tolerance along with good eating quality for jhum cultivation acceptable to tribal of Chattogram hill districts. Seven crosses were made involving10 parents including 4 local Jhum cultivars, 2 exotic varieties, single BRRI variety and 3 advance breeding lines having low to intermediate level amylose content. Six out of 15 crosses were confirmed as true F_1. A total of 18,970 progenies obtained from 17 crosses of F_3 generation were advanced through field RGA. Fourteen, eight and eight entries from 31 entries in OYT-1, 18 entries in OYT-2 and 9 entries in OYT-3 were selected, respectively. Six genotypes such as Shili, Bekui, Sona Jhuri, Bodakusum, Chuli and Gellong-2 out of 15 and four genotypes i.e. Kala Binni (2), Binni (Red) (8), Binni Dhan (Reddish) (10) and Kutkutta Binni out of 9 were selected in Preliminary yield trial-1 and 2 (PYT-1 and PYT-2), respectively. Five genotypes such as Ranqui, Gunda, Sanki,	For B. Aus, promising lines/ varieties will be developed with short duration: 90-95 days, yield potential: 4.0-4.5 t/ha, with early vigor. For Jhum rice, high yielding rice variety with low (10-19%) to high (>25%) grain amylose content and drought tolerance along with good eating quality for jhum cultivation acceptable to tribal of Chattogram hill districts will be developed.

	Chinese rice and YAAS-V5 out of 8 were selected in SYT. Chinese rice variety (Luyin 46) was chosen by farmers in AYT (Advanced yield trial) in hills of three upazilas of two hill districts i.e. Khagrachari and Bandarban having about half ton/ha yield advantage over the local cultivar Mongthongno along with medium slender grain, dense panicle, lodging and drought tolerance, high amylose content with light aroma.	
1.2	**Development of T. Aus** In total, 20 crosses were made using 35 parents and 5348 F1 seeds were obtained; 29 crosses were confirmed as true F1; 18270 progenies of 37 crosses in T. Aus season were advanced through modified field Rapid Generation Advance (FRGA). Out of 12491 lines of 39 crosses, 792 uniform lines were identified from LST based on uniformity in heading, plant height, and acceptable grain type in the field condition. Finally, 713 fixed lines were selected from 792 lines on the basis of trait genotyping with 12-SNP indica panel. Ninety-three genotypes were selected from 384 entries from observational yield trial (OYT), and ten advanced lines out of 37 from PYT were selected for T. Aus growing areas of Bangladesh on the basis of homogeneity with respect to plant height, phenotypic acceptability at vegetative and maturity stages and physicochemical properties. With respect to performance in ALART, one genotype BR8781-16-1-3-P2 was recommended for PVT for the non-saline tidal condition of Bangladesh.	Promising lines/ varieties will be developed with better yield potential (5.0–5.5 t/ha) and shorter growth duration (105-110 days) in comparison to existing varieties
1.3	**Development of rice for shallow flooded and deep-water environment** In total, seventeen crosses were made by using 21 parents and produced 1413 F_1 Seeds. In total 25 F_1s crosses were confirmed through QC SNP panel analysis. A total of 3,748 progenies of 21 F_2 crosses, 3,541 progenies of 20 F_3 crosses, 2,001 progenies of 18 F_4 crosses were advanced through RGA. In Yield trials, 15 genotypes were selected out of 30 genotypes. In OYT the genotype BR10211-22-9-2_PS4 gave highest yield (2.6 t/ha) which is significantly higher than the check variety BRRI dhan91 (1.4 t/ha) whereas in PYT the genotype BR10260-7-19-2B (3.8 t/h) gave highest yield which was significantly higher than the check variety BRRI dhan91 (1.7 t/ha). In SYT trial, two tall advanced breeding lines (stagnant water, 50-90 cm) were evaluated. The breeding lines BR9377-21-3B (5.9 tha^{-1}) and BR9396-6-2-2B (5.4 tha^{-1}) with BRRI dhan91 (4.7 tha^{-1}) performed better than Fulkori (2.6 tha^{-1}) as checks. Six RYT breeding materials under direct seeded deep flooded (100-150 cm	High yielding (4.0-5.0 t/ha) rice varieties for shallow flooded area (up to 1.0 m depth), shallow deep area (30 cm water) and medium deep area (50-60 cm water) along with submergence, facultative elongation and hypoxia tolerance will be developed.

	water depth) condition was evaluated. The designation of the genotypes wereBR10230-7-19-2B(2.5 tha^{-1}), BR9892-6-2-2B(2.8 tha^{-1}), BR9376-6-2-2B(2.9 tha^{-1}), BR9392-6-2-1B(3.0 tha^{-1}), BR-KM(Mun)-PL-5-7-3-B(2.9 tha^{-1}), BR-DL(Hbj)-PL-12-4-7-B(3.2 tha^{-1}) perform better than Fulkori (2.4 tha^{-1}) as local check. ALART for shallow deep (50-100 cm) flooded areas were conducted in five locations, two advanced genotypes BRBR9390-6-2-1B(3.4 tha^{-1}) and BR10260-5-15-21-6B(4.5 tha^{-1}) gave better yield than BRRI dhan91 (2.35 tha^{-1}) as standard check. The genotypes were characterized with moderate elongation and better yield than check variety. Notably, BR9390-6-2-1B was found as strongly photoperiod sensitive, BR10260-5-15-21-6B and BRRI dhan91 were moderately photoperiod sensitive.	
1.4	**Development of Rainfed Lowland Rice (RLR)** In T. Aman 2020-21 reporting year, totally 7,442 F_1 seeds were obtained from 37 single crosses. Twenty-three F_1 crosses were confirmed as true hybrid. Panicles of 7,506 progenies from F_2 to F_5 generation of 32 crosses were harvested at the time of maturity and preserved and processed with proper labels through RGA/FRGA method. From Line Stage Testing trials (LST), 507 genotypes were visually selected out of 10,333 lines. A total of 699 genotypes were evaluated in four Observation Yield Trials (OYTs) in Gazipur, Cumilla and Rangpur. Among the tested genotypes 60 genotypes were selected and forwarded in Advanced Yield Trial (AYT). Preliminary Yield Trials (PYT) containing seven tested genotypes, only three were forwarded for secondary yield evaluation based on grain yield. Only one genotype was selected for advancing in Regional Yield Trial (RYT) among the five tested genotypes of secondary Yield Trial (SYT). Three genotypes were selected for re-trial in Regional Yield Trial (RYT. None of the genotypes were selected out of 31 from IRLON.	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.
1.5	**Development of Salt Tolerant Rice (STR)** The objective of this project is to develop high yielding salt tolerant rice cultivars based on product profile. Salinity is one of the major constraints for the Rainfed lowland and Boro rice ecosystem in the southern coastal zone of Bangladesh. In the T. Aman season, 29 crosses were made using 39 well characterized elite parents. A total of 14 were confirmed as true hybrid through F_1 verification by quality check (QC) genotyping with purity SNP panel during the T. Aman season. The Field Rapid Generation Advance (FRGA) was done at BRRI Farm, Gazipur. In the T. Aman season, 106268 segregating progenies derived from 128 crosses were	Promising Salt tolerant lines/salt tolerant varieties will be developed with seedling stage (EC 14 dS/m) & reproductive stage tolerance (EC 8-10 dS/m) and better yield potential (5.5-6.5 t/ha for the T.Aman and 7.5-8.0 for Boro season) in comparison to existing varieties

	advanced in F_2-F_6 generations using FRGA technique. Yield trials were carried out in Gazipur, Koyra, Khulna and Assasuni, Debnagar, Kaliganj and BRRI Farm, Satkhira in the T. Aman season. In LST, out of 6199 breeding lines from 33 crosses, 658 lines were selected on the basis of strong culm with good plant ideotype, acceptable grain type and uniformity at heading in field condition. A total of 658 LST lines were genotyped using trait-specific SNP panel to identify promising breeding lines with trait of interest (ToI). The highest number (67 lines) of LST lines from the cross BR13105-4R (IR112501-B-16-3-1 / IR59418-7B-21-3) and the lowest number of lines (1lines) selected from the cross BR13129-4R (D(R) 6 / BINA dhan10) and BR13131-4R (Rata Boro / BRRI dhan67) respectively**.** High selection pressure (90%) was applied in LST in the T. Aman2021-22. Considering phenotypic acceptability and uniformity, 658 genotypes were selected and out of 658 genotypes, 205 genotypes had QTLs for salinity stress related traits. Out of 722 genotypes, 226 genotypes were selected from OYT and three genotypes were selected from OYT_IRSSTN. Three PYTs (PYT-1 to PYT-3) were conducted using 232 breeding lines. Eighty-three genotypes were selected from these trials depending on grain yield, salinity tolerance and phenotypic acceptability. Out of 8 genotypes, three genotypes as BR11716-4R-120, BR11716-4R-123 and BR11716-4R-147 were selected from RYT in the T. Aman based on yield, growth duration, earliness and phenotypic acceptability with comparing checks. From RYT2, out of 8 genotypes, three genotypes as BR11712-4R-218, BR11716-4R-102, and BR11723-4R-172 were selected based on grain yield and grain quality for conducting ALART**.** The mean grain yield of selected lines ranged from 5.53 t/ha (BR11716-4R-102) to 5.29 t/ha (BR11723-4R-1172) which were higher than the check varieties BRRI dhan87 (4.99t/ha) and BRRI dhan73 (4.73 t/ha). In RYT3, four genotypes were selected for crossing parent. In the Boro Season, 38 crosses were made using40 elite parents. A total of 33 F_1s was confirmed as true hybrid through F_1 verification by quality check (QC) genotyping with purity SNP panel. Total 1258205 segregating progenies from 108 crosses (F_2-F_5 generation) were harvested from FRGA nursery and grown in the subsequent generation. Out of 5170 lines, a total of 320 lines from 20 crosses were selected in LST trial during Boro 2021-22 based on identical flowering, acceptable grain type (MS/LS) traits and phenotypic acceptability under field	

	condition at Debhata, Satkhira. Out of 320 breeding lines, about 50 lines harbored the 5-7 QTLs/genes that regulate ToI (Trait of Interest) that are designated as Genetically Important Lines (GILs). Each line assayed against QTLs and genes of interest to assess the presence or absence of useful traits High selection pressure (94%) was applied in LST in the Boro season 2021-22. Yield trials were carried out in Gazipur, Debhata, Kaliganj, Satkhira and BRRI Farm, Satkhira in Boro season. A total of 54 genotypes selected out of 422 from OYT and 4 genotypes from OYT-IRSSTN based on growth duration, grain yield, and homogeneity in different morpho-agronomic traits. Out of 112 genotypes, 46 genotypes were selected from two PYTs. From AYT1 and AYT2 twenty genotypes from 105 were selected. AYT1, two promising genotypes such asBR11712-4R-44 and BR11712-4R-93 was yielded 8.32 t/ha ans 7.09 t/ha at Kaliganj, Satkhira respectively. The range of salinity level (EC) from 2.12 dS/m to 3.26 dS/m at Satkhira farm, 5.0 dS/m to 7.0dS/m at Debhata and 3.5 to 8.0 dS/m at Kaliganj. Total 17genotypes were evaluated in RYT1 and RYT2. No genotypes were selected from RYT and RYT2. These two trials will be revaluated in the next year**.**	
1.6	**Development of Premium Quality Rice (PQR) for T. Aman and Boro Seasons** In T. Aman 2021-22, a total of 109 crosses (52 single crosses and 10 backcrosses for PQR, 34 single crosses for anti-oxidant enriched rice and 22 single crosses and 1 backcrosse for photosensitive rice) were made and 70 crosses (51 for PQR, eight for anti-oxidant enriched rice and 11 for photosensitive rice) were confirmed as true hybrid using quality control SNP panel analysis. A total of 14,800 progenies (11,038 progenies of 24 F_2 crosses, 1,681 progenies of 12 F_3 crosses, and 2,081 progenies of 14 F_4 crosses) were advanced through RGA under PQR. A total of 5,638 progenies (1,564 progenies of four F_2 crosses, 1,448 progenies from 5 F_3 crosses, 484 progenies from 10 F_4 crosses and 1,300 progenies from 15 F_5 crosses and 842 progenies from 3 F_6 crosses) were advanced through RGA under Antioxidant program. A total of 1,633 progenies (945 progenies of five F_2 crosses, 177 progenies from five F_3 crosses, 484 progenies from 5 F_4 crosses and 27 progenies from 3 F_6 crosses) were advanced through RGA under photosensitive program. Under PQR program a total of 62 genotypes were selected out of 158 from different yield trials based on growth duration, yield, homogeneity and morpho-agronomic traits. From Observational Yield Trial (OYT) 26 genotypes were selected out of 66 genotypes. From	National and international grade (Kalizira, Chinigura, Kataribhog, Basmati, Jasmine, Banglamoti and BRRI dhan34 type) high yielding aromatic varieties with earliness, good plant type, anti-oxidant potential will be developed.

	Preliminary Yield Trial (PYT), a total of 23 genotypes were selected out of 64 genotypes. Seven genotypes were selected out of 16 genotypes from Secondary Yield Trial (SYT). In OYT#1, the genotype BR10820-2-3-3-5-3 produced highest yield (6.5 t/ha) which is non-aromatic whereas the second highest yielder genotype having 5.7 t/ha yield is an aromatic line with 136 days growth duration. In OYT#2, the aromatic genotype BR9178-7-2-4-4 produced highest yield of 7.0 t/ha with a growth duration of 130 days. In PYT#1 the genotype BR11224-7-9-4-3 produced highest yield (6.5 t/ha) which is a non-aromatic genotype having long slender type grain whereas the aromatic genotype BR10062-8-3-2-1-P2 produced 4.4 t/ha yield with a growth duration of 107 days. In PYT#2, the aromatic genotype BR11811-9-2-2 produced 6.6 t/ha yield but grain is bold while the genotype BR8493-12-7-4-P1 produced 5.6 t/ha yield with grain type almost same with BRRI dhan90**.** In SYT, the aromatic genotype BR10824-5-6-4-1 having 34 type grain gave 4.3 t/ha with a growth duration of 141 days. In AYT, the aromatic genotype BR9126-15-3-4-1 having 34 type grain gave 5.7 t/ha with a growth duration of 128 days. Another aromatic BR10813-75-20-10-2 having kalijira type grain gave 4.0 t/ha with of 125 days growth duration. The aromatic genotype BR8493-3-5-1-P1 having 90 type grain produced 6.2 t/ha yield during seed purification stage which were recommended to evaluate in ALART as polaw rice whereas a non-aromatic genotype producing 6.5 t/h yield was also recommended to evaluate in ALART as table rice. The growth duration of these two genotypes are 139 days and 135 days respectively. Under Antioxidant enriched rice breeding program, a total of 1075 fixed lines were selected from LST in T Aman 2021, which were evaluated under observational yield trial in Boro 2021-22. From OYT a total of 152 advanced lines were selected. The yields of the selected lines ranged from 4.0 t/ha to 6.9 t/ha. Most of the selected lower yielder genotypes have very long slender or katary type grain and possessed aroma. The genotype BR12839-4R-93 gave 6.9 t/ha yield followed by the genotype BR12839-4R-72-1 having 6.5 t/ha yield. Under photosensitive rice program, a total of 36 genotypes were selected out of 111 from different yield trials. From Observational Yield Trial (OYT) 28 genotypes were selected from 86 genotypes based on growth duration, yield, homogeneity and morpho-agronomic traits. From Preliminary Yield Trial (PYT), eight genotypes were selected out of 14 genotypes. Seven genotypes were selected out of 11 genotypes from Secondary Yield Trial (SYT). In OYT, the genotype BR8845-21-1-10-3-4 produced significantly higher yield (6.5	

	t/ha) than the check varieties BR22 (4.7 t/ha) and BR23 (4.9 t/ha) followed by the genotype BR8845-21-1-10-3-5 (6.0 t/ha). Both of the genotypes have similar growth duration with the check varieties. The genotype TL Aus-Gaz10-40-5-11 produced 5.4 t/ha yield which also possesses aroma. In PYT, the genotypes BR8845-21-1-10-6-1 produced significantly higher yield (5.4 t/ha) than the check varieties BR22 (4.7 t/ha) and BR23 (4.9 t/ha) possessed aroma having shorter growth duration, which has been transferred to trial under premium quality rice for the next season. In SYT, the genotype TL Aus Kushtia-3 (PR-2)-2 produced significantly higher yield (6.0 t/ha) followed by the genotype BR8845-21-1-5-10-3-P4 (5.7 t/ha). The genotype TL Aus Kushtia-3 (PR-2)-2 have bold grain type while the genotype BR8845-21-1-5-10-3-P4 have aroma. The heritability obtained for growth duration was ranging from 86% to 96% while that for grain yield was ranging from 80 % to 88% indicating acceptable level of precision in these experiments.. In Boro 2021-22 season totally 1802 F_1 seeds were obtained from 29 crosses. Twenty-six F_1 crosses were confirmed as true hybrid using 10-SNP indica QC panel. A total of 13,210 progenies of 29 crosses were harvested from F_3 to F_5 generations and preserved and processed with proper labels through RGA/FRGA method. From LST, 623 genotypes were visually selected based on uniformity, plant height, growth duration, grain type and lodging tolerance out of 6546 lines. From three OYTs, a number of 56 lines were selected for PYT. None of the genotypes were selected from PYT. From SYT, twelve genotypes were selected out of 27 tested genotypes. No genotypes were selected from RYT. ALART was conducted at 10 different locations of Bangladesh. Considering all necessary attributes ARD did not recommend any genotypes for PVT. BR8862-29-1-5-1-3 and BRC266-5-1-1-1 advanced lines were recommended for PVT.	
1.7	**Development of Favorable Boro Rice (FBR)** Twenty-four crosses were made using 25 varieties/lines as parents targeting to develop high yielding breeding lines enriched with favorable alleles of key target traits, viz. disease resistance (Blast and BLB), insect resistance (BPH) and acceptable grain quality (amylose, chalkiness, palatability, zinc content, etc. Twenty one out of 30 were confirmed as true F_1 through a hybridity test using QC SNP genotyping. From segregating RGA nurseries, in total 18892 individual plants were advanced from 72 cross combinations of F_2-F_6 generations. Out of 2516 lines tested in LST 415	Rice varieties for favorable irrigated ecosystem will be developed with high yield potential (7.0-8.5 t/ha), earliness to long duration and acceptable grain quality.

	lines were selected based on the presence of the favorable alleles of key target genes for BLB resistance (xa5, xa13 and Xa21), blast resistance (Pi-ta, Pi-9 and Pb1), BPH resistance (Bph17, BPH32), grain quality (Wx-a, Wx-b, Wx-10, Chalk5 and BADH2) and uniformity in plant height, days to flowering, grain size and shape. Fifty-nine genotypes out of 558 tested in four locations following sparse testing model of genomic selection in OYT were selected based on genomic BLUP for yield. Out of 79 breeding lines tested in AYT at three locations, 14 genotypes having 150-154 days growth duration and 5-29% yield advantage over the check varieties (BRRI dhan28 and BRRI dhan81). From RYT, nine lead breeding lines showing almost similar yield to that of BRRI dhan89 and BRRI dhan81 with at least seven days shorter duration were selected for further advancement.	
1.8	**Development of Cold Tolerance Rice (CTR)** Twenty one and three back crosses were made using 24 breeding lines for the development of a high yielding breeding population enriched with favorable alleles of key target traits, viz. cold tolerance at seedling and reproductive stage, disease resistance (BLB and Blast), insect resistance (BPH) and acceptable grain quality (Amylose, palatability, chalkiness, zinc content, etc.). Twenty five crosses out of 24 were confirmed as true F_1 through a hybridity test using QC SNP genotyping. In total 14578 individual plants were advanced from 56 crosses of F_2-F_6 generations of segregating RGA populations. Out of 2445 lines tested in LST, 278 uniform lines in terms of plant height, days to flowering, grain size and shape were selected based on the presence of the favorable alleles of key target genes for cold tolerance (SCT1, COLD1, CTb), BLB resistance (xa5, xa13 and Xa21), blast resistance (Pi-ta, Pi-9 and Pb1), BPH resistance (Bph17 and BPH32) grain quality (Wx-a, Wx-b, Wx-10, Chalk5 and BADH2). Thirteen genotypes out of 456 breeding lines and 25 genotypes out of 778 breeding lines tested under natural cold stress (at booting stage) and non-stress conditions at two locations in OYT-1 and OYT-2, respectively were selected based on significantly higher yield than the check varieties of similar growth duration under non-stress condition and minimum yield reduction under cold stress condition for further yield trial. From AYT with 59 breeding lines tested at five locations, six breeding lines showing yield of 7.18 - 7.75 t/ha (8.41% to 18.77% higher than BRRI dhan28) with 150-153 days growth duration and eight breeding lines having growth duration 153-156 days and 14.20% to 21.05% higher yield than BRRI dhan28 and	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).

	10.48-17.16% higher yield than BRRI dhan67 were selected for further evaluation. Three genotypes out of 21 breeding lines/varieties tested in RYT at eight locations showed a growth duration similar to BRRI dhan28 and 0.22 - 0.39 t/ha higher yield. From another set of RYT with seven breeding lines/varieties conducted under natural cold stress (at booting stage) and non-stress conditions at 10 haor sites under Kishoreganj, Sunamganj, and Habiganj districts, two lead lines were selected based on 0.7 t/ha and 1.2 t/ha higher yield, respectively over BRRI dhan67 and BRRI dhan28 under non-stress condition and 1.8 -2.2 t/ha yield advantage over BRRI dhan28 under cold stress for further advancement.	
1.9	**Development of Zinc Enriched Rice (ZER)** The experiments were conducted in both T. Aman and Boro seasons. In T. Aman season, 59 single crosses were made which produces a total 9,906 seeds. A total of 48 crosses were selected and confirmed as true F_1 comparing with their parents and registered. From F_2 population 1512 plants from 18 crosses were selected. From pedigree nursery, a total of 2,504 progenies and 69 fixed lines from 87 crosses were harvested from F_3-F_6 generations at the time of maturity. From Observational Trials (OT), 56 genotypes out of 169 were selected based on yield and growth duration considering significant difference in growth duration from the check variety. Totally, 11 genotypes from two PYTs were selected out of 48 genotypes. From two SYTs, 01 genotype from 15 genotypes was selected. None of the genotype from RYT and ALART was found promising out of 2 and 1 genotype, respectively. In Boro season, 20 single crosses were made which produced 1,424 seeds. A total of 58 crosses were confirmed as true F_1 comparing with their parents. From F_2 population 18,500 plants of 50 crosses were selected. In pedigree nursery, 11,589 progenies with 471 fixed lines were harvested from 62 crosses of F_3 to F_6 generations at the time of maturity. From OT, 64 genotypes out of 184 were selected based on yield and growth duration considering significant difference in growth duration from the check variety. Fifteen genotypes from PYT were selected out of 53 genotypes to advance in SYT. From SYTs, three genotypes out of 07 genotypes were selected. None of the genotypes were selected from RYT.	Rice varieties with high iron and zinc content with resistance to major insect pests and diseases and acceptable grain quality will be developed.
1.10	**Development of Insect Resistant Rice (IRR)** The experiments were conducted in both T. Aman and Boro seasons. In the T. Aman season, twelve crosses for forward breeding, three F_1 crosses for Line Augmentation and three	BPH and Gall midge resistant variety will be developed with better yield potential (5.5-6.5 t/ha

	BC_2F_1 crosses for QTL Deployment were made and 22 crosses were confirmed as true hybrids using quality check (QC) genotyping with purity SNP panel. In total 62,530 segregating progenies from 67 crosses of F_2-F_5 generations were advanced using Field Rapid Generation Advanced (FRGA) technique. A total of 204 lines were selected out of 3569 lines derived from 16 different crosses. The yield trials (OYT, PYT and AYT) were conducted at three locations of BRRI Gazipur, Cumilla and Rajshahi. Ninety-three genotypes from 432 were selected for further evaluation in OYT. Nine selected OYT genotypes had both bph9 and bph17 SNP favorable alleles. Fifteen and Eighteen genotypes were selected compared to the respective check varieties for further evaluation from PYT and AYT, respectively. None of the entry was selected due to poor performance compared to the check varieties in RYT and ALART. In Boro season, 16 crosses for forward breeding, three F_1 and three BC_1F_1 crosses for Line Augmentation were made and 23 crosses were confirmed as true hybrids through F_1 verification using quality check (QC) genotyping with purity SNP panel. A total of 39,851 individual plants were harvested from 76 crosses in F_2-F_5 generations by FRGA technique. In LST, Total 257 out of 2350 lines comprising 12 different crosses were selected. Out of 542 genotypes, 57 were selected for further evaluation, as they showed higher yield over the respective check varieties. Fifteen genotypes were selected from PYT for further evaluation. Out of 60 genotypes, 10 were selected for further evaluation from AYT.	for T. Aman and 7.0-8.0 t/ha for irrigated Boro season).
1.11	**Development of Disease Resistant Rice (DRR)** Efforts were made for developing varieties resistant to bacterial blight (BB), rice tungro virus (RTV) and blast diseases. The experiments were conducted in both T. Aman and Boro seasons. Seven crosses for BB and nine for blast in T. Aman and 12 crosses for BB and 18 for blast were made in Boro season. Sixteen crosses for BB and five for blast in T. Aman and seven crosses for BB and nine for blast in Boro season were confirmed as true F_1. A total of 17900 progenies for BB and 13250 progenies for blast were advanced from $F_{2\text{-}6}$ generation through Green-house RGA and FRGA. Out of 6700 lines, 1150 lines were selected from LST in Boro season based on uniformity in heading, plant height and grain type. Seventeen genotypes for BB were selected from observational yield trial (OYT) in T. Aman season whereas 60 entries out of 750 for BB during Boro season showed better yield potential and agronomic performance over the check	BB, Blast and RTV resistant varieties will be developed with better yield potential (5.5 – 6.0 t/ha for T. Aman season and 7.5-8.0 t/ha for Boro season).

	varieties and tolerance to BB. From AYT, three advanced lines were promoted based on growth duration, grain yield and BB score compared to the check varieties in T. Aman season and 21 genotypes out of 87 for BB were selected in Boro season. From MLT, three genotypes for T. Aman season and six for Boro were selected compared to yield, growth duration, BB resistance and better grain quality characters and three BB resistant genotypes performed better but yield was not >10% higher than the check variety. Therefore, the high yielding background of BB resistant promising lines will be used as genetic resource to develop high yielding disease resistant varieties. The promising BB resistant line BR8938-19-4-3-1-1-P2-HR3 was released as BRRI dhan101. The average yield of this variety was 7.72 ton per hectare. Growth duration of it was 142 days, which was four days earlier than the popular variety BRRI dhan58.	
1.12	**Development of Submergence and Water Stagnation Tolerant Rice varieties** Totally 4,885 F_1 seeds were obtained from 33 single and two back crosses. Thirty-four single F_1s crosses were selected and confirmed through QC SNP panel analysis. Panicles of 4,350 from 15 F_2 crosses, 2,510 from nine F_3, 2,324 from ten F_4 progenies, 3,080 from nine F_5 progenies, and 5,072 from 22 F_6 progenies were harvested at the time of maturity, processed with proper labels and preserved. The ranges of mortality percentage of different RGA generations were around 15%. From LST population, 2,230 lines from nine crosses were genotyped with trait markers using custom SNP panel among which 178 lines were selected based on uniformity and traits markers like Sub1, Wx-A group, Wx-A_NB, xa13, Xa21 etc. In yield trial, 573 genotypes were tested out of which 122 genotypes were selected based on phenotypic acceptance, growth duration, survivability and higher yield performance. From OYT#1, thirty genotypes out of 148 genotypes, from OYT#2, thirteen genotypes out of 43 genotypes, from OYT#3 (INGER_IRSTN_FP), four genotypes out of 10 genotypes, from OYT#4 (AGGRi Network trial), 35 genotypes out of 265 genotypes, from PYT#1_Early, eight genotypes out of 21 genotypes, from PYT#2_Late, eight genotypes out of 18 genotypes, from AYT#1_Early, nine genotypes out of 28 genotypes, from AYT#2_Late, eleven genotype out of 29 genotypes were selected. Three lines were evaluated in ALART from which one line was recommended to evaluate in PVT. In OYT#1, the genotype BR10211-22-9-2-1 with 89% survivability produced highest yield of 6.7 t/ha under stress condition. In	High yielding rice varieties with different growth duration and three weeks submergence, stagnant flood and anaerobic germination tolerances with yield target 6.0-6.5 t/ha in normal condition and 5.5 t/ha in stress condition.

	OYT#2 the genotype BR12162-5R-350 showed higher yield (6.6 t/ha) under controlled stress with 95% survivability. In OYT#3, the genotype SV1170_WS21-FP-5 produced highest yield (5.8 t/ha) under rainfed condition. In OYT#4, the highest yield was 7.2 t/ha given by the genotype IR18T1135 with survivability of 83% followed by the genotype IR19A1914 (7.1 t/ha) with survivability of 73%. In PYT#1 the genotype BR11690-5R-98 produced highest yield (6.1 t/ha) with survivability of 98% and growth duration of 137 days under 18 days of controlled submergence stress condition. In PYT#2, the genotype BR11686-5R-179 produced highest yield (5.9 t/ha) with 130 days growth duration in flood prone farmers field with 100% survivability. In AYT#1 the genotype IR16F1033 produced highest yield of 7.0 t/ha followed by the genotype IR103782-B-B-1-1 (6.1 t/ha) under controlled stress condition. In AYT#2, the genotype BR10212-7-5-1 gave highest yield of 6.9 t/ha with 96% survivability followed by the genotype BR11185-5R-569-3 (5.8 t/ha) with 80% survivability. In ALART#1 the genotype IR16F1148 produced significantly higher yield (5.0 t/ha) over both the submergence tolerant check BINA dhan11 (4.06 t/ha) and the susceptible check BRRI dhan71 (4.02 t/ha) with similar growth duration which is shown in Table 1. The genotype also has almost similar growth duration with check varieties. This line was recommended to evaluate in PVT. The ALART#2 trial was recommended for re-trial in tidal submergence ecosystem. The heritability obtained for grain yield under stress of all trials conducted was ranging from 55 % to 99%, whereas that for non-stress trials was ranging from 50 % to 93%, indicating acceptable level of precision in these experiments.	
1.13	**Development of Water Saving and Aerobic Rice varieties** A total of 18 crosses were made using 23 parents and obtained 1,670 F_1 seeds, and 13 single crosses were selected and confirmed through QC SNP panel analysis. Panicles of 292 F_3 from four crosses were advanced through FRGA. From advanced yield trial (AYT) conducted under AWD condition, seven genotypes were selected from 12 genotypes tested. In OYT, 53 genotypes were selected from 140 genotypes. In AYT, the genotype BR11206-5B-351 produced highest yield (6.6 t/ha) under AWD condition however it was not significantly higher than the check varieties BRRI dhan89 (6.2 t/ha). In OYT yield of some genotypes IR18R1109 (7.5 t/ha), IR18R1179 (7.3 t/ha), IR18R1176 (7.3 t/ha) and so on were significantly higher than the check variety BRRI dhan81 (5.5 t/ha) with similar growth duration.	Short duration water-use-efficient rice genotypes with 10% more yield than the standard check varieties will be developed for Boro season under transplanted alternate wetting and drying (AWD) & aerobic condition.

	The heritability obtained for grain yield under stress of the trials conducted was ranging from 74 % to 99% indicating acceptable level of precision in these experiments.	
1.14	**Development of Drought Tolerant Rice (DTR)** In T. Aman 2021-22 reporting year, totally 1916 F_1 seeds were obtained from 14 crosses. Nineteen single F_1s crosses were selected and confirmed through QC SNP panel analysis. In total, 2,398 and 5,071 plants were harvested F_4-F_5 generations at the time of maturity and preserved and processed with proper labels through RGA/FRGA method. From LST, 620 genotypes were visually selected out of 7,634 lines. In total, out of 717 genotypes 23 were selected from 3 OYTs. Twelve genotypes were advanced from 181 in Observational Trial. RYT was evaluated in five drought prone locations and 01 genotype out of 04 was selected for ALART. In Boro 2021-22, 5,071 progenies were harvested F_2-F_5 generations at the time of maturity and preserved and processed with proper labels through RGA/FRGA method.	Drought Tolerant Varieties for T. Aman season will be developed with potential yield target (5.0 – 6.0 t/ha).
1.15	**Deployment and Validation of High Beta-carotene Rice and High-Iron & Zinc Rice Varieties (Healthier Rice Project)** In T. Aman 2021-22 season, 2,280 F_1 seeds were collected from six single crosses. 123 and 57 hemizygous and azygous plants were selected from BC_3F_2 of six back crosses for introgression of provitamin A in BRRI dhna48, BRRI dhan67, BRRI dhan71, BRRI dhan84, BRRI dhan87 and BRRI dhan89. A total of 12 lines were selected from the introgression program of GR2-E trait from Contained Trial trough Marker Assisted Selection (MAS) breeding method. In Boro 2021-22, in total 782 F_1 seeds of six backcrosses of BC_3F_1 generation through MAS breeding method. From the Confined Field Trial (CFT) of high iron and zinc rice (Event IRS1030-039, IRS1030-031, IRS1027-059), 5 lines were selected for further evaluation.	Development of high yielding rice varieties with enhanced Provitamin A, high Iron and Zinc content in polished rice grain.
1.16	**International Network for Genetic Evaluation of Rice (INGER)** This project focused on sharing and use of germplasm and breeding lines through international platform for the acceleration of genetic improvement of rice varieties. Totally 28 genotypes out of 116 genotypes from six INGER nursery sets of T.Aman 2021-22 and five genotypes out of 62 genotypes from two INGER nursery sets of Boro 2021-22 seasons were selected to be used in different breeding programs for direct use in the breeding pipeline.	Exchange of elite rice germplasm among the rice growing countries of the world and their evaluation, characterization and utilization under wider range of environments for ultimate use by farmers.
	Biotechnology Division	

	Program Area/Project (Duration): Varietal Development program (VDP)	
Sl. No.	**Research Progress 2021-22**	**Expected Output**
	PROJECT I: DEVELOPMENT OF DOUBLED HAPLOID RICE VARIETY THROUGH ANTHER CULTURE	
1	**Expt. 1.1:** Development of low glycemic index (GI) rice variety through anther culture.	
	Six (6) doubled haploid lined were grown as PYT in T Aman 2021	During T Aman, two lines were selected for Secondary yield trial (SYT).
	Seven (7) doubled haploid lined were grown as PYT in T Aman 2021	During T Aman, three lines were selected for Secondary yield trial (SYT).
	During Boro 2021-22, two doubled haploid lines derived from a cross between BRRI dhan29 and Kanaklata were evaluated as a Regional Yield Trial (RYT).	None of them was selected.
2	**Expt. 1.2** Development of salt tolerant rice variety through anther culture	
	Two double haploid fixed lines from BRRI dhan28/BRRI dhan61 cross were evaluated along with check BRRI dhan28, BRRI dhan96 and BRRI dhan86 during Boro 2021-22 as SYT.	Among them no lines were selected due to lower yield than check varieties.
	A total of 7171 hybrid anthers from thirteen (13) crosses were plated on N6 media.	In total of 17 calli were obtained from different crosses and no green plants were regenerated yet Ten (10) crosses were done and 470 F_1 seeds were collected during Boro 2021-22 for further salt tolerant anther culture.
3	**Expt. 1.3** Development of premium quality rice variety through anther culture	
	During T. Aman 2021, a total of 4969 and 7776 hybrid anthers from nine (9) crosses were plated on N6 and M10 media.	In a total of 126 calli were obtained from different crosses and 94 green plants were regenerated from BRRI dhan90/Kataribhog, BRRI dhan90/Kalijira, BRRI dhan90/BRRI dhan34, and BRRI dhan90/Tulshimala cross. Among them seeds were harvested from 19 regenerated double haploid plants of BRRI dhan90/Kataribhog cross.
	Ten (10) crosses were done and seeds were harvested for generation advancement.	842 F_1 seeds were harvested for future anther culture program.
	Thirteen (13) backcrosses with anther culture derived plants were done for generation advancement.	560 seeds were harvested for generation advancement.
	During T. Aman 2021, Four (4) double haploid lines (DH_3) derived from BRRI dhan38/ Bashful (Acc. No. 3954) were	None of them was selected due to lodging.

	evaluated as OT in T. Aman 2021.	
	Seven doubled haploid (DH_4) lines from BRRI dhan50/ Bashful (Acc. No. 3954) were evaluated in Boro 2021-22 as pedigree.	Among them 103 plants were selected.
	Backcross progeny ($BC2F_3$) of BRRI dhan50/Bashful (DH1)//*[2] BRRI dhan50 were grown in T Aman 2021 as pedigree.	Seven (7) plants were selected for further evaluation.
4	**Expt. 1.4** Development of Aus variety through anther culture	
	Ten (10) crosses were made	A total of 261 F_1 seeds were harvested for future anther culture anther culture program.
5	**Expt. 1.5** Developmnt of antioxidant enriched black rice variety through anther culture	
	During Boro 2021-22, five antioxidant enriched black rice were developed using anther culture were evaluated as PYT.	Four lines were selected for RYT.
	Forty antioxidant enriched black rice developed using both seed and anther culture were evaluated as OT in T Aman 2021.	12 lines were selected for further evaluation.
	Sixty nine antioxidant enriched black rice developed using both seed and anther culture were evaluated as OT in Boro 2021-22.	Nineteen lines were selected for PYT.
	Moreover 46 somaclonal (SC4) variants of antioxidant enriched black rice were evaluated as pedigree.	Among them 32 somaclonal (SC4) variants of antioxidant enriched black rice were evaluated as pedigree.
6	**Expt. 1.6** Development of doubled haploid rice variety for high yield	
	Four (4) doubled haploids were grown as SYT in T Aman 2021.	None of them was selected for further evaluation because amylose content of these materials was less than 20%.
7	**Expt. 1.7** Development of doubled haploid photoperiod sensitive rice variety through anther culture	
	A total 6067 anther were plated in 2 media.	Two calli were obtained from the cross BRRI dhan87/BR22 and each BRRI dhan87/ BR23. BRRI dhan87/BRRI dhan46 produced single callus.
	Seven (07) crosses were done in T. Aman 2021	A total of 273 F_1 seeds were harvested for anther culture in T Aman 2021
8	**Expt. 1.8** Development of doubled haploid rice variety through anther culture for intermediate amylose rice	
	Three (3) doubled haploid lined were grown as SYT in T Aman 2021	Among them one (1) line was selected for evaluation. These materials were given to Plant Breeding division for evaluation

		under hilly areas.
	PROJECT II: DEVELOPMENT OF RICE VARIETY THROUGH SOMACLONAL VARIATION	
9	**Expt. 2.1** Progeny selection of somaclonal variants using EMS treated rice seed	During Aus, 2020 a total of 10 fixed lines selected from 34 EMS treated somaclonal variants of BRRI dhan48 (M_1SC_5). On the other hand, a total of 50 fixed lines were selected from EMS treated somaclonal variants of BR11.
10	**Expt. 2.2:** Observational yield trial (OT) of somaclonal variants in Aus	During Aus 2021, 20 fixed lines of EMS treated somaclonal variants of BR11 But none of them was selected due to lower yield than check variety (Table 16 and Fig. 4). During T Aman 21, one OT was conducted with 20 fixed EMS treated somaclonal variants of BR11 with check variety BR11 and among them 6 lines were selected for further evaluation
11	**Expt.2.3** Development of premium quality (Kalijira type) variety through somaclonal variation	Fourteen (14) lines somaclonal variants (SCV_1) of Kalijira rice were grown in T Aman 2021. 126 plants were harvested for further evaluation.
12	**Expt 2.4:** Progeny selection of antioxidant enriched black rice somaclonal variants	A total 47 (SC_5) antioxidant enriched black rice plants of Selasih were selected from 134 lines, during T Aman 2021. On the other hand during Boro 2021-22, 46 (SC_5) antioxidant enriched black rice plants of Padi Kool and Selasih were selected
	PROJECT III: DEVELOPMENT OF RICE VARIETY THROUGH WIDE HYBRIDIZATION	
13	**Expt. 3.1** Development of rice variety through wide hybridization followed by embryo rescue	
	Thirty eight (38) lines from different generation of wide hybridization followed by embryo rescue program were evaluated in T. Aman 2021 and Boro 2021-22. Besides those, nine backcrosses were done with previously embryo rescued plants to reduce hybrid sterility. Seeds were	Among them in a total eighty four (84) plants were selected from BRRI dhan28/O. nivara (IRGC103821), BRRI dhan28/O. glaberrima (IRGC105190), BRRI dhan87/O. glaberrima (IRGC105190), BRRI dhan48/O.

	harvested from those and evaluated in T. Aman 2021.	glaberrima (IRGC105190) for generation advancement. Among them 9 plants (BC_2F_2) were selected for generation advancement.
	PROJECT IV: MOLECULAR MARKER ASSISTED SELECTION	
14	**Expt. 4.1** Identification of QTLs for taller seedling height in rice	
	Genotyping was done using fifty (55) polymorphic primers with 184 F_2 individuals developed from a cross between BR11 x Sadamota (acc. no. 1576).	One QTL (q7.1 TSH) on chromosome 7 was identified for taller seedling height in rice.
15	**Expt. 4.2** Marker assisted selection for fragrance in F_5 Population of BRRI dhan87 and Kalijira**.**	
	72 pedigree lines developed from a cross between BRRI dhan87 and Kalijira were evaluated	Among them 107 plants were selected on the basis of aroma, growth duration and plant height. All tested aromatic lines were confirmed by using functional marker of fragrance gene BADH2. The primers combination of ESP and IFAP amplified the fragrance specific allele at 257 bp. On the other hand, the primers combination of INSP and EAP amplified the expected non-fragrance-specific allele (355 bp).
16	**Expt. 4.3** Marker assisted selection for aromatic and submergence tolerance rice genotype	
	Hybridization between BRRI dhan90/kalijira and BRRI dhan52/kalijira were done	93 and 185 F_1 seeds were harvested from BRRI dhan90/kalijira and BRRI dhan52/kalijira
17	**Expt. 4.4** Development of multiple disease resistant (blast and bacterial blight) rice varieties using marker assisted selection	
	For both BB and blast resistant four crosses such as BR(Bio)11447-1-28-14-3/IR64Pi9 (L), BR(Bio)11447-1-28-14-3/IR64Pi9 (E), BR(Bio)11447-3-10-7-1/IR64Pi9 (L), BR(Bio)11447-3-10-7-1/IR64Pi9 (E) were made.	A total 28, 103, 90 and 28 F_1 seeds were harvested from four crosses respectively
18	**Expt. 4.5** Association mapping for rice photosensitivity	
	An association mapping panel of 147 was raised in two replications in short-day condition	Heading dates were scored for each.
	PROJECT V: GENE CLONING	
19	**Expt 5.1: Isolation and cloning of stress tolerant gene from Wheat**	
	cDNA was synthesized from RNA of wheat to isolate and clone heat and drought tolerant gene	TaCRT gene was isolated from wheat and send for sequencing

	using Qiagen kit and PCR was carried out using specific primer. Wheat calreticulin was targeted to isolate for cloning purpose	
	PROJECT VI: RICE GENETIC ENGINEERING	
20	**Expt. 6.1** Development of salt tolerant transgenic rice	
	BRRI dhan29 was transformed with salt tolerant genes (GlyI and GlyII).	After transformation with GlyI and GlyII genes, plants were confirmed by GlyI and GlyII primers and sequencing. Seed from 17 T_5 plants were harvested. Now growing in transgenic net house for further evaluation.
21	**Expt. 6.2** Introgression of salt tolerant mangrove gene	
	Transgenic plant containing mangrove salt tolerant gene, AeMDHAR was crossed with BRRI dhan28 for the introgression of salt tolerant gene AeMDHAR	AeMDHAR salt tolerant gene (from mangrove plant) containing transgenic was crossed with BRRI dhan28 to introgress AeMDHAR salt tolerant gene. Three BC_2F_3 plants of BRRI dhan28 are now in in transgenic net house for further evaluation and confirm by gene specific primer.
22	**Expt. 6.3** Development of salt tolerant transgenic rice with PVA1	
	A construct was made at Biotechnology Division of BRRI by using vacuolar ATPase (PVA1) from a wild rice, Porteresia coarctata to develop salt tolerant transgenic rice variety.	Twenty one days old calii of BRRI dhan86 were used transform with PcPVA1 through Agrobacterium. Calli were co-cultured with PVA1
23	**Expt. 6.4** Development of high yielding aromatic rice lines through genome editing	
	For deactivate of Function of BADH2 gene, two primers were designed for construct preparation. Vector pRGEB31 was used in this experiment.	DNA was extracted from pRGEB31. Both primer and vector pRGEB31 were digested with Bsa1 and ligated for construct preparation
	PROJECT VII: C4 RICE DEVELOPMENT	
24	**Expt. 7.1** Identification of major regulators for C4 rice	
	Generation advancement for high-throughput screened for loss of C4 functions.	Total number of 7000 M4 lines Kaoun (Setaria italica) have been developed for further study. These lines are gradually raised, subjected to CO2 stress in low concentration (20 ppm) CO2 chamber for 72 hours and high-throughput screened for loss of C4 functions.
	PROJECT VIII: DEVELOPMENT OF RICE VARIETY THROUGH MUTATION BREEDING	
25	**Expt. 8.1** Development of variants using EMS of BRH-11-9-11-4-5B having reduced	
	500 BRH-11-9-11-4-5B seeds were treated with 20 mM EMS solution for 6 hrs to create variation	Six(6) M_2 lines along with check were transplanted in Boro 2021-22 and 31 plants were selected for further evaluation

26	**Expt. 8.2** Development of Kilijira type rice variety through mutation by NMU	
	Seed from 215 M_2 Kilizira lines were transplanted in T Aman 2021	Seeds from 91 M_3 plants were harvested during T Aman2021 for further evaluation.
27	**Expt. 8.3** Development of high yielding sheath blight resistant rice variety	
	During T. Aman 2021, 500 seeds of BRRI dhan87 were treated by 20 mM EMS solution for 6 hrs to create variation.	Twenty two M_2 plants were selected for further evaluation
28	**Expt. 8.4** Development of Premium Quality Rice through Mutation by EMS (Ethyle Methane sulfonate)	
	EMS treated seeds of two local varieties were evaluated during T. Aman 2021. Data of plant height, flowering days, tiller number, panicle length, maturity days, grain per panicle and grain per plant were collected. Pedigree selections were done with desirable traits.	Treated seeds of two local varieties were evaluated during T. Aman 2021. Among them thirty six (36) M_2 Kataribhog plants and twenty nine (29) M_2 Tulshimala plants were selected for further evaluation.
	PROJECT IX: BASIC RESEARCH	
29	**Expt. 9.1** Study on Kernel Elongation of Rice	
	Fifty seven selected genotypes were grown in T Aman, 21 from single plant to make genetic purity.	Purified seed from single hill were harvested
30	**Expt. 9.2** Variation of BADH2 gene sequences in rice genotypes	
	DNA of seven aromatic and two non-aromatic rice lines was amplified with a functional marker of BADH2 gene and sequenced.	After sequence analysis with functional BADH2 gene, 8bp deletion was observed in all aromatic rice which is similar with Pakistani Basmoti rice.
	Hybrid Rice Division	
Sl. No.	**Research Progress 2021-22**	**Expected Output**
	Program Area: Varietal Development **Project: Material development, seed production and its distribution** **Duration: 2021-2022**	
01.	One potential Boro hybrid rice variety selected through multi-location trials and submitted to SCA as BRRI hybrid dhan8 having yield potentiality 9.5-10.0 t/ha coupled with slender grain and growth duration 145-150 days. Hopefully this variety will be released within year of 2022.	This variety will bring new hope for Boro growing areas of Bangladesh
02.	Four new CMS (A) line was developed having diverse characters for T Aman season. Five new restorer lines were identified having high fertility restoration ability	This CMS and restorer lines will be used for new hybrid rice variety development for T Aman 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, preliminary yield trials and multi-location trials will be conducted. Finally selected combinations

		will submit to Seed Certification Agency (SCA) for registration as new release hybrid.
04.	A total of 29050 kg of F_1 seeds of BRRI hybrid dhan2, BRRI hybrid dhan3, BRRI hybrid dhan4, BRRI hybrid dhan5, BRRI hybrid dhan6 and BRRI hybrid dhan7 were distributed among farmers, department of agricultural extension and different seed companies through Head Quarter and Regional Stations of BRRI	Popularization of BRRI released hybrid varieties.
05.	Seed production program of BRRI hybrid dhan2, BRRI hybrid dhan3, BRRI hybrid dhan4, BRRI hybrid dhan5, BRRI hybrid dhan6 and BRRI hybrid dhan7 was initiated at farmers level under Mymensingh, Gopalganj, Ishrdi (Pabna), Sirajganj, Sherpur, Rangpur, Kurigram, Naogaon, Dinajpur, Nilphamari, Barishal, Satkhira and Khulna district	Farmers can 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
06.	Large scale marketing of BRRI released Boro and T. Aman season hybrid were started by ACI, Supreme seed, Ahasan seeds, JF Agro and Babylon Agro and Dairy Ltd.	Availability of BRRI released hybrid in the market will be increased and help popularizing BRRI released hybrid varieties.
	Genetic Resources and Seed Division (GRSD)	
	Proposed Research Program: 2022-23	
Sl. No.	**Research Progress 2021-22**	**Expected Output**
1	**Project 01: Rice Germplasm Conservation and Management.**	In total, 150 rice germplasm of which three in Aus, 20 Jhum rice, 25 in T. Aman, 36 in Aman and 66 in Boro seasons were collected from different districts of Bangladesh including hilly areas. One hundred and thirty-six germplasm accessions were morphologically characterized using 'Rice Germplasm Descriptors and Evaluation Form' of GRSD. Rejuvenation of 2,848 accessions was completed. Apart from this, 41 new germplasm were registered as new accessions (from accession number 8,655 to 8,695) in BRRI Genebank. Besides, 2,399 samples of rice germplasm and BRRI developed varieties were supplied to 33 different users.
2	**Project 02: Exploratory and Genetic Studies.**	Acc. 516 along with BRRI dhan80 will be evaluated at BRRI HQ, Gazipur and BRRI RS Barishal in T. Aman 2022-23 as

		Regional Yield Trial (RYT). Acc. 7888 along with BRRI dhan77 will be evaluated at BRRI HQ, Gazipur and BRRI RS Barishal in T. Aman 2022-23 as Regional Yield Trial (RYT). From Secondary Yield Trial (SYT) of aromatic rice germplasm, the highest grain yield (2.5 t ha^{-1}) was observed in Chinisail, Subal Lata and BRRI dhan34. From Evaluation of photosensitive rice germplasm, one Malshira, one Bindi Pakri accession and Indur Sail showed better performance on the basis of their morpho-agronomic traits among the tested entries. Grain weights for five hills of Malshira (Acc. 545), BindiPakri (Acc. 4810) and Indur Sail (Acc. 3661) germplasm were 22.97 g, 22.54 g and 20.16 g, respectively. Twenty-eight Jhum rice germplasm were characterized to study the selection criteria during Aus 2020-21. The highest grain yield/hill (31.52 g) was observed in Katak Tara, followed by 28.11 g in BR 84-4-1-2-P2, 27.02 g in Guri Galon. Freshly harvested 13 new BRRI released rice varieties of T. Aman season were tested for germination to check the dormancy and storage ability and no dormancy period was observed in any of the studied varieties The result of conformation of selected blast resistant materials using blast isolates and molecular markers revealed that nine genotypes contained Piz-t gene but genotype "Duria Sashpai" and "Lara" contained all of the target genes (Pi9, Pb1 and Piz-t). Genotypes Beti Chikon, Voratain, Dingamoni and Holde Barud possessed Pi9 and Piz-t genes, whereas genotypes Lal Jamai Babu, Bowaldar and Kambui possessed Pb1 and Piz-t genes only
3	**Project 03: Seed Production and Variety Maintenance**	One hundred and sixteen BRRI developed and recommended rice varieties were maintained along with nucleus seed. Besides, nucleus seed stocks of 63

		varieties were produced for the source of breeder seed. In total, 218.72 tons of breeder seed with tags of which 143.44 tons of 20 Boro varieties, 16.36 tons of ten Aus varieties and 58.92 tons of 35 T. Aman varieties were produced. At the same time, 198.994 tons of breeder seed of which 131.341 tons of 20 Boro varieties, 16.215 tons of ten Aus varieties and 51.438 tons of 34 T. Aman varieties were distributed among 718 partners (GO, NGO and PS) of BRRI 'Rice Seed Network'. Breeder and foundation seed producing plots and farms were also visited to observe the varietal purity and performance of respective seed.
	Grain Quality and Nutrition Division	
	Research Progress 2021-2022	
Sl. No	**Research Progress**	**Major Output**
1	**Project 1:** Grain Quality Characteristics for Varietal Development	
	1.1 Determination of physicochemical and cooking properties of advanced breeding lines **Progress:** A total of 663 breeding lines were analyzed,	75 had more than 70% milling outturn, 92 had more than 60% head rice recovery, 22 have shown translucent (Tr) grain, 257 had long grain, 172 had more than 3.0 L/B ratio, 371 had more than 25.0% amylose content, 55 had more than 9.0% protein content, 27 had more than 1.5 elongation ratio and 190 had between the range of (4.0-5.0) volume expansion ratio. Some of the promising lines were identified for higher milling and head rice recovery, size and shape, amylose content, protein content, elongation ratio and acceptable other physicochemical properties.
	1.2: Determination of physicochemical and cooking properties of TRB lines **Progress:** A total of four thousand four hundred five (4405) transforming breeding lines were evaluated for physicochemical and cooking properties for superior quality.	Based on the performance on grain quality, we were recommended twenty one (21) preliminary yield trial and nine (9) advance yield trial of favorable boro and cold tolerant rice lines for further advancement.
	Project 3: Nutritional Quality Assessment of Rice	

	1.3: Effect of Zn and phytate activities on Zn enriched rice varieties at different locations in T. Aman season **Progress:** Physicochemical properties and micronutrient contents of same variety have shown variation at different locations due to climatic factor such as drought, flood, salinity, high temperature and soil conditions.	The range of milling outturn is 69 to 72%, head rice recovery is 57 to 67%, milled rice length is 6.5 to 6.9 mm, L/B ratio is 3.1 to 3.7, 1000 grain wt. is 23.3 to 25.5g, amylose content is 20.0 to 23.1%, protein content is 8.6 to 9.8, cooking time is 16:30 to 18:30 min., imbibition ratio is 3.9 to 4.3, iron content is 6.5 to13.2 ppm and zinc content is 15.9 to 20.1 ppm of BRRI dhan62. Similarly, the range of milling outturn is 69 to 72%, head rice recovery is 53 to 61%, milled rice length is 6.5 to 6.7 mm, L/B ratio is 2.6 to 2.8, 1000 grain wt. is 27.8 to 28.9g, amylose content is 22.3 to 26%, protein content is 6.9 to 9.2%, imbibition ratio is 3.7 to 4.5, iron content is 4.5 to15.0 ppm and zinc content is 10.7 to 17.4 ppm of BRRI dhan72.
	1.4 Study on anti-cancer properties of pigmented (black, red, purple) rice varieties in Bangladesh. **Progress:** A total of 15 germplasms including 11 black pericarp rice such as BK1, BK2, BK3, BK4, BK5, BK6, BK7, BK8, BK9, BK10, BK11, two red pericarp rice such as laxmidegga, BRRI dhan84 and two white pericarp rice such as BRRI dhan80, Gabura were analyzed.	Black pericarp rice has been reported for the presence of anti-cancerous component such as anthocyanidin specially Cyanidin-3-Glocoside (C3G). A total of 15 germplasms including 11 black pericarp rice such as BK1, BK2, BK3, BK4, BK5, BK6, BK7, BK8, BK9, BK10, BK11, two red pericarp rice such as laxmidegga, BRRI dhan84 and two white pericarp rice such as BRRI dhan80, Gabura were grown in BRRI westbyed farm and collected from GQN (Grain Quality and Nutrition) Division of BRRI (Bangladesh Rice Research Institute) Gazipur to evaluate the presence of Cyanidin-3-Glocoside (C3G). Our data reveals all black rice possess Cyanidin-3-Glocoside (C3G), an active anti-cancerous compound with a ride range of 2.58 to 806.17 ppm except red and white pericarp rice in Bangladesh. C3G content has a thermal sensitive property as it reduces 48% of C3G content just after cooking. So, regarding developing black rice breeding materials, we should consider the higher C3G content germplasm for parental selection. In this regard BK11,

		BK10, BK8 and BK9 (aromatic) can potentially be used in black rice breeding program at BRRI.
	Project 4. Commercial Rice Based Products	
	4.1 Determination of physicochemical properties and quality of puffed, popped and flattened rice from newly released BRRI varieties **Progress:** Puffed, popped and flattened rice were produced from BRRI varieties to evaluate the quality products	Comparing few parameters (fully puffed rice, length and breadth increased percentage) with BR16 (Std), it is ascertained from the results that BRRI dhan92 and BRRI hybrid dhan6 are better in producing whole puffed rice followed by BRRI dhan90 and BRRI dhan95. Considering physical parameters, BRRI dhan87 and BRRI dhan89 show excellent performance for whole, partial broken, broken and unpopped rice. Among the tested varieties, in terms of weight of whole, partial broken and broken flattened rice as well as percentage of length increased, BRRI dhan93 showed the best performance comparing with BR16.
	Rice Farming Systems Division	
	Research Progress: 2021-2022	
Sl. No.	**Research Progress 2021-22**	**Expected Output**
1	**Survey**	
1.1	Survey on tobacco based cropping system	Tobacco is distributed in 14 cropping patterns. Total tobacco area was recorded as 49 thousand hectares which is equivalent to 0.57% of net cropped area in Bangladesh. Tobacco cultivation is concentrated in 45 upazilas of 15 districts. As a short duration winter crop it is well fitted in an intensive cropping system of three crops. Farmers consider tobacco farming as a business and as a guaranteed cash crop at a pre-declared price rate. Poor farmers explore the opportunity of family labour employment in tobacco production and processing. Various incentives from tobacco companies and on the contrary unpredictable market price of winter vegetables also push the farmers for the business. Most of the

		farmers believe the hazardous issues of tobacco at an insignificant level.
2	**Development of Cropping System and Component Technology for Favorable Environment**	
2.1	Performance evaluation of four-crop cropping pattern for irrigated medium high land ecosystem	Veg-Veg-Veg-T. Aman cropping pattern turned out 43.55 t/ha REY which was 238% higher than the control pattern.
2.2	Performance evaluation of three-crop cropping pattern for irrigated medium high land ecosystem	Potato-Boro-T. Aman cropping pattern resulted 18.58 t/ha REY which was 65% higher than the control pattern.
2.3	Long-term evaluation of major rice based cropping pattern	The highest gross margin (431860 Tk/ha) was obtained from Onion-Jute-T. Aman cropping pattern which was 236% higher than the two rice cropping system.
2.4	Optimizing transplanting window of premium quality T. Aman rice varieties under different and changing climatic conditions in Bangladesh using ORYZA V3	In all locations, BRRI dhan34 gave higher grain yield when seeded at 20 June-05 July with 20-30 days old seedling. Whereas BRRI dhan75 and 87 yielded better at 20 June-20 July with 20 days old seedling.
2.5	Optimizing transplanting window of premium quality Boro rice varieties under different and changing climatic conditions in Bangladesh using ORYZA v3	In all locations, BRRI dhan50 gave higher grain yield when seeded at 16 Nov -16 Dec with 35-45 days old seedling. Whereas BRRI dhan63 and 92 yielded better at 16 Nov-01 Dec with 35-45 days old seedling in Jhenaidah. In Dinajpur and Gazipur, BRRI dhan63 and 92 yielded better at 16 Nov-16 Dec with 35-45 days old seedling.
2.6	Determine the effect of nutrient management practices on premium quality rice variety/(s) for improved yield, grain quality, and milling traits	In Jhenaidah, All the additional foliar sprayed treatments performed better than the unsprayed treatment of BRRI dhan50, 63 & 92. In Dinajpur, BRRI dhan50 performed better with 2 times 0.5% Zn and 3 times 0.5% Zn sprayed treatments. Whereas, BRRI dhan63 yielded better with 2 times 0.5% K, 1 time 0.5% K and 0.5% Si sprayed treatments. In addition, BRRI dhan92 gave higher grain yield from all the additional foliar sprayed treatments except 1 time 0.5% K sprayed treatment. In Gazipur, BRRI dhan63 performed better with 2 and 3 times 0.5% Zn sprayed treatments. BRRI dhan50 gave higher grain yield with 2 times 0.5% Zn sprayed treatments. Whereas there was no

		significant difference in grain yield among the treatments in case of BRRI dhan92.
2.7	On-farm performance evaluation dry direct seeded rice (DSR) as compared with transplanted rice (TPR) in Aus season	In Jhenaidah, the grain yield of Aus rice was not affected by establishment methods except in low land type where manual transplanted method performed better than other establishment methods. However, line sowing and hand broadcast method didn't affect the Aus grain yield across the land type except manual transplanted method. Where Aus varieties performed better in medium and low land types. In Faridpur, manual transplanted method, performed better than other establishment method across all land types. In addition, land types didn't affect the grain yield of Aus varieties in case of hand broadcast and manual transplanted methods. However, line sowing performed better in high and medium land types. In Dinajpur, manual transplanted method, performed better than other establishment method across all land types. In all establishment methods, the grain yield was greater in medium and low land eco-systems. Irrespective of establishment methods and land types, BRRI dhan83 performed better than other tested varieties in all locations. Production cost was higher in highland eco-system over all locations. Whereas the cost of manual transplanting was higher compared to other establishment methods in all locations.
3	**Development of Cropping System and Component Technology for Stress Prone Area**	
3.1	Evaluation of newly released BRRI rice varieties under Watermelon-T. Aus-T. Aman cropping pattern	The yield of watermelon was 29.32-33.26 t/ha. In T. Aman season, BRRI dhan 87 yielded 5.23-5.76 t/ha and BRRI dhan756 turned out 4.82-4.91 t/ha grain yield.
4	**Development of Cropping System Technologies for Hill Ecosystem**	
4.1	Improvement of Jhum production system through the introduction of modern HYV Aus varieties in hilly areas	All the HYV varieties performed better than the local varieties. The grain yield of BR26, BRRI dhan48, BRRI dhan82,

		BRRI dhan83, BRRI dhan85 ranged from 2.89-3.45, 3.24-3.58, 3.27-3.63, 3.34-3.75 and 3.22-3.42 t/ha respectively. Whereas different local varieties yielded 1.79-3.32 t/ha.
4.2	Inclusion of mustard in Boro – Fallow –T. Aman cropping pattern in piedmont plain land	BRRI dhan87-Mustard-BRRI dhan89 cropping pattern resulted 17.83 t/ha REY which was 60-91% higher than the control pattern.
4.3	Intensification of Fallow-Fallow-T. Aman cropping pattern through the inclusion of modern Aus rice in piedmont plain land in hilly areas	All the improved cropping pattern performed better than the existing cropping patterns. Among the improved cropping patterns, Fallow-T. Aus (BRRI dhan48)-T. Aman (BRRI dhan87) gave the highest REY of 10.81 t/ha.
4.4	Fertilizer management in HYV Aus rice in Jhum cultivation system	In case of all tested varieties, ring placement of fertilizer around the dibbling hole gave higher grain yield than other treatments and it was found well manageable in the hilly areas.
5	**Validation and Delivery of Cropping System Technology**	
5.1	Intensification of Boro-Fallow-T. Aman cropping pattern through the inclusion of mustard in irrigated ecosystem of Madhupur Tract	The highest gross margin (281300 Tk/ha) was obtained from BRRI dhan87-Mustard-BRRI dhan92 cropping pattern which was 106% higher than the two rice cropping system.
5.2	Inclusion of mustard after Aman rice in Boro-Fallow-T. Aman cropping system	Mustard-Boro-T. Aman was resulted 72% higher gross margin (100950 Tk/ha) than the existing Boro-Fallow-T. Aman cropping pattern.
5.3	Piloting of cropping pattern technologies to increase the productivity at Kishoreganj	Among the three tested cropping pattern Potato-Jute-T. Aman gave the highest REY (25.84 t/ha) with highest BCR (2.37).
5.4	Evaluation of newly released BRRI rice varieties under Potato-Boro-T. Aman cropping pattern	BRRI dhan95-Potato-BRRI dhan98 produced the highest REY (27.73 t/ha) and gross margin (2,43,640 Tk/ha). Considering the rice varieties, BRRI dhan98 and BRRI dhan88 in Boro season and BRRI dhan95 in Aman season performed better under Potato-Boro-T. Aman cropping pattern.
6	**Integrated Farming Systems**	
6.1.1	Characterization of the farming systems research and development site	Physical, biological, social and economic conditions, infra-structural condition,

		existing farming systems, resource situation, general problems of the FSRD site has been generated.
6.1.2	Monitoring the whole farm activities of intervened farmers	Interventions on homestead, crop, livestock, fisheries and agroforestry system were provided to the 10 selected farmers of the site.
6.1.3	Integration of mustard in the rice-based cropping system under different rice growing environments	BARI sarisha-14-BRRI dhan98-BRRI dhan75, BARI sarisha-14-BRRI dhan98-BRRI dhan87 and BARI sarisha-14-BRRI dhan98-BRRI dhan71 were found most profitable among the all tested cropping pattern combinations. Farmers showed interest to cultivate mustard during the transition period to increase system productivity.
6.1.4	Field days and farmers' training on different farming systems activities	Two farmer's training and three field day were organized to improve the knowledge of the farmers about new technologies.
	Agronomy Division	
	Research Progress 2021-2022	
Sl. No.	**Research Progress**	**Major Output**
	Planting Practices	
1	Title: Influence of Dates of Transplanting on the Yield of T.Aman Rice in Rangpur region Progress: Completed	• To achieve appreciable higher yield in the Rangpur region, BRRI dhan75 should preferably be transplanted on the 20th of July to get a higher yield (5.46t ha^{-1}) • BRRI dhan87 (5.92 t ha^{-1}) & BRRI dhan93 (7.05 t ha^{-1}) should be transplanted on the 10th of August for higher yield.
	Title: Enhancing rice yield by optimizing planting time of newly released transplanted Aman varieties Progress: Completed	• 10 to 25 July transplanting BRRI dhan93 (4.41-5.10 t ha^{-1}) and BRRIdhan94 (4.54-5.34 t ha^{-1}) gave similar grain yield and growth duration. After 25 July grain yield decreased but growth duration increases gradually • In the case of BRRI dhan95 growth duration as well as grain yield decreasing from 10 July to 10 September transplanting (5.09-4.28 t ha^{-}

		^{1}). BRRI dhan95 gave flowering in October at all transplanting dates.
	Title: Enhancing rice yield by optimizing planting time of T. Aman varieties at BRRI Regional Station Barisal Progress: Completed	• Results indicated that from 05-20 August transplanting, BRRI dhan23 produced the highest grain yield (4.94-5.59t ha-1) followed by BRRI dhan72 and BRRI dhan76 with 121-135 days growth duration • However, considering the grain yield and growth duration, early transplanting 05 August was found suitable with BRRI dhan72 (5.49 t/ha) and late transplanting 20 August was found suitable with BRRI dhan23 (5.59 t/ha). • Overall 5 August transplanting is better yielded irrespective of varieties
	Title: Effect of time of planting on grain yield and growth duration of ALART, Low Glycemic Index Rice line in Boro, 2020-21 season at BRRI farm Gazipur Progress: Completed	• From 05-20 January transplanting, BR16 produced the higher grain yield (6.68 tha^{-1}) followed by BRRI dhan58(5.99t ha^{-1}) and BRCC266-5-1-1-1(5.97 t ha^{-1}) with 162-148 days growth duration . • Advanced line BRCC266-5-1-1-1 mature 5-6 days earlier than BRRI dhan58 and 7-8 days earlier than BR16.
	Fertilizer Management	
	Title: Nitrogen application to maximize grain yield of Swarna type varieties in T. Aman season Progress: Completed	STB treatment of both BRRI dhan93 (5.33 t ha^{-1}) and BRRI dhan95 (5.25 t ha^{-1}) gave higher grain yield than BRRI recommended dose and required 16% less Nitrogen from BRRI recommended dose.
	Title: Growth and yield improvement of T. Aman rice in charland ecosystem through integrated nutrient management Progress: Completed	• The application of 50 % RDF along with cowdung @5 t ha^{-1} obtained 6.14 t ha-1 grain yield in BRRI dhan87. • Poultry manure @ 3 t ha^{-1} got 5.44 t ha-1 grain yield in BRRI dhan87 in charland area.
	Title: Application of Nano-Zinc Oxide to Improve Salt Tolerance of Rice in Aman Season Progress: Completed	• Both BRRI dhan73 and BRRI dhan87 could not tolerate 50 mM NaCl (Approximately 5.25 ds m-1) salinity level. • 100 ppm Nano-Zn oxide spray did not improve the growth and yield of any

		tested varieties
	Title: Effect of different N levels on growth, yield, nitrogen use efficiencies (NUEs) and grain quality of aromatic rice varieties Progress: Completed	Differentiating the quadratic equation of yield response with respect to applied different N doses the optimum N rate and economic N rate (ENR) appeared as 57 and , 56 kg ha^{-1} and 56 and 55kg for BRRI dhan34 and BRRI dhan90, respectively.
	Title: Application of chitosan to improve salt tolerance in rice in reproductive stage Progress: Completed	• In 65 mM salinity level BRRI dhan67 gave 35% higher yield with 250 ppm chitosan spray than without spray. In control condition, BRRI dhan67 gave 12% higher yield with 250 ppm chitosan spray than without spray • In saline condition, yield reduction was found from both variety and chitosan spray could slightly mitigate the saline stress in BRRI dhan28.
	Weed Management	
	Title: Evaluation of candidate herbicide for weed control efficiency in T Aman 2021 and Boro 2021-22 season Progress: Completed	• Weed control efficiency found 80%-93%
	Title: Residue analysis of widely used herbicides in the irrigated rice ecosystem by LCMS-MS Progress: Field experiment completed and laboratory analysis is ongoing as new method need to develop in LCMS-MS	• The maximum residue limit (MRL) of brown rice is 100 ppb and HPLC detection can't reach up to that point precisely. • So, this year we received LCMS-MS and we use this machine to detect the herbicides. • The limit of detection of Bensulphuran Methyl and Pendamethyline in LCMS-MS is 10 ppb and 12 ppb, respectively which method is now applying to detect both of these herbicide in the grain, soil and plants. • Furthermore, the method development of other herbicides are under process
	Title: Effect of herbicides on soil microbial Population in T aman 2021 and Boro 2021-22 season Progress: Completed	• Fungus could be recovered their numbers 7 days after the application of Pendamethalin 33EC whereas NFB & PSB could be recovered 20-25 days after its application and total bacteria could be recovered 30-60 days after its application.

		• In case of Penoxlum 20EC, NFB & total bacteria could be recovered their numbers 10 days after its application whereas PSB & fungus could be recovered their numbers 20 days after its application. • On the other hand, NFB, total bacteria & fungus could be recovered their numbers 20 days after the application of Ethoxysulfuron whereas PBS could be recovered their numbers 10 days after its application.
	Yield Maximization	
	Title: Maximizing yield of BRRI developed new varieties through influencing some Agronomic Critical Factors in Boro seasons at BRRI farm Gazipur. Progress: Completed	• The highest grain yield was observed by BRRI dhan89 (7.79 t ha^{-1}) in management M_3 treatment followed by BRRI dhan29 (7.28 t ha^{-1}) in management M_2 • Short duration variety BRRI dhan88 produced highest grain yield in management M_3(6.45 t ha^{-1}) • STB fertilizer management would be followed and additionally 1% MoP solution to be spray on 30 and 45 DAT.
	Title: Maximizing yield of some local fine aromatic cultivars through manipulating some Agronomic management in Aman seasons Progress: Completed	• Among the tested 8 variety, BRRI dhan34 (3.44 t ha^{-1}) and Tulshi Mala (2.60 t ha^{-1}) have higher sensitivities to Agronomic management and produced higher grain yield compared to other tested varieties. • Kalo Malshira and Gobidha Voaug have less management sensitivity on grain yield production, • Among the four Agronomic managements, Management 3 and Management 4 have more effect on grain yield production rather than other two tested Agronomic management.
	Title: Maximizing yield of BRRI developed new varieties through influencing some Agronomic Critical Factors in T Aman seasons at BRRI farm Gazipur. Progress: Completed	• The result showed that BRRI dhan71 (5.61 t ha-1) (Short duration, 114 days), BRRI dhan87 (5.72 t ha-1) (Medium duration, 128 days) and BRRI dhan52 (6.24t ha-1) (Long duration

		variety, 145 days) varieties obtained the highest yield by M_4 and M_5 agronomic management combinations than other tested agronomic management.
	Title: Yield maximization of Boro rice through good agricultural practice (GAP) Progress: Completed	• GAPs management showed better performance in all aspects. Highest grain yield was observed in BRRI dhan89×GAPs (7.34 t ha^{-1}) followed by BRRI dhan89×CRM practices (7.15 t ha^{-1}). • BRRI dhan88 and BRRI dhan50 also produced highest yield with GAPs. • According to the results it seems that GAPs produced higher grain yield compared to conventional BRRI recommended practices in different varieties which is safe and environment friendly.
	Title: Study on biodegradation of pesticides in soil using selected microbial strain Progress: Completed	• The two bacterial strains showed its sensitivity to CTP after 3 days of inoculation (Figure 4) . • However, bacterial strains were capable of overcoming the negative effect of pesticides for the rest of the growth period. • Among the two bacterial strains, Bacillus tequilensis was highly performed to degrade CTP in Tryptic Soy Broth (TSB) media.
	Soil Science Division	
	Research Progress 2021-2022	
Sl. No	**Research Progress**	**Major Output**
	Sub-sub program I: Soil Fertility and Plant Nutrition	
1.1	Nitrogen Requirement of ZER ALART materials in T. Aman season (Six months) Field trial was conducted for ZER (BR 9674-1-1-5-2-P4) at BRRI HQ farm, Gazipur during T. Aman 2021 following split-plot design with 3 replications, where Six urea-N doses (kg ha^{-1}): N_0, N_{20}, N_{40}, N_{60}, N_{80} and N_{100} with standard doses (soil test based) of P, K, S were assigned in main-plot and rice genotypes in sub-plot with check varieties	Nitrogen requirement of ZER advanced line BR 9674-1-1-5-2-P4 was 64 kg N ha^{-1} and produced lower grain than check varieties.
1.2	Nitrogen Requirement of PQR ALART materials in	Higher grain yield was obtained with the

	Boro season (Six months) PQR lines BR9930-2-3-2-2 and BR9930-2-3-3-1 and three rice varieties viz. BRRI dhan50, BRRI dhan63 and BRRI dhan81 as check were evaluated in Boro 2021-22 following split-plot design with 3 replications, where fertilizer N doses (kg ha^{-1}): N_0, N_{30}, N_{60}, N_{90}, N_{120} and N_{150} with standard doses of P, K, S and Zn were assigned in main-plot and rice genotypes in sub-plot.	two PQR genotypes BR9930-2-3-2-2 and BR9930-2-3-3-1 compared to three check rice varieties The economic optimum N dose for PQR advanced lines BR9930-2-3-2-2 and BR9930-2-3-3-1 were 122 kg and 121 kg N ha^{-1}, respectively.
1.3	Updating of Nitrogen doses for modern rice varieties (one year) The experiment was conducted at BRRI, Gazipur in T. Aman 2021 and Boro, 2021-22 seasons to determine the optimum N requirement of BRRI dhan95 and BRRI dhan92, respectively. The experiment was laid out in a RCB design with three replications. The applied N doses (kg ha^{-1}) for T. Aman was 0, 30, 60, 90, 120, 150 and Boro was 0, 40, 80, 120, 160, 200, respectively, along with flat doses of P, K, S fertilizer.	The economic optimum N dose for BRRI dhan95 in T. Aman season was 88 kg ha^{-1} and in Boro season for BRRI dhan92 it was 180 kg ha^{-1}
1.4	Improving rice yield and N use efficiency through nanotechnology and zeolite amendment (Six months) A rice growth pot experiment was set up using a terrace paddy soil of BRRI Gazipur at Boro season covering 6 fertilizer treatments × 3 replicates. The intent was to investigate the N use efficiency of typically synthesized urea-HA (hydroxyapatite) nanohybrid and urea plus purified natural zeolite (71% SiO_2) over prilled urea. Transplanted rice (BRRI dhan89) was grown in the green house under continuous flooding for 114 days. Six treatments viz. T_1: PKSZn, T_2: Urea-N_{120} PKSZn, T_3: Nano fert.-N_{120} PKSZn, T_4: Nano fert.-N_{60} PKSZn, T_5: Urea-N_{120} PKSZn + purified natural zeolite (71% SiO_2) @ 2.5 t ha^{-1} and T_6: Urea-N_{60} PKSZn were tested.	Urea-HA nanohybrid may save up to 50% urea use providing comparable N use efficiency with widely applied prilled urea.
1.5	Response of modern rice varieties to differe phosphorus levels (One year) The experiments were conducted at BRRI farm, Gazipur having deficit soil available P conditions. Six treatments of P doses calculating from soil test value (STB) viz. T_1= P control, T_2= 50% of STB P (11 kg ha^{-1}), T_3= 75% of STB P (16.5 kg ha^{-1}), T_4= 100% of STB P (22 kg ha^{-1}), T_5= 125% of STB P	The economic optimum dose of P for BRRI dhan87 in T. Aman was 27.5 kg P ha^{-1} and for BRRI dhan89 and BRRI dhan96 in Boro were 27 and 26.8 kg P ha^{-1}, respectively.

	(kg ha^{-1}) and T_6= 150% of STB P (27.5 kg ha^{-1}) were applied in both the seasons. BRRI dhan87 in T. Aman and BRRI dhan89 and BRRI dhan96 in Boro season were used as tested rice varieties. Each plot received a flat dose of N-K-S-Zn (kg ha^{-1}) @ 90-42-10-1 in T. Aman and 160-60-20-2 in Boro	
1.6	Effect of potassium fertilization at different growth stages on growth and yield of rice (One year) The experiments were conducted at two farmer's field each of Dumuria, Khulna and Amtali, Borguna, and one farmer's field at Rajshahi with the objective to study the effect of split application of potassium on the yield and yield contributing characters of rice grown in T. Aman and Boro season. The five treatments for Khulna and Barguna viz, T_1= K application (RD) as basal T_2= K application @ 2/3 as basal + 1/3 at Tillering Stage (TS) T_3= K application @ 2/3 as basal + 1/3 at Maximum Tillering (MT) stage T_4= K application @ 2/3 as basal + 1/3 at Panicle Initiation (PI) stage T_5= K application 1/3 as basal +1/3 at MT stage +1/3 at PI stage. For Rajshahi nine treatments were assigned as follows: $T_1 = K_0$ (No Potassium), $T_2 = K_{Basal(RD)}$ (Recommended dose as basal), $T_3 = T_2 + K_{20}$15 DAT (20kg k/ha at tillering stage), $T_4 = T_2 + K_{20}$15 DAT $+K_{20}$ 30 DAT (20kg k/ha at max. tillering stage), $T_5 = T_2 + K_{20}$15 DAT $+K_{20}$30DAT $+K_{20}$ 50 DAT (20kg k/ha at panicle initiation stage), $T_6 = T_2 + K_{20}$ MTS + K_{20}PIS, $T_7 = T_2 + K_{20}$MTS, $T_8 = T_2 + K_{20}$PIS, T_9 = Two-third of RD as basal + one-third at PIS. Experiments were laid -out in a Randomized Complete Block Design (RCBD) with three replications. The variety was BRRI dhan87 in T. Aman and BRRI dhan28/81 in Boro season.	Split application of K (2/3rd as basal and 1/3rd at PI stage) showed positive effects on rice cultivation at Khulna, Barguna and Rajshahi.
1.7	Effect of nitrogen and potassium rates on modern rice cultivation (One year) The study was conducted to observe the effect of nitrogen (N) and potassium (K) on the yield and nutrition of modern rice at BRRI farm, Gazipur. The experiment was laid out in split-plot design with three replications assigning the rates of K in the main plots and that of N in the subplots. Soil test based flat rates of P and S were applied to all the plots. The application rate of K was 0, 50, 100, 150, and 200 kg ha^{-1} both in T. Aman and Boro seasons. Nitrogen was applied @ 0, 50, 75, and 100 kg ha^{-1},	The optimum N and K rates for achieving the maximum grain yield were 98 and 106 kg ha^{-1}, respectively, for BRRI hybrid dhan6 during T. Aman, while for BRRI dhan89 in Boro season, the rates were 128 kg N and 100 kg K ha^{-1}. Soil analysis of the experimental plots shows that K mining occurs at low application rate and that to maintain soil K fertility.

	in T. Aman season, while in Boro season, the rate of N was 0, 100, 150 and 200 kg ha^{-1}. The test varieties were BRRI hybrid dhan6 and BRRI dhan89 in T. Aman and Boro seasons, respectively.	
1.8	Nutrient management for growing four crops in a year (One year) The experiment has been initiated to grow four crops in a year to sustain soil fertility and increase productivity. Three fertilizer treatments viz. soil test based (STB) fertilizer (T_1), crop residues (CR) + STB fertilizer (T_2) and fertilizer control i.e. native soil nutrients (T_3) were tested with Mustard-Boro-T. Aus-T. Aman (CP-1) and Mustard-Mungbean-T. Aus-T. Aman (CP-2) patterns. The experimental design was randomized complete block with 3 replicates. First crop Mungbean was incorporated in T_2 treatment.	Under four crops in a year, incorporation of crop residues with AEZ based or STB chemical fertilizers is suitable to improve soil nutrients with consistency in yield trends than chemical fertilizers only after 6^{th} crop cycle. Moreover, considering REY and improvement of soil physio-chemical properties, Mustard-Boro-T. Aus-T. Aman performed better than Mustard-Mungbean-T. Aus-T. Aman cropping pattern.
1.9	Effect of Flora on growth and yield of Boro rice (One year) The present study was conducted at the experimental field of BRRI Gazipur and BRRI R/S Sonagazi, Feni during the Boro season, 2021-22. The following four treatment combinations were tested in both sites: T1= Recommended Fertilizer (RF)+Flora (2.0 mL/L), T2 = RF+Flora (3.0 mL/L), T3 = RF+Flora (4.0 mL/L), T4 = RF (Control). The experiments were laid out in a RCB block design with three replications. At BRRI, Gazipur and Sonagazi the recommended dose of N-P-K-S-Zn was 160-20-60-15-2 kg ha^{-1}.	Application of Flora @ 3 ml/l along with recommended fertilizer produced the maximum grain yield.
1.10	Effect of NPK Combo fertilizer on growth and yield of Boro rice (One year) The present study was conducted at the experimental field of BRRI farm Gazipur and the BRRI R/S Sonagazi, Feni to know the efficacy of NPK combo fertilizer. The following four treatment combinations were tested in both sites: T1= Recommended Dose (RD)– straight fertilizer, T2 = RD - NPK Combo, T3 = 25% less RD- Straight fertilizer, T4 = 25% less RD- NPK Combo. The experiments were laid out in a randomized complete block design with three replications At BRRI, Gazipur and Sonagazi the recommended dose of N-P-K-S-Zn was 180-16-76-06-1.5 kg ha-1 (FRG 2018). The NPK content of NPK Combo 22:3.5:10	The single application of NPK compound fertilizer at the time of final land preparation performed well compared with the straight fertilizer application.

	was considered when calculating nutrient dose for each plot.	
	Sub-sub program 2: Identification and management of nutritional disorder	
2.1	Long-term effect of organic and inorganic nutrients on yield and yield trend of lowland rice (One year) A long-term experiment was initiated on a permanent layout at BRRI HQ farm Gazipur in 1985 Boro season having 12 treatments assigned in RCB design with four replications. The objective of the study was to find the impact of long-term nutrient management on grain yield and soil health. The treatments were revised according to needs (see BRRI, 2016 and BRRI, 2020). The recent STB doses of NPKSZn were 160-12-80-5-2 kg ha^{-1} and 100-10-80-5-2 kg ha^{-1} for Boro and T. Aman rice, respectively. The tested rice varieties were BRRI dhan87 in T. Aman and BRRI dhan89 in Boro season.	Long-term omission of N, P, K, S and Zn adversely affected rice yield in Grey Terrace soil of BRRI farm, Gazipur (AEZ 28, Modhupur Tract) in both Boro and T. Aman season. Application of IPNS based fertilizers had great positive effect on rice yield and nutrient uptake
2.2	Long-term missing element trial in BRRI regional station farm, Rangpur (One year) The experiment was initiated in a permanent layout at BRRI farm Rangpur combining 7 treatments in RCB design with 3 replicates. Fertilizer nutrients i.e., N-P-K-S-Zn rate was 95-8-40-12-1 kg ha^{-1} and 145-10-60-15-2 kg ha^{-1} in T. Aman and Boro seasons, respectively. BRRI dhan87 in T. Aman and BRRI dhan89 in Boro seasons were cultivated as test rice varieties.	The omission of N, P in T. Aman and omission of N, P, K and S in Boro season from complete fertilizer significantly reduced the grain yield of rice at BRRI Rangpur farm. Among the major nutrient elements, omission of N appeared as the most yield limiting nutrient.
2.3	Effect of intensive rice cropping on rice yield under continuous wetland condition (One year) The experiment was designed to harvest three rice crops per year with the evaluation of the consequences of intensive rice cropping under continuous wetland conditions and to monitor soil fertility changes over time. This experiment was initiated in 1971 in a permanent layout with NPK fertilizer application. Since Boro 2000, the experiment was modified to accommodate six treatments viz. control (native nutrient), reverse control (NPKSZnCu), NPK, NPKS, NPKSZn and NPKSZnCu after several revision in the year of 1982, 1984 and 1991. In Boro 2020-21, the experiment was revised again the N and K fertilizer	Intensive rice cropping with NPKSZn resulted in highest annual yield of rice compared to other missing fertilizer treatments. Application of Zn and Cu fertilizer showed positive effect on rice yield.

	from 140 to 160 and 80 to100 kg ha^{-1},respectively. The varieties tested in T. Aus, T. Aman and Boro seasons were BRRI dhan48, BRRI dhan87 and BRRI dhan84, respectively. The NPK doses used were 160-25-100, 60-15-80 and 60-10-60 kg ha^{-1} for Boro, T. Aman and T. Aus, respectively. Sulfur, Zn and Cu were applied at 10, 4 and 1 kg ha^{-1} in Boro season only.	
	Sub-sub program 3: Integrated nutrient management for intensive rice cropping	
3.1	Integrated nutrient management for double and trip rice cropping for maximizing productivity (One year) The experiment was initiated in to find the suitable fertilizer management for double and triple rice cropping system and to find out the impact of triple rice cropping on soil health. In Boro-Fallow-T. Aman pattern, BRRI dhan58 and BRRI dhan87 were used. In Boro-T. Aus-T. Aman pattern, BRRI dhan84, BRRI dhan48 and BRRI dhan87 were included as test variety. Fertilizer treatments used were: control, STB dose (NPKS @ 160-25-60-20 kg ha^{-1} for Boro, 70-12-48-10 kg ha^{-1} for T. Aus and 84-21-32-06 kg ha^{-1} for T. Aman), STB (50%) + Mixed manure (MM) (CD @ 2 t ha^{-1} + ash @ 1 t ha^{-1} oven dried), farmers' practice (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.	50% STB + mixed manure (2 t cow dung and 1 t ash ha^{-1}) was found to be good options for sustaining crop productivity under intensive rice culture.
3.2	Increase rice yield through the vermin-compost amendment in coastal soils (Six months) The experiments were initiated at three farmer's fields each of Dumuria, Khulna and Amtali, Borguna, Bangladesh in T. Aman (wet) season to find out the effect of VC on grain yield improvement. Treatments were @ 0, 1, 2 t ha^{-1} (oven dry basis) VC with full dose of chemical fertilizer (FRG, 2018)**.**	Grain yield was significantly increasing due to vermicompost added at the rate of 1 and 2 t ha^{-1} in Dumuria, Khulna in T. Aman 2021 but insignificant in Boro 2021-22. In Amtali, Borguna site vermicompost added at the rate of 1 and 2 t/ha with a full dose of chemical fertilizer significantly increased grain yield both in T. Aman 2021 and Boro 2021-22 seasons
3.3	Increase rice yield through the organic and inorganic amendment (One year) The experiment was initiated at the BRRI, Gazipur to investigate the effect of vermicompost and silicon on rice grain yield and soil health. The experiment	Results of Boro 2020-21 showed that grain yield of BRRI dhan89 with different vermicompost rates did not increased significantly. Among silicon rates, 400 kg ha^{-1} performed better however, it was statistically similar with all the silicon

	was laid out in a split- plot design with three replications, where main plots comprised of four levels of vermicompost (0, 2.5, 5, 10 t ha^{-1}) and sub-plots had four silicon rates (0, 100, 200, 400 kg ha^{-1}). The variety was BRRI dhan87 in T. Aman and BRRI dhan89 in Boro season.	rates.
3.4	Nutrient management under conservation agriculture in double rice cropping system (One year) This experiment was initiated at Paba, Rajshahi, in Boro 2018-19 seasons with the objectives to determine the nutrient requirement of rice in Boro-Fallow-T. Aman cropping pattern, and to improve soil health under conservation agriculture practices. Two crop establishment methods (unpuddled and puddled) in the main plot, two residue management practices (straw retained and straw removed) in the sub plot and four fertilizer doses as recommended fertilizer (RD) 100%, 125% of RD. 75% of RD, and 50% of RD were assigned in split-split plot design with three replications.	In Boro 2020-21 and T. Aman 2021, grain yields were insignificant among puddled and unpuddled cultivation, but rice straw incorporation significantly increased the rice yield. FRG recommendation (100%) fertilizer application was enough for the grain yield of rice irrespective of residue management and crop establishment methods in both seasons.
	Sub-sub program 4: Problem soil management and greenhouse gas emission	
4.1	Effect of different micro and beneficial nutrients on the growth and yield of rice (six months) The study was undertaken with the objective to determine the effect of micronutrients and beneficial nutrients on growth and yield of rice. A pot experiment was set up in the glass house of Soil Science Division, BRRI Gazipur. The study was laid out in a completely randomized block design with three replications and five treatments: T_1= NPKSZn, T_2= T_1 + CuNiSeSi, T_3= T_1 + CuNiSi, T_4= T_1 + CuSi and T_5= T_1 + Si. All treatments received a blanket dose of chemical fertilizer i.e. N-P-K-S-Zn @ 120-15-60-10-1.5 kg ha^{-1}. The Cu, Ni, Se and Si were applied as a foliar spray with the rate of 1%, 0.2%, 10 ppm and 0.2%, respectively.	Different micronutrients and beneficial nutrients had positive effects on yield contributing parameters and rice yield in the pot experiment.
4.2	Effect of silicon on growth and yield of rice (six months) A pot experiment was conducted in the net house of BRRI, Gazipur. Sandy loamy soil was used for pot culture. The study was laid out in a RCBD design with three replications. There were five treatments as follows: T_1 = NPKSZn, T_2 = T_1+ Si (0.1%), T_3 = T_1+ Si (0.2%), T_4 = T_1 + Si (0.4%) and T_5 = T_1+ Si	Foliar spray of 0.2% Si with the recommended fertilizer showed positive effect on the growth and yield of BRRI dhan89.

	(0.8%). The N, P, K, S and Zn were applied as basal with the rate of 120, 15, 60, 10 and 1.5 kg ha^{-1}, respectively. Foliar application of Si was done at 20, 35, 50, 65 and 80 days after transplanting (DAT) using pressurized hand sprayer.	
4.3	Effect of biochar on rice yield and soil health on problem soils (one year) The study was conducted at BRRI RS, Sirajganj with the objective to determine the effect of biochar on rice growth and yield and soil health in problem soils. The experiment was consisted of four treatments: T_1= Control, T_2= recommended fertilizer (RF), T_3= RF + biochar @ 2 t ha^{-1} and T_4= RF + biochar @ 4 t ha^{-1}. The treatments were arranged in RCB design with 3 replications. The biochar was produced from chita dhan (unfilled grain). The recommended dose of N-P-K-S was 100-15-40-10 kg ha^{-1} in T. Aman and 138-21-75-18 kg ha^{-1} in Boro season. Biochar was applied only in Boro season and incorporated with soil before 7 days of transplanting. In T. Aman season, 30 % fertilizer was reduced from the recommended dose in the biochar treated plots to observe the residual effect of biochar on rice yield.	Application of biochar had positive impact on growth and yield of rice.
4.4	Management interventions to improve N use efficiency and reduce N losses in typical rice cropping system of Bangladesh (One year) The field experiment was conducted at BRRI farm, Gazipur to quantify the fate of N fertiliser (crop, soil and losses) and N fertilizer use efficiency (NUE) under various N management options. The selected rice cultivars were BRRI dhan87 for T. Aman and BRRI dhan89 for Boro season. In both seasons, overall 28 (7 Treatments × 4 Replication), 20m^2 plots were established. The experiment was laid out in a RCB design. The tested seven treatments were: T_1: no N fertilizer (N0), T_2: 110 kg N ha^{-1} from prilled urea (N110PU), T_3: T_2+25% N (N138PU), T_4: T_2-25% N (N83PU), T_5: Cow dung (CD) (2 t ha^{-1}) + IPNS with T_2 (N110 PU+CD), T_6: BRRI organic fertilizer (2 t ha^{-1}) + IPNS with T_4 (N87 PU+ BRRI organic fert.) and T_7: Deep placed urea alike T_4 (N83 UDP). During Boro season, the tested seven treatments were: T_1: no N fertilizer (N0), T_2: 140 kg N ha^{-1} from prilled urea (N140PU), T_3:	Considering yield, N use efficiencies and NH_3-N loss, N applied at the rate of 105 kg ha^{-1} from deep placed urea and PU + BOF in Boro season and N applied at 83 kg ha^{-1} from deep placed urea could be the most suitable N management interventions to sustain rice production, reduce environmental harm from reactive N (Nr) and sustain soil health

	T_2+25% N (N175PU), T_4: T_2-25% N (N105PU), T_5: Cow dung (CD) (2 t ha^{-1}) + IPNS with T_2 (N140 PU+CD), T_6: BRRI organic fertilizer (2 t ha^{-1}) + IPNS with T_4 (N105 PU+ BRRI organic fert.) and T_7: Deep placed urea (UDP) alike T_4 (N105 UDP). The blanket rates of P-K-S-Zn were 20-60-10-1 kg ha^{-1}, resp. in T. Aman and 25-80-10-1 kg ha^{-1}, resp. in Boro season. In both seasons, gas samples were collected covering 25 to 26 sampling events to analyze CH_4 and N_2O emission. Locally fabricated lysimeter was installed to analyze NH_4^+-N and NO_3^--N in the collected leachates. Measurement of NH_3 emission (volatilization) was performed by using closed chamber technique and Boric Acid Trap method. At maturity, grain, straw and root yields were recorded. The N content in all these samples were analyzed to assess plant N uptake.	
4.5	Varietal effects on rice yield and greenhouse gas emissions under different fertilizer management in the coastal ecosystems of Bangladesh (one year) The field experiments were conducted in BRRI farm, Satkhira. Two rice varieties were tested including BRRI dhan67 and BRRI dhan92. Five fertilizer treatments were tested: (i) N control, broadcast prilled urea (PU) at 78 kg N ha^{-1}, (ii) urea deep placement at 78 kg N ha^{-1}, (iii) BRRI recommended dose at 120 kg N ha^{-1}, and (iv) integrated nutrient management at 78 kg N ha^{-1} with cow dung 2 ton/ha and ash 1 ton/ha. The experiment was laid out in a split-plot design with three replications, distributing the variety to the main plots and treatments to the sub-plots. Soil amendments (cow dung & ash) were applied three days prior to transplanting.	Integrated nutrient management (INM-N78 kg/ha) with 2 ton CD and 1 ton ash produced the highest grain yield of 5.87 t/ha in BRRI dhan67 and 5.15 t /ha in BRRI dha92 and it was statistically similar with UDP-N78 and PU-N120 treatment
	Sub-sub program 5: Soil Microbiology and Biofertilizer	
5.1	Evaluation of BRRI organic fertilizer in soil-plant system (one year) BRRI bio-organic fertilizer was developed with the objectives to reduce synthetic N and P fertilizer use in rice cultivation and improve soil health. To evaluate its field performance, one field experiments were conducted at BRRI, HQ in both the season of T. Aman 2021, and Boro 2021-2022. Bio-organic fertilizer (BoF) was used at 2 t ha^{-1}. The treatment combinations were NPKS (100%), BoF + 70% (N)	Application of BRRI-organic fertilizer at 2 t ha^{-1} (dry weight basis) along with 30% reduced urea and 100% removal of TSP fertilizer gave 15 % yield improvement in T. Aman and 39% in Boro season over chemical fertilizer application.

	+100% (KS), BoF +100% NPKS and fertilizer control. Recommendation rates of chemical fertilizers for T. Aman and Boro were (kg ha^{-1}) N-P-K-S @ 67-10-41-10 and 140-20-80-10, respectively. BRRI dhan87 at T. Aman and BRRI dhan89 was grown in the Boro season.	
5.2	Status of soil micro-organisms in eight AEZs of Bangladesh (one year) Studies were conducted with the aim to determine the soil microbial populations from eight AEZ's of Bangladesh and to characterize the potential free-living N_2 fixing, phosphate solubilizing, and indoleacetic acid (IAA) producing bacteria and finally prepared a climate smart biofertilizer using the potential bacteria for higher rice productivity. Soil samples (0-15 cm depth) were collected using GPS recording from AEZ-10 (Faridpur), AEZ-11 (Jashore- Rajshahi), AEZ-13 (Satkhira), AEZ-15 (Munshiganj), AEZ-16 (Brahmanbaria-Munshiganj), AEZ-19 (Cumilla- Kishoreganj), AEZ-22 (Moulavibazar- Habiganj) and AEZ-27 (Rangpur- Bogura) and tested for microbial properties.	Study report showed that the range of total bacteria populations were significantly high in the Decreerchar union of AEZ-10 (2×10^6 to 2×10^9 cfu/g soil), Panisara union of AEZ-11 (2×10^7 to 2×10^9 cfu/g soil), and Deorghachi union of AEZ-22 (7×10^6 to 1×10^9 cfu/g soil). The lowest total bacteria range was in AEZ-13. Total fungus population range was comparatively lower in the AEZ-10, AEZ-13, AEZ-15, AEZ-16 and AEZ-27. On an average, Actinomycetes populations were low in all the tested AEZ's. Among the dominant potential bacteria strains, the highest N_2 fixation (28 ppm) NH_4) was recorded by Bacillus thuringiensis (B49) and the highest 3746 ppm P was solubilized by the Stentrophomonas maltophilia (B53), isolated from Shahjahnpur upazela of AEZ-27. The highest amount of IAA (144 ppm) was produced by the strain B59 isolated from Shyamshiddhi union of Sreenagar upazila (AEZ-15).
5.3	Evaluation of bio-coated TSP fertilizer for the improvement of phosphorus fertilizer use efficiency and rice yield in acid soil (Six month) Isolated 15 potential strains were coated with TSP fertilizer and named as 'Bio-coated TSP' biofertilizer with the objective to improve P fertilizer use efficiency and rice yield in acid soil (pH 4.5). Nutrient mineralization form Bio-coated TSP fertilizer and survival of the bacteria during the incubation study were determined. Treatment combinations were as; T_0= Control (without fertilizer), T_1= Bio-coated TSP@ 30 kg P/ha, T_2 = Bio-coated TSP @ 20 kg P /ha, T_3= Bio-coated TSP @10kgP /ha, T_4 = TSP @ 20 kg P/ha. Bio-coated TSP (BCP) was used as P source in the T_1, T_2 and T_3 treatments. Treatments were assigned as	Bio-coated TSP @ 10 kg P ha^{-1} was the best treatment and save 50% TSP fertilizer for rice cultivation in the acid soil

	completely randomized design with six replications. Soil samples were collected at initial, 1, 2, 3, 7, 10, 15, 20 and 30 day of incubation and analyzed for available P, and populations of phosphate solubilizing. Pot experiments was conducted with 2.5 kg acid soil/pot and plant harvested at maturity	
5.4	Evaluation of bio-coated urea fertilizer for the improvement of growth and yield of BRRI dhan99 in saline soil (six months) Nutrient mineralization and pot study was conducted to determine the efficacy of Bio-coated urea in saline soil. Saline soil (7.8 ds/m) was collected from Kaliganj, Satkhira. Exact 2.5.0 kg of saline soil was added with treatments as; Treatments were imposed as T_1= control (without fertilizer), T_2 = CF_1: NPKS (kg ha^{-1}) @120-20-50-20, T_3 = CF_2: NPKS (kg ha^{-1}) @120-20-120-20, T_4= NPKS (kg ha^{-1}) @120-20-50-20, T_5 = NPKS (kg ha^{-1}) @120-20-120-20 and incubated for 30 days. Bio-coated urea (BCU) was used as N source in the T_4, and T_5 treatments. Treatments were assigned in completely randomized design with six replications. Soil samples were collected at initial, 1, 2, 3, 7, 10, 15, 20 and 30 day and analyzed for NH_4^+ and beneficial bacteria populations.	Bio-coated urea can be an option to mitigate saline stress in rice cultivation
	Irrigation and Water Management Division	
	Research Progress 2021-2022	
Sl. No.	**Research Progress**	**Expected Output**
	Sub-Program: Water Management	
	Sub-Sub-Program I: Water Use Efficiency Improvement in Irrigated Agriculture	
1.	**Water Requirement Experiments:**	
1.1	**Determination of physical and hydraulic properties in different soil types** **Progress:** RETC program was used to fit soil water release curve with measured water contents and metric potential data for BRRI Kushtia, BRRI Sirajganj, and BRRI Rangpur Soils. Soil textural classes were predominantly loam and silty loam. The average saturated water contents varied between 26.3-22.4, average water contents at field capacity varied between 19.8-17.8, and average water contents at wilting point were 3.4-2.8 within	Documentation of important soil physical properties can help for implementing efficient water management and can contribute to data bank generation for crop modeling.

	the soil profile of 0-60 cm depth. The average available water contents (AWC) were found in between 16.8-14.8 and, the average drainable porosity (DP) range was from 7.9 to 4 in the same depth of soil profile.	
1.2	**Problem and potentials for crop productivity improvement through water management in hilly areas** **Progress:** About 855 ha fallow area could be brought under cultivation with the help of irrigation facility in Khagrachari Sadar upazilla. The feasible options are: constructing rubber dams, installation of solar pump, installation of modern water distribution systems along with high yielding crop varieties. This area is also a potential spot to spread agro-forestry technologies with the backup of irrigation equipment and power sources.	Suitable water management options will be recommended for agriculture and livelihood improvement in the hilly area.
1.3	**Study on water-stress tolerance for different advanced rice genotypes of BRRI** **Progress:** None of the ALART had stress tolerance capacity. ALART BR9930-2-3-2-2 gave higher yield (25.52 g/hill) with continuous standing water treatment.	The outcomes of this study would provide information regarding scaling of water-stress tolerance capacity (WSTC) of each variety.
1.4	**Performance evaluation of the proposed rice varieties under different water regimes** **Progress:** Good yield could be achieved from BR11715-4R-186, BR11723-4R-27, BR11723-4R-12 under continuous standing water management. Also, in terms of yield, BR11716-4R-105 and BRRI dhan92 performed better under AWD practice.	The outcomes will provide guidelines for selecting irrigation water saving rice variety and water management package identification for specific variety.
1.5	**Improving soil-water availability for crop production in Charland by amendment practices** **Progress:** In Charland, about 30% yield was increased by compaction over control followed by clay mixing at the top layer of the soil during T. Aman season. In Boro season, Higher grain yield (7.54 t/ha) obtained from cow dung added at topsoil layer treatment followed by vermicompost added treatment.	Improvement of soil water holding capacity of char land and extension of crop productivity.
1.6	**Determining Minimum Irrigation Water Requirement of Rice at Different Regions of Bangladesh through Water Balance from On-**	The expected outcomes of this study will fulfill the gap between simulated and on-farm demand-based water requirements.

	Farm Demand and Model Simulation **Progress:** Comparative study between on farm demand and model predicted irrigation requirement assessment figured out that the CROPWAT model performed better compared to previous year simulation. So, Irrigation scheduling by CROPWAT model might be a potential approach to save irrigation water.	
1.7	**Optimization of Water Use Efficiency Through Subirrigation and Mini-sprinkler Irrigation System in Fine (light) Textured Soils of Bangladesh** **Progress:** Subirrigation system operated successfully in first season of installation. Mini-sprinkler irrigation system saved 71 percent irrigation water compared to conventional irrigation method.	Feasibility of subirrigation and sprinkler irrigation system in rice cultivation will be assessed.
1.8	**Impact of delayed transplanting on irrigation requirement and yield of Boro rice at BRRI farm Gazipur** **Progress:** Transplanting on 15 and 31 January required more irrigation water but produced highest yield. Transplanting on 14 February and 31 January needed less irrigation water due to reduced growth duration and increased rainfall but had 20-40% lower yield.	The possible outcomes of this study would be the identification of cutoff date for decreasing potential yield of transplanted Boro rice.
	Sub- Sub Program II: Utilization of Water Resources in Rainfed Environment	
2.	**Water Management for rice cultivation in climate change environment Experiments:**	
2.1	**Validation of agricultural drought forecasting for mitigating drought in T. Aman rice at Kushtia region** **Progress:** Drought simulation model (DSM) underestimated drought with an overall prediction error of 20.23%. DSM forecasting saved irrigation water by 30.5% compared to AWD system	The outcomes will provide a good drought forecasting system.
2.2	**Irrigation Scheduling of Rice (Oryza sativa L.) Based on Weather Forecasting in Gazipur** **Progress:** Medium-range (7-days) weather forecasting based irrigation scheduling following the water balance simulation model can be	Irrigation water requirement can be determined through weather forecasting.

	considered as a better method for irrigation scheduling of Boro rice cultivation.	
	Sub- Sub Program III: Land productivity improvement in the costal environment	
3.	**Land and Water Resources Use for Sustainable Crop Production Experiments:**	
3.1	**Saline water irrigation strategies for Boro rice cultivation in the coastal saline area** **Progress:** Salt tolerant rice varieties with irrigation water salinity below 4 dS/m can give potential yield. Therefore, to increase boro rice cultivation in the coastal area, the maximum volume of irrigation water should be stored in the internal canal after rainy season.	The outcome will evaluate the saline water irrigation management options for rice production in the coastal saline zone.
	Sub- Sub Program IV: Sustainable Management of Water Resources	
4.	**Surface and Ground Water Assessment Experiments:**	
4.1	**Assessment of Groundwater resources and safe utilization in different Geo-hydrological regions** **Progress:** The fluctuation was higher than the previous year. In 1998, the minimum groundwater level was about 5.23 m below the ground surface which was 48.17 m in 2022. Therefore, the lowering was about 42.94 m in 24 years. The high rate of declination is very alarming.	The possible outcomes will determine fluctuation of groundwater level over time and its relationships with rainfall.
4.2	**Conjunctive use of wastewater and freshwater for irrigation in Boro rice cultivation** **Progress:** Use of wastewater with freshwater (50% freshwater with 50% wastewater) had significantly increased the rice yield and yield contributing parameters. Municipal wastewater with freshwater is a good option than using bulk industrial or municipal wastewater. There is a possibility of change in soil properties by continuously using the wastewater.	The study outcomes will provide information on proper use of wastewater and reduction of pressure on groundwater for irrigation.
4.3	**Assessment of surface and groundwater quality for irrigation in selected locations of Bangladesh** **Progress:** The irrigation water quality assessment found all tested samples suitable in terms of KR value less than 1.0 except Barishal. Soluble sodium percentage and magnesium absorption ratio (desired	Identification of safe irrigation water sources for crop production

	range <50) found suitable for irrigation.	
4.4	**Assessing On-farm Water-use Efficiency of BRRI Research Farm, Gazipur** **Progress:** One of the BRRI Gazipur research field pump had water use efficiency (WUE) of 66.74 percent. A complete guide of efficient water management will be provided after measuring WUE of all pumps.	Water use efficiency of BRRI Gazipur farm will be increased.
	Sub- Sub Program V: RENEWABLE ENERGY	
5.	**Renewable Energy Experiments:**	
5.1	**Feasibility Assessment of Solar Pump Utilization for Irrigation Purpose in Chattogram Region** **Progress:** A survey on solar pump utilization for irrigation in Chattogram region indicated that solar-run irrigation pumps can emerge as a blessing for many farmers in Chattogram region amid inadequate rain, frequent power cuts and higher prices of diesel.	The expected outputs would give present irrigation scenario and recommendation for solar energy utilization.
	Sub- Sub Program V: CLIMATE CHANGE IMPACT ASSESSMENT AND ADAPTATION TECHNIQUES DEVELOPMENT	
6.	**Climate change assessment and adoption experiments:**	
6.1	**Effect of irrigation suspension on mitigating greenhouse gas emission in irrigated rice cultivation** **Progress:** Among the irrigation systems, AWD method found better to reduce total CH4 emission, and GWP and GHG intensity without sacrificing rice yield. Irrigation suspension by 20 days and 30 days saved irrigation compared to continuous standing water management. However, it sacrificed significant grain yield than the control treatment.	The study outcomes will provide information on suitable irrigation management for reducing global warming potentials.
	Sub-Sub Program VI: Water Management Technologies Demonstration and Dissemination at Farmers' Field	
7.	**Technology Validation in the Farmers' Field Projects:**	
7.1	**Modeling climate change impact on agriculture and developing mitigation and adaptation strategies for sustaining agricultural production in Bangladesh** **Progress:** The "Modeling climate change impact on agriculture and developing mitigation and	The possible outcomes will be used for adaptation and mitigation of climate change effects on agriculture and livelihood.

	adaptation strategies for sustaining agricultural production in Bangladesh" project studies showed that the area coverage of STW, DTW and LLP were 56.8%, 19.2% and 24.0%, whereas the GHG emissions were 35.4%, 55.5% and 9.2%, respectively.	
7.2	**Intervention in surface water utilization through integrated minor irrigation schemes for escalating water and land productivity in coastal region** **Progress:** The "Intervention in surface water utilization through integrated minor irrigation schemes for escalating water and land productivity in coastal region" project studies showed that Boro rice cultivation, which is dependent on the irrigation with fresh or less saline water, can be done in the areas that are located at the closer vicinity of the river Burishwar. Thousands of fallow lands can be brought under Boro and rabi crops using the surface water available in all canals of Polder number 44. Sixty-eight hectares of fellow lands were brought under Boro rice cultivation that helped in increasing the crop productivity. Early transplanting of Boro rice gave better yield compared to farmers existing transplanting dates (after 5 Feb). But early transplanting of Boro rice requires early harvest of T. Aman.	The possible outcomes will be used for boosting up the livelihood of the people of Barishal region.
7.3	**Increasing cropping intensity in the coastal Barishal and Khulna region through water resources and soil salinity management** **Progress:** The findings of the project named "Increasing Cropping Intensity in the Coastal Barishal and Khulna Region Through Water Resources and Soil Salinity Management" reveled that Practicing alternate wetting and drying (AWD) irrigation in the Barishal region had no effect on soil salinity. However, in the Khulna region, AWD method increased soil salinity slightly. The increased soil salinity did not affect on yield. An agronomic management with high yielding varieties can increase 15-20% yield hence increase the land productivity in coastal region. Barishal region is more favorable for Aus cultivation due to availability of fresh water than the Khulna region.	The possible outcomes will be used for boosting up the livelihood of the people of Barishal and Khulna region.

	Providing high yielding rice varieties along with better management is essential to reduce the risk of the rainfed T. Aman rice cultivation in the coastal areas. Freshwater availability is the main concern for Boro rice cultivation in the coastal area. In the Khulna and Satkhira region, fresh water is limited. Farmers are highly interested to cultivate Boro rice by using stored less saline water in the internal canal systems through controlling sluice gate and constructing earthen bund.	
7.4	**Upscaling of improved water management practices for sustainable productivity in the Haor areas** **Progress:** A Haor based project named "Upscaling of Improved Water Management Practices for Sustainable Productivity in the Haor areas" found that average yield reduction in less stress, moderate stress, severe stress, and very severe stress plots were 12.9%, 27.0 %, 37.5% and 49.3%, respectively compared to the no stressed plots due to less rainfall during reproductive phase of rice. In Haor area, AWD practice could save 2-3 irrigation events in Boro season. Around 67% rice yield could be saved by using polythene pipe instead of earthen canal.	The possible outcomes will be used for boosting up the livelihood of the people of Haor region of Bangladesh.
7.5	**Mitigating risk and scaling-out profitable cropping system intensification practices in the salt-affected coastal zones of the Ganges delta** **Progress:** The studies in a project named "Mitigating risk and scaling-out profitable cropping system intensification practices in the salt-affected coastal zones of the Ganges Delta" indicated that dry season rice or rabi crop cultivation could be increased by trapping and conserving fresh water in canals within December. The integrated rice-vegetable system became economically attractive in salt-affected coastal region. For early establishment of Boro rice floating, dapog or tray seedbed could be used in the coastal saline areas which may escape the water shortage at latter part of dry season.	The possible outcomes will be used for boosting up the livelihood of the people of salt-affected coastal zone.
	Plant Physiology Division	
	Research Progress 2021-22	
Sl. No	**Research Progress**	**Major Output**
1	Screening of rice germplasm for salinity tolerance	20 germplasm (namely Genebank Acc.

		No. 3291, 3141, 3142, 3155, 3157, 3163, 3195, 3196, 3197, 3201, 3204, 3218, 3306, 3346, 3347, 3393, 3397, 3406, 3431 and 3603) were found tolerant with SES score 3.
2	Screening of rice advanced breeding lines for salinity tolerance at Aman 2021	9 genotypes (namely SV1154, SV1155, SV0525, SV0529, SV1176, MTU1010, IR93354:34-B-5-1-23-1RGA-2RGA, M202 and Sahel134) were found tolerant to salinity with SES score 3.
3	Screening of rice advanced breeding lines for salinity tolerance at Boro 2021-22	10 genotypes (namely BR11712-4R-333, BR11722-4R-73, BR11722-4R-398, TP24493, IR18T1073, IR15T1319, BR11714-4R-69, BR11714-4R-74, IR 108604-2-1-AJY 3-B-1 and IR16T1661) were found moderately tolerant to salinity with SES score 3.
4	Characterization of salt tolerant varieties in artificial saline condition for whole growth period during Aman Season	BRRI dhan47 and BRRI dhan99 Showed the lowest reduction (6-48% and 22-48% respectively) in grain per panicle followed by BRRI dhan97 (11-56%) under different salinity stress. The yield reduction of tolerant and susceptible check was 27-35% and 35-61% respectively
5	Characterization of Advanced Breeding Lines for Salinity Tolerance at Reproductive Stage	Considering the yield potentiality and tolerance ability BRRI dhan67 showed tolerance ability at different salinity level. However, genotypes BR(Bio)8961, PN 151, PN232 and IR58443-6B-10- 3 showed tolerance ability at 8 dS/m salinity stress.
6	CRISPR-Cas9 mutagenesis of the OsRR22 gene for improving salinity tolerance of rice	Hygromycinphosphotransferase positive plants were identified using HPT primer pair designed from Hygromycinphosphotransferase resistant zone of the Cas9 vector
7	Identification of rice germplasm and advanced breeding line for two weeks flash flood submergence tolerance	one germplasm (Acc. No. 1710) was found tolerant (SES score 1) having survivability 100 percent but elongating type
8	Screening of advanced breeding lines for Anaerobic tillering ability under water stagnant condition at T. Aman season	44 lines were produced higher tiller/hill (>5) compare to check varieties BR10 and BRRI dhan30 under water stagnant conditions. Among the 44 higher tiller producing lines, BR11921-4R-356,

		BR11925-4R-162 and BR11920-4R-521 were produced the highest number of tiller/hill under water stagnant conditions.
9	Evaluation for elongation ability of BRRI dhan91 under deep flooding condition	The plant height of the attempt variety BRRI dhan91 was found 161.9 cm with poor tillering ability (3.3/hill).
10	Screening of rice germplasm for drought tolerance at reproductive phase, T. Aman' 2021	46 genotypes showed better performance in relation to yield under rainfed condition at reproductive phase which were selected for further confirmation under control condition in rainout shelter.
11	Confirmation of performance for advanced breeding lines under control drought condition at reproductive phase	4 advanced breeding lines BR10540-4-1-2-4-1 performed better followed by BR10538-2-1-2-3-2
12	Evaluation of previously selected germplasm under drought stress at reproductive phase in the rain-out shelter	Acc. no. 1934 yielded highest followed by Acc. no. 1996, 2022, 2288, 2290, 2292 and 2420. The sterility percentage of these genotypes was less than 50
13	High temperature tolerance of spikelet fertility QTL introgression lines under controlled high temperature condition	Out of 8 lines, 4 lines scored 5 classified as moderately heat tolerant. However, rest 4 lines scored 7 classified as moderately sensitive to heat stress. Two tolerant donor, N22 and Kachalath scored 3 and 5 respectively.
14	Observational trial of high temperature induced spikelet fertility introgression lines in the background BRRI dhan28 and BRRI dhan29	Out of the 133 lines, 4 and 21 lines in the background of BRRI dhan28 and BRRI dhan29 respectively, having >0.5 t/ha yield advantage were selected for further evaluation.
15	Marker assisted introgression of high temperature induced spikelet fertility QTL (qHTSF4.1) in the background of BRRI dhan48 and BRRI dhan62	A total of 60 BC_1F_1 of BRRI dhan48, BRRI dhan62 and BRRI dhan71were planted and after genotyping with R4M30 markers the selected progenies were backcrossed with respective parents and 110 BC_2F_1 seeds were produced.
16	Screening of rice genotypes for seedling stage cold tolerance	Out of 250 Genebank germplasm, 38 accessions showed moderately cold tolerant at seedling stage. Out of 1411 advanced breeding lines 334 lines were selected of which 65 and 269 lines were found cold tolerant and moderately cold tolerant at seedling stage, respectively. Rest of the genotypes were susceptible to

		highly susceptible.
17	Evaluation of advanced breeding lines for reproductive stage cold tolerance	Short to medium duration advanced breeding lines (BR11894-R-110, BR11894-R-134, BR11894-R-169, BR11894-R-299 and BR11894-R-309) and two long duration lines (BR10715-5R-9 and BR10715-5R-1) were selected as moderately cold tolerant
18	Characterization and evaluation of some selected rice genotypes for cold tolerance	Advanced rice genotypes BR10717-5R-82 was selected as moderately cold tolerant line which was similar to BRRI dhan67. Other four rice genotypes such as Black rice (Phil), GB-34, BR11001-5R-37 and BR11000-5R-27 were found moderately cold susceptible lines at reproductive phase.
19	Evaluation of lodging tolerance of some advanced breeding lines, T Aus 2021	T. Aus advanced breeding lines BR8781-16-1-3-P2 showed lodging tolerance due to its shorter 4 th internode length, better wrapping score and higher stem density (51.17 mg/ cm), although it had longer plant height (126.81 cm) and higher moment (1321.67 g.cm).
20	Studies on lodging tolerance of T Aman rice varieties at reproductive phase	Seed sowing of T Aman before 15 July: BRRI dhan87, BRRI dhan93, BRRI dhan94 were found lodging susceptible.BRRI dhan49 lodged partially while BRRI dhan95 did not lodge. Seed sowing of T Aman after 15 July: None of the varietieslodged. Less panicle weight and well wrapped stem of BRRI dhan95 might be the main reason of its lodging tolerance
21	Effect of polythene covering on seedling raising in Boro season	Polythene covering seedbed techniques (covering for all time with opening at both ends, covering during cold wave and covering from 11.0 am to sun set) produced healthy seedlings in Boro season. The highest seedling strength was recorded from seedbed covered for all time with opening at both ends followed by polythene covering during cold wave and covering from 11.0 am to sun set. The lowest seedling mortality rate after transplanting in the main field was

		recorded from polythene covering during cold wave followed by covering for all timewith opening at both ends. Seedling mortality aftertransplanting was slightly higher in covering from 11.0 am to sun set than control treatment.
22	Effect of sowing time on growth and yield of newly released Aman varieties	Highest yield of BRRI dhan93 was observed at 20th July seeding (4.34 t/ha) with 128 days growth duration. Statistical similar highest yield was observed between 20th July to 5th August seeding for BRRI dhan94 (around 4.54 t/ha) with 122 to 128 days of growth duration. BRRI dhan95 gave maximum yield (5.84 t/ha) at 5th July seeding with 124 days of growth duration. On the other hand highest yield (4.92 t/ha) of BR11 was found at 20th June seeding. BRRI dhan49 had no significant variation in yield among the different sowing time and maximum yield (5.0 t/ha) was found at 20th July.
23	Effect of sowing time on growth and yield of newly released Boro varieties	BRRI dhan96 gave highest yield at 30th Nov. (6.5 t/ha) followed by 15th Nov. seeding (5.9 t/ha) but which was statistically similar. BRRI dhan97 and Bangabandhu dhan100 gave statistically similar highest yield at 15th Nov. to 15 Dec. seeding. The yield range was 5.3 to 5.8 t/ha and 4.6 to 5.7 t/ha respectively with 145-163 days and 145-159 days of growth duration respectively. BRRI dhan99 gave highest yield at 30th Nov. seeding (6.3 t/ha) with 149 days of growth duration.
24	Screening of Pre-harvest sprouting (PHS) of some BRRI varieties	BRRI dhan50, BRRI dhan60, BRRI dhan69, BRRI dhan86 and BRRI dhan89 was found highly susceptible to pre-harvest sprouting (PHS) and BR19, BR16, BRRI dhan63, BRRI dhan45, BRRI dhan36, BR27, BRRI dhan55, BRRI dhan48, BRRI dhan88, BRRI dhan82, BRRI dhan67, BRRI dhan84, BRRI dhan42 and BRRI dhan28 found moderately tolerant to PHS.
25	Identification of regeneration ability of Aus rice varieties	None of the genotypes performed better in terms of tillering ability than the

		control condition
26	Determination of growth phase of short duration (60 days in India) Aus rice varieties	Pandedhan(A short duration Aus variety of india) and BRRI dhan42 were direct seeded to determine the duration of the different growth phases and yield. Pandedhan was found higher growth duration(2 weeks more than the check BRRI dhan42).
27	Phenological development of newly released two BRRI varieties	It took 85 days when seed was sown at the beginning of April and 91 days for mid-April sowing and then decreased to 84 days for the variety BRRI dhan92. Similar trend was observed for the variety IR64. For BRRI dhan88, the days required for PI almost similar in 1st and 2nd sowing but it was decreased when sowing was done at the beginning of May. The days required from PI to 50% flowering was taken in consideration for flowering stage. The time required for 50% flowering (from PI to 50% flowering) and maturity (from 50% flowering to maturity) more or less similar irrespective of varieties and sowing time
28	Response to photoperiod of some advance breeding lines under controlled photoperiod condition	On the basis of RPS, 2 breeding lines (BR11032-4R-31 and BR11046-4R-95) showed strong response in flowering with an increase in photoperiod similar to BR22. But rest of breeding lines showed nearly insensitive to moderately sensitive to photoperiod. The relative photoperiod sensitivity of BR10, BR11 and BRRI dhan30 was ranged from 36% to 39% compared to Nizersail, which are considered as moderately sensitive variety.
29	Photosensitivity test of Deep-water, shallow-deep water and stagnant shallow water lines	On the basis of RPS, one deep-water line (BR9390-6-2-1B) showed strong response in flowering with an increase in photoperiod similar to BR22 (Table 9). However, one local deep-water genotype (Khoiamotor) and one shallow-deep water line (BR10230-7-19-B) showed fairly strong sensitive having RPS (~80%) (Table 9). But rest of breeding lines

		showed weakly to moderately sensitive to photoperiod.
30	Investigation of anatomical differences in the leaves of C3 and C4 species	In comparison to rice, Uri dhan has a greater number of veins and a denser vascular bundle. The mesophyll cells and vascular bundle in the Uri dhan were both well-organized and highly composed compared to rice
32	Optimizing chlorophyll fluorescence imaging system for photosynthetic efficiencies of rice in the salinity stress	IR58443 (standard tolerant check) and IRRI154 (standard sensitive check) were evaluated under soil-based salinity stress for 0, 6 and 12 dS/m stress. Chlorophyll fluorescence image was taken 24 (Day1), 48 (Day2) and 72 hrs. (Day3) after stress application. Initial Fv/Fm values (Day1) were noticeably low, but they progressively increased and were kept very near to normal for the tolerant genotype (IR58443), whereas the pattern was exactly the opposite for the sensitive genotype (IRRI154)
33	Generation of male sterile rice line for two-line hybrid system by editing TMS5 gene using CRISPR/Cas9 system	Hygromycinphosphotransferase positive plants were identified using HPT primer pair designed from Hygromycinphosphotransferase resistant zone of the Cas9 vector (Fig. 17). PCRs amplifications are being performed using primer pairs which generated an amplicon harboring the target site, and the resulting amplicons are being sequenced using the Sanger method.
	Entomology Division	
	Research Progress 2021-22	
Sl. No.	**Research Progress**	**Major output**
1	**Project I: Survey and Monitoring of Rice Arthropods** **Expt. 1. Pest and natural enemy incidence at BRRI farm, Gazipur** **Progress:** Rice insect pests, natural enemies and crop damage intensities in five habitats (seedbed, grass fallow, transplanted rice (T. rice), rice bund and Boro rice (B. rice) were monitored weekly at BRRI research farm, Gazipur.	Green leafhopper (GLH), white leafhopper (WLH) and grasshoppers (GH) were the most abundant pests and found in all habitats. Highest number of short horned grasshopper (SGH) was found in grass fallow followed by rice bund, seedbed and transplanted rice. Higher numbers of natural enemies were found in the seedbed. Spider, damsel fly (Dam. fly), green mirid bug (GMB) and

	Insect pests and natural enemies were recorded weekly by 100 complete sweeps from each habitat. Survey was conducted throughout the year, July 2021 to June 2022. Collected samples were sorted, identified and counted as individual insect.	carabid beetle (CDB) were the dominant predators in all the habitats during the reporting year.
2	**Expt. 2. Incidence of insect pest and natural enemies in light trap** **Progress:** Pennsylvanian light trap was installed at BRRI, Gazipur and six BRRI regional stations i.e., Barishal, Cumilla, Rajshahi, Rangpur, Habiganj and Sonagazi. Insect pest and natural enemies captured in each light trap were collected at every morning. Trapped insects were sorted, identified, counted and analyzed.	Higher peak of insect pests was found in November across the locations. The highest number of BPH was observed during the month of November at Gazipur. The highest peak of YSB was observed at Barishal and Rajshahi in the month of November & May respectively. In case of natural enemies, the highest catch of natural enemies in light trap was recorded at Habiganj followed by Barishal, Rajshahi, Gazipur, Rangpur, Sonagazi and Cumilla.
3	**Expt. 3. Survey of rice insect pests in selected AEZ's of Bangladesh** **Progress:** The insect pest population, their damage intensities and abundance of the natural enemies were surveyed during T. Aman 2021 in Barishal, Patuakhali, Lalmonirhat, Kurigram, Dinajpur and Rangpur. The incidence patterns of major insect pests and their natural enemies in different AEZ´s of Bangladesh were assayed. Twenty complete sweeps were conducted randomly in rice field at each geographic location. Twenty hills were also investigated and counted the number of insects observed in each hill.	Insect pests were below the economic threshold level (ETL) during the reported period. Highest number of yellow stem borer (YSB), and GLH was found in Barishal followed by Patuakhali and Rangpur. Highest number of BPH population was observed in Lalmonirhat than that of other two geographic locations. Barishal also harbored higher number of natural enemies than that of other two locations. LBB and spiers were the most abundant observed in all locations but Patuakhali harbored highest number of them. Staphylinid beetle (STPD) was only found in Barishal.
4	**Expt. 4. Fall Armyworm (FAW) monitoring in rice field** **Progress:** Five pheromone traps were set 100 m between traps (in separate fields) in rice from vegetative to ripening stage of rice crops (in separate fields) at BRRI HQ Gazipur, during Boro 2021-22. There were no maize fields (at least apart 200 m). In each of the 5 field, BRRI scientists were carefully examine 10 rice leaves for signs of new Fall Armyworm damage for Fresh Windowpanes (FW) (Fresh pinholes, window panes, leave damage etc.) or Infested Plants (IW) (infested stem, infested	The highest population of FAW (07 moths) was trapped in April 2022 at BRRI Gazipur. FAW was monitored 08 weeks but no fresh window panes and infested plant found during scouting. On an average 0 to 2.2 moth /trap/week i.e., 0 to 0.31 moth /trap/day observed at BRRI, Gazipur.

	panicle, fresh frass etc.). Every Monday the trap catch and field scouting data were collected and recorded. The average trap catch and field scouting data were recorded.	
5	**Project II: Host Plant Resistance** **Expt. 1. Suppression of serotonin synthesis in rice using CRISPR Cas9 for insect control** **Progress:** The oligonucleotide sequence of target insertion part of CYP71A1 gene was purchased from Macrogen company (Humanizing Genomics, Seoul, Korea) via Biotech Concern (Dhaka, Bangladesh). The Cas9/gRNA (Catalog. No. VK005-01, VIEWSOLID BIOTEC, Beijing, China) was purchased and used in this experiment. The recombinant Cas9 vector was selected, and cultured and transformed into Agrobacterium tumefaciens LBA4404 competent cell. Calli of BRRI dhan92 were developed using tissue culture technique. Successful calli were co-cultivated with recombinant Agrobacterium. Shoot was developed from callus and healthy shoot was transferred to root inducing media in glass bottle. DNA of regenerated plant were extracted and sequenced.	In the production of CYP71A1 knockout (CYP71A1-KO) rice plant, a 20 bp fragment (5'-TGGTCGCGTTGAGGAGGAGC -3') of CYP71A1 gene was successfully cloned into the transfer vector, VK00-01. Electrophoresis and sequencing results confirmed the generated recombinant Cas9/gRNA contained the target sequence of interest. Successful recombinant Cas9/gRNA-CYP71A1 vector was transformed into Agrobacterium tumefaciens LBA4404 competent cell. Electrophoresis confirmed the successful recombinant Agrobacterium with target gene of interest was confirmed by PCR and used for co-cultivation. Calli of BRRI dhan87, BRRI dhan89 and BRRI dhan92 were developed using tissue culture technique. Successful calli were co-cultivated with recombinant Agrobacterium. Calli were cultured with shoot and root inducing media supplemented with different hormone and antibiotic. Shoot was developed from callus and healthy shoot was transferred to root inducing media in glass bottle. After 20 days in rooting media, rooted plants were transplanted in plastic pot and kept in greenhouse for further growth. Cas9 specific primers were used to confirm the genome edited plants. The plants confirmed with Cas9 were progressed to next stage and leaf of all growing plants were collected and stored for genomic analysis. Sequencing of genome edited plants shows mutation occurred in target part of CYP71A1. Clear mutation area was identified in CRISPR Cas9 edited plants.
6	**Expt. 2. Screening of rice germplasm, advance**	Among thirteen Rainfed lowland Rice (RLR) two lines BRH15-24-7-B and

	line against major insect pests **Progress:** Seeds of advanced breeding lines/ INGER IRBPHN were collected from different sources. Each test variety or line was seeded in 20-cm-long rows in a seed box (60 × 45 × 10 cm). Rows were 5 cm apart. A row of the susceptible check variety (BR3) and a resistant check variety (T27A) was planted randomly in the seed boxes. At the sixth day after seeding, plants were thinned 20 to 30 seedlings per row. The seed boxes were placed on a galvanized iron tray on a table inside a screening room in the greenhouse. The seedlings were infested at two-leaf stage (about 7 days after seeding) by uniformly scattering a large number of 2nd to 3rd instar BPH nymphs on them. The seed boxes were covered with fine mesh nylon nets after infestation. The damage rating was taken when about 90% of the plants of the susceptible check were died, usually takes about 5 to 7 days after infestation. The varieties were rated/scored following the standard evaluation system for rice (IRRI 1988).	BRH14-9-13-16B were found moderately susceptible (score 5) against BPH. Among six drought tolerant Rice (DTR) lines, no entry was found resistant. Among four zinc enriched rice (ZER) breeding lines two lines BR10005-25-8-4-7-20 and BR10022-2-8-9-5-22 were found moderately susceptible (score 5) against BPH. Among seven Submergence Tolerance Rice (ALART) lines one-line IR16F1148 showed moderately susceptible (score 5) reaction against GLH. Among five RYT#1 advanced breeding lines of deepwater rice (DWR), One line, BRH11-2-4-7B was found moderately susceptible (score 5) to WBPH. Among seven RYT#2 and seven RYT#3 advanced breeding lines of deepwater rice (DWR), no entry was found resistant. Among ten Boro 2021-22 RYT insect resistance (IRR) lines, eight Salinity Tolerant Rice (STR-RYT#1) lines, twelve Salinity Tolerant Rice (STRRYT#2) lines, three Salinity Tolerant Rice (STR-ALART#1) lines, six Salinity Tolerant Rice (STR-ALART#2) lines, five premium quality (PQR), five Boro 2021-22 Zinc enriched rice (ZER) advanced breeding lines, no entry showed any resistant reaction.
7	**Expt. 3. Evaluation of advanced breeding lines screening against Brown Planthopper (BPH).** **Progress:** A total of 236 rice breeding lines were screened against BPH at greenhouse condition including OYT#2 (Insect), OYT#1 (Insect) and AYT (insect) from T. Aman season. In OYT#2 (insect) & OYT#1 all entries showed susceptible reaction against BPH during T. Aman 2020-21 seasons. In this screening, the breeding line BR11040-4R-137, BR11040-4R-206 & BR11033-4R-33 from AYT (IRR) showed moderately susceptible reaction against BPH. A total of 552 rice breeding lines were screened including OYT (Insect), PYT (Insect) and AYT	A total of 1335 advance line was screened against BPH. Among them 78 line showed moderately susceptible reaction (score 5) against BPH.

	(insect). In OYT (insect) about 31 lines showed moderately susceptible reaction against BPH. However, the breeding line BR10766-4R-5, and SVIN320from PYT (Insect) showed moderately susceptible reaction against BPH. In AYT (Insect) lines all entries showed susceptible reaction against BPH. A total of 547 rice breeding lines were screened including OYT. In OYT (insect) 42 lines showed moderately susceptible reaction against BPH. In OYT (insect) 42 lines showed moderately susceptible reaction against BPH. A total of 87 rice breeding lines were screened against BPH at greenhouse condition including PYT (insect) from Boro seasons. In the screening period, only one breeding line BR12208-5R-402 showed moderately susceptible reaction against BPH.	
8	**Expt. 4. Identification of BPH resistant sources from local germplasm** **Progress:** A total of 280 F_3 lines were advanced to F_4 generation from the population of BRRI dhan89 × Acc489 cross.	F_4 generation was advanced in Rapid Generation Advance Nursery.
9	**Expt. 5. Screening of INGER IRSBN lines against major insect pests of rice** **Progress:** Twenty-one INGER IRSB, T. Aman 2021 breeding lines including two local susceptible and resistant checks were evaluated against stem borer in field condition according to IRRI prescribed procedure. The test entries were planted in small plots following CRD with two replications. Six border rows were planted with susceptible variety BR3. The borders were planted across each end of the test entries. One to four 1-m rows of the test entries were planted with two rows. A transparent polyethylene sheet 1-m in height was erected to restrict stem borer movement all around plot. The border rows were applied with resurgence insecticide eg.; Virtako 40 WG (thiamethoxam+chlorantraniliprole) two times at a low rate beginning at 30 days after transplanting directing the spray at the canopy.	Infestation was not exceeded the ETL for stem borer, 10% for DH and 5% for WH. So, scoring of the entries following SES of rice didn't reveal actual resistant reaction. Among the entries dead heart ranged from 0 to 4.89% and white head ranged from 0.15% to 1.74%. Only five entries SV0245, SV1078, SV1093, SV2003 and SV2018 showed no dead heart.

	Data of dead heart and white head was taken based on the scale described in the Standard Evaluation System for Rice (SES, 2014).	
10	**Expt. 6. Pyramiding three BPH resistance genes (Bph2, Bph20, & Bph32) using marker-assisted selection in BRRI dhan89** **Progress:** We made a cross between IR 101791-10-1-4-3-2-4 which has two resistance genes (Bph2 + Bph32) and BRRI dhan89 susceptible to BPH. The F_1 plants were confirmed using molecular marker. The F1 plant which showed two BPH resistance genes was selected and allowed to develop grains. At harvesting stage, seeds of selected plants were collected and seeded for crossing again with IR 101796-1-2-3-20 which carrying one BPH resistance gene (Bph20). We crossed IR 101791-10-1-4-3-2-4 and the elite indica variety BRRI dhan89 susceptible to BPH. True F^1 plants were selected based on molecular marker and allowed to be progressed further development.	Gene pyramiding is an effective avenue for developing durable BPH resistance rice variety. Bph1 and Bph2 were first pyramided into japonica cultivars, and the gene pyramided lines show higher resistance than the single-gene lines and three genes (Bph14, Bph15, and Bph18) into the elite indica variety. We got 5 F_1 plants from the desired cross. Gel electrophoresis picture shows the target gene in F_1 population (Fig. 8). Seed from all true F_1 plants were harvested and stored for further studies. Some seeds of F_1 plants were seeded for further crossing with IR 101796-1-2-3-20 which has one BPH resistance gene (Bph20)
11	**Expt. 7. Resistance mechanism in BRRI dhan33 to rice gall midge** **Progress:** A gall midge resistance rice variety BRRI dhan33 was crossed with BRRI dhan49 highly susceptible to gall midge. BRRI dhan49, an elite mega cultivar for transplanted Aman (T. Aman) rice, is famous for its good quality, high yield, and wide culturing in Bangladesh. The F_1 seeds were harvested and seeded to progress for next generation. We used RM5770 marker to identify the true F_1 population. Selected F_1 plants were progressed to F_2 by selfing. Seeds from all F_2 plants were harvested and stored for phenotyping test against gall midge. In addition, some F_2 population advanced and harvested seeds of F_3 population.	The F_1 population was screened using molecular marker and identified five true F_1 population. Polyacrylamide gel electrophoresis picture shows the true F_1 population derived from their cross. The seeds of true F_1 population were seeded to develop F_2 population and harvested F_2 seeds. The harvested F_2 population seeds were stored for phenotyping test against gall midge.
8	**Project III: Insect Molecular Biology** **Expt. 1. Molecular characterization of Nilaparvata lugens population in Bangladesh based on COI analysis.**	Based on the partial COI gene, genetic homogeneity was detected in N. lugens populations of Bangladesh and they form a single genetic group. The Tajima's D test and Fu's F test also support our result,

	Progress: The genetic diversity of N. lugens by employing a partial fragment of the mitochondrial gene encoding cytochrome oxidase I (COI) using samples from 9 different localities of Bangladesh was analyzed. BPH (Nilaparvata lugens) populations were collected from 9 different geographic locations including Gazipur, Chandpur, Dinajpur, Rajshahi, Barishal, Satkhira, Sirajganj, Cumilla and Cox's Bazar). The universal barcode primer (LCO-1490-5′- GGT CAA CAA ATC ATA AAG ATA TTG G-3′; HCO-2198-5′-TAA ACT TCA GGG TGA CCA AAA AAT CA-3′) was used to amplify the target part of COI gene. The purified DNA was sent to company for sequencing. Sequencing results will be analyzed. Phylogenetic tree was constructed using Mega software.	and indicate recent population expansion, while the phylogenetic tree suggests that geographically distinct populations of N. lugens do not exist in Bangladesh. Indian population shows geographically distinct different clades. However, our BPH population is distinctly different from Indian population.
9	**Expt. 2. Gene drive to control Nilaparvata lugens using CRISPR Cas9 genome editing tool** **Progress:**Selected female sex determinant gene (NIFmd) and designed 19 bp sgRNA UGGGCGGAAAAAGGGAGGA Purchased CRISPRevolution sgRNA EZ Kit (1.5 nmol) - NIFmd2 Mixed the two sgRNAs (100 ng/ µL of each, with 200 ng/µL of Cas9 protein) Gently mixed and kept for 30 min to 1 h, mixing about every 10 min. Injected100-200 nL, per insect. The Protein is positively charged. The 34d instar nymph of BPH was used for this study. Before injection, insect was kept in -20°C freezer (chilling) for 3-8 minutes. Injected BPH nymphs were kept in petridish with rice stem and investigated further.	Nanoject III Programmable Nanoliter Injector which is used inject DNA into insect body/egg was purchased from Drummond Scientific Company (USA). We injected CRISPR/Cas9/gRNA into200 insects using DNA microinjector. However, all insects died after injection. It indicates that insect did not revive due to cold shock as well as Cas9 protein injection. Later, we injected more than 400 insects using water without Cas9 protein. However, more investigations are required to recover insects after injection.
10	**Project IV: Insecticide Toxicology** **Expt. 1. Residues analysis of different insecticide in rice grain** **Progress:** Sample was collected from insecticide treated field and pesticide residues were detected using a LC-MS2020 fitted with electrospray	The concentrations were 0.012 to 0.013 and 0.014 to 0.073 mg/kg in chlorantraniliprole and thiamethoxam respectively in the polished rice grain of different treatments. The correlation coefficients (r^2) were 0.999 (standard

	ionization (ESI) probe operated in the positive ion mode. The following parameters were optimized for chlorantraniliprole and thiamethoxam: capillary voltage, 3500 V; ion source temperature, 150°C; desolvation gas temperature, 500°C; desolvation gas flow rate, 1000 L h-1 of nitrogen. Detection was carried out in multiple reactions monitoring (MRM) mode. The retention time of chlorantraniliprole was 2.3 minute and thiamethoxam 1.9 minute.Residue analysis of chlorantraniliprole in rice grain at different days after flowering (DAF) was also tested. Detection was carried out in multiple reaction monitoring (MRM) mode. The retention time of chlorantraniliprole was 2.3 minute and thiamethoxam 1.9 minute and imidacloprid 7.95 minute.	solutions). The imidacloprid concentrations were 0.008 to 0.013 mg/kg in the polished rice grain of different treatments. The concentrations of chlorantraniliprole were 0.015 to 0.060 mg/kg in the polished rice grain spraying different days after flowering. However, the detected amount of chlorantraniliprole, thiamethoxam and imidacloprid in the samples were below the Maximum Residue Limit (MRL: 0.4 mg kg^{-1} for chlorantraniliprole) 0.6 mg kg^{-1} for both thiamethoxam and imidacloprid, EU).
11	**Expt. 2. Detection of pesticide residue in different rice varieties** **Progress:** Different rice samples were collected from various sources including Indian and Thai rice varieties. Insecticide residues were detected using a LC-MS2020 fitted with electrospray ionization (ESI) probe operated in the positive ion mode. The collected samples were then stored in a freezer at -20°C during 30-day period until extraction for pesticide residues analysis and pesticide residues were detected using a LC-MS2020 fitted with electrospray ionization (ESI) probe operated in the positive ion mode.	Matrix standard solutions (0.025 - 25 lg L^{-1}) were chosen to calibrate for samples. The linear equations were y = 12107x + 7150 (standard solutions). The correlation coefficients (r^2) were 0.999 (standard solutions). The retention time of chlorantraniliprole was 2.3 minute and thiamethoxam 1.9 minute. The concentrations of chlorantraniliprole and thiamethoxam in the tested samples were below the Maximum Residue Limit (MRL: 0.4 mg kg-1 for chlorantraniliprole) and 0.6 mg kg-1 for thiamethoxam, EU). In some samples (Indian white rice, Thai home mali rice) insecticides were not detected.
12	**Project V: Biological Control of Rice Insect Pests** **Expt. 1. Leveraging diversity for ecologically based pest management** **Progress:** Two experiments were conducted with BRRI dhan87 and BRRI dhan88 at BRRI farm Gazipur during T. Aman 2021 and Boro 2021-22 season respectively. The treatments were T_1=Rice field with flowering plants (sesame and cosmos in T. Aman season Marigold and cosmos in Boro	Insect pest status remained below the economic threshold level (ETL) in both the treatments and seasons. During T. Aman 2021 season, highest number of grasshopper (GH) was found in T_1 (16.50/20 sweep) followed by rice leaffolder (RLF) and yellow stem borer (YSB) (7.7 and 2.50 respectively) at BRRI Gazipur. Highest number of natural enemies except dragon fly (Drag. fly) was found in T_1 where insecticide was not

	season) on bunds. T_2=Farmers practice i.e. prophylactic insecticide use. The insecticide applied four times (carbofuran 5G@10.0 kg/ha for 2 times and chlorpyrifos 20EC @ 1.0L/ ha for 2 times) in T_2 at 15 days interval. Carbofuran 5G was used with 1st top dressing of urea fertilizer followed by 15 days interval. Twenty complete sweeps were taken from both the blocks 3 days after insecticide used. Insect pests and natural enemies of all sweeps from both blocks were counted and recorded separately. Egg parasitism of yellow stem borer (YSB) was determined through retrieval method and natural parasitism of rice leaffolder (RLF) larvae was also determined.	used. Number of spider (SPD), damsel fly (Dam. fly), lady bird beetle (LBB) and carabid beetle (CBB) were found highest 8.25, 8.0, 5.0 and 1.25 per 20 complete sweeps respectively in T_1 compared to T_2 (3.00, 1.25, 1.75 and 0.75 respectively) at BRRI farm, Gazipur. YSB egg parasitism and RLF larval parasitism were observed highest in T_1 (19.3 and 22.70 % respectively) compared to T_2 (0 and 2.25 % respectively) at BRRI, Gazipur. Though grain yield was observed similar both in T_1 and T_2 (5.81 and 5.85 t/ha respectively). But additional sesame was produced in T_1 which increase the rice equivalent yield (REY). As a result, 4.25 % additional yield obtained in T_1 compared to T_2. During Boro 2021-22 season, green leafhopper (GLH), white leafhopper (WLH) and Short horned grasshopper (SHG) were found both in T_1 and T_2 at BRRI farm, Gazipur but the incidence was very low. In case of natural enemies, highest number of spider (SPD), damsel fly (Dam. fly) and lady bird beetle (LBB) (3.83, 2.50 and 3.17 respectively per 20 complete sweep) were found in T_1 compared to T_2.
13	**Expt.2. Study on entomogenous fungi to control brown planthopper (BPH)** **Progress:** Fungus was isolated from naturally dead BPH.Then fungus culture was purified by standard protocol. Potted BR3 plants were infested by 10 3rd-4th instar BPH nymphs of greenhouse populations and confined by mylar film cages. Fungus was sprayed at the rate of 1 $X10^6$ conidia/ml per plant. Each treatment had six replications with CRD in pots in the net house of entomology division. Number of alive BPH was recorded after 1, 3 and 7 days after treatment. Treatments are given below: T_1- Fungus spray before 3 days of insect infestation T_2- Fungus spray after 2 days of insect infestation T_3- Control	Mortality rate of BPH was observed 60-63% after 7 days of applying treatment.

14	**Project VI: Crop Loss Assessment** **Expt. 1. Effect of dead heart and whitehead on grain yield of BRRI dhan89.** **Progress:** The experiment was conducted at BRRI research farm, Gazipur to determine the yield loss and recovery abilities of BRRI dhan89 against stem borer damage. Four hills were randomly selected diagonally from each plot and infested with the 1st instar larvae of one egg mass at 35 days after transplanting (DAT). The larvae along with the selected hills were captivated by mylar film cages for about 2-3 days. Four hills from the same plots were also selected as control.The rice yield and yield component data from the marked hills (each of infested and un-infested 60 hills) were recorded and analyzed statistically.	On an average 3.13 % dead heart and 0.77% white head observed when rice plant was infested at 35 DAT. There was no significant difference was found in tiller per hill between infested and un-infested hill when average 3.13% dead heart was found at 50 DAT in BRRI dhan89. At maturity stage, significant difference was also not found in panicle per hill, plant height and panicle length between infested and un-infested hill. But significantly higher filled grain number (1705.73/hill) was found in infested hill compared to un-infested hill (1634.57/hill). As a result, significantly similar grain weight was found (80.64 g/hill) in infested hill compared to un-infested hill, 79.53 g/hill. Again, unfilled grain number reduced significantly in infested hill (332.59/hill) compared to un-infested hill (410.33/hill). As a result, percent filled grain per panicle was found highest (80.64%) in infested hills compared to un-infested. This indicated that when YSB larvae damaged any tiller of a particular hill the plant supply more nutrient to other tiller of the same hill. As a result, more filled grain number was found in the panicle of infested hill which compensate the loss of damaged tiller. So, no yield loss was found by the damage of YSB at early crop stage when dead heart and white head remain below 3 and 1% respectively.
15	**Project VII:** Evaluation of Chemicals and Botanicals **Expt. 1. Test of different insecticides against major insect pests** **Progress:** A large rice field divided into unit plots. Each plot measuring 4mX5m (20 m^2) and the rice variety was BR3. In each unit plot a test insecticide was applied with standard doses and four hills were selected randomly from each plot. Each hill represented one replication. One hour after spraying of test insecticides, ten 3rd-4th instar BPH nymphs of	A total of 104, 16 and 04 commercial formulations of insecticides were evaluated against brown plant hopper, yellow stem borer and rice weevil respectively. Among them 85, 14 and 04 insecticides were found effective against brown plant hopper, yellow stem borer and rice weevil respectively.

	greenhouse populations were released and confined by mylar film cages on each of four randomly selected rice hills. Another plot of same size was used as control without insecticide. Four hills were also selected randomly from the control plots and same number of test insects was confined with the same procedure. Mortality of insects was counted both from treated and untreated plots at 24 and 48 hours after treatment (HAT) and the results were adjusted by Abbott's formula.	
16	**Expt. 2. Effect of insecticides on natural enemies of rice insect pests.** **Progress:** Six commercially registered insecticides for rice of different chemical group were evaluated at BRRI, Gazipur in T. Aman and Boro 2021-22 with popular BRRI variety. The generic name of six insecticides is acetamiprid, spinosad, abamectin, chlorantraniliprole (virtako), fipronil and chlorpyrifos. These insecticides were sprayed in rice at vegetative stage with three replicated trial and control plot. Recommended dose was used for each insecticide. Insects and natural enemy population were collected after 48 hours after spraying (HAS) by twenty complete sweeps. The data of natural enemy populations was counted later in laboratory.	Chemical pesticides were potentially harmful to natural enemies of both target and non-target pests. Natural enemies and other non-pest insects were more susceptible to insecticides in rice field and were lower in all the treated plots of insecticides than the control plot (Fig. 12). Sweeping data of insect pests and non-pest insects (natural enemies and neutral insects) was counted after 48 hours of spraying. Spider (SPD), green mirid bug (GMB), damsel fly (Dam. fly), dragon fly, lady bird beetle, carabid beetle (CBD), chironomids, wasp, parasitoid, dipteran fly, pentatomid bugs and saprophytes were the major rice insect natural enemies (NE) in the counted sweep sample. Total non-pest insects including natural enemy were found higher in control (466), then in abamectin (311) and fipronil (259) respectively. So, abamectin showed comparatively safe for natural enemies of rice field.
17	**Project VIII: Integrated Pest Management (IPM)** **Expt. 1. Use of nanoparticle to control rice insect pests** **Progress:** The efficacy of Ag, Cu and ZnO nanoparticles against brown plant hopper was tested at five different concentrations (4000, 2000, 1500, 1000, and 500 PPM), which were prepared by dilutions with distilled water. Distilled water was used as a negative control treatment. Ten-15 days	Despite the fact that there are several available alternative methods, pest control is still largely based on the use of chemical pesticides which has tremendous impact of environment and human health. Recently, nanoparticle shows a promising environmentally safe technology to control insect pests. Three nanoparticles including Ag, Cu and ZnO were tested against brown planthopper (BPH). The size of Ag, Cu and ZnO nanoparticles is 20, 40 and 20-30 nm

	old rice seedlings were dipped into each nanoparticle solution at five concentrations. After 60s seedlings were removed from the solution and allowed to air dry.The treated seedlings were then placed into a 25 ml test tube. Fifteen 3rd -4th instar nymphs of BPH were released into each test tube and kept them at 27 ± 1°C. Mortality was recorded after 48 and 120 h. The nymphs were considered dead if they failed to move when gently prodded with a fine bristle.	respectively. Tested nano-particles showed below 30% mortality of BPH nymph (Fig. 13). It indicates that tested nanoparticles are not effective against BPH. More experiments with new synthesis nanoparticles are planned to be tested again using more insect pests.
18	**Expt. 2. Use of sex pheromone to control rice leaffolder and yellow stem borer** **Progress:** Pheromone lures for rice leaffolder were collected from Ispahani Agro Limited and used for these studies. The test was conducted in BRRI research field at Gazipur during T. Aman 2020. 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 optimal dosage is 500 µg Z13-18:Ald per poly-vinyl chloride (PVC) tubing lure. Traps were installed in three blocks of west and East byed of BRRI research field. The trap was placed in rice field @ of 15-20 traps/ha.Trapped insects were collected after one week and counted.	Significant numbers of leaffolder were caught in each trap both in Gazipur (Fig. 14). Number of moth catches varied to time. Figure 15 shows that catches per trap per week increases from August to October. However, highest number of leaffolder catches observed in 25 October 2021. This result indicates that pheromone trap can be effective to monitor and control YSB and leaffolder in rice field**.**
19	**Expt. 8.3. Reduction of insecticide use in rice cultivation to ensure safe food production** **Progress:** The experiment was conducted in a block of 18 farmer's fields during T. Aman 2021 season at the village Fatepur, Pirganj, Rangpur. The field size of the block was 7.92 acre. The plot size was 20-200 decimal for different farmer. During Boro 2021-22 season, 12 experiments (7 in Pirganj, 2 in Mithapukur and 3 in Taraganj) were conducted with in 12 different farmer's field. The field size was 35 to 90 decimals. One portion of farmer's field was managed with BRRI recommended practices treated as T_1 (Researchers practice). Another portion was remained under the respective farmers' supervision without any intervention treated as T_2 (Farmers practice). In T_1, rice field was refrained from insecticide use up to 60 days after transplanting (DAT) to increase natural enemies in rice field. In T_2, the farmers used 3 times insecticide in both seasons to control the insect pests.	During T. Aman season, green leafhopper (GLH) population was found highest (7.22/20 sweep) in August and September. But other insect pests remain below 1.0/20 sweep. In the month of October, a peak of brown planthopper (BPH) and white backed planthopper (WBPH) was observed. BPH and WBPH were found 35.75 and 17.00/ 20 sweep respectively followed by grasshopper (GH), GLH, LR and YSB 1.22 to 1.44/20 sweep. Among the natural enemies Spider population was found highest both in August-September and also in October 6.89 and 6.44/20 sweep. Other natural enemies like Damsel fly (Dam. Fly), dragon fly (Drag. Fly), LBB and green mirid bug (GMB) population reduced during October in comparison to Aug-September. That might be happened due

	Insect pest in the rice field was monitored fortnightly by sweeping and visual counting of randomly selected 20 hills. Insect pests and natural enemy data from 20 complete sweeps were collected and recorded. Perching @100/ha was used in T_1 and insecticide cartap 50SP was used @1.2 kg/ha only one time at ETL during T. Aman season but insecticide was not used in Boro season.	to frequent insecticide application in neighbouring field (i.e., farmers practiced field) of the block. During Boro season, insect pest incidence was very low GH was found 4.67 /20 sweep followed by LR (0.67 /20 sweep). Other insect pest was found less than 1.0 per 20 sweeps. Grain yield obtained similar both in research practiced field (T_1) and farmers practiced field (T_2) i.e., 5.36 and 5.13 t/ha respectively during T. Aman season. In Boro season, grain yield obtained 7.81 and 7.75 t/ha in T_1 and T_2 respectively. Two field days were conducted during two seasons. More than 100 neighboring farmers were attended in each field day programme.
20	**Project** IX: **Bio-Ecology of Rice Insect Pest and Natural Enemy** **Expt. 1. Behavior and biological parameters of Fall Armyworm (FAW) when feeding rice** **Progress:** The leaf consumption rate of fall armyworm larvae against 7 rice varieties as well maize was evaluated at 27 ± 2°C and 65 ± 5 % RH in a greenhouse room. Leaf was cut to 6 cm length and measured the weight of 3-4 pieces of each variety leaves. One site of weighed leaves were wrapped with moistened cotton and kept in individual petridish (NORMAX, Portugal, 120 mm OD and 20 mm height). Two filter papers were soaked in water and placed on petridish. This prevented the leaves from dry out. The wrapped leaf was kept in each petridish. Individual 11-day old larva was released in each petridish and allowed to feed the prepared leaves. After 24 h the remaining leaves in each petridish were measured using same analytical balance.	Results showed that FAW larvae consumed significant higher amount of maize leaf than that of all tested rice varieties (Fig. 16, $F = 70.989$, $df = 6, 56$, $P < 0.01$) in dry weight bases. Result indicates that significant variation was not observed among rice varieties when it was compared based on fresh weight ($F = 0.982$; $df = 5, 48$; $P = 0.440$). However, it was significantly differed when compared based on dry weight (Fig. 16; $F = 8.112$; $df = 5, 48$; $P < 0.01$). FAW larvae consumed significantly higher amount of maize than that of rice irrespective varieties (Fig. 16).
21	**Expt. 2. Behavioral adaptation of rice leafroller (RLR) in different temperature** **Progress:** To know the impact of elevated temperature on the development of Rice Leaffolder Cnaphalocrocis medinalis (Guenee) [Lepidoptera: Pyralidae] colony was maintained on BR3 plants under greenhouse conditions at BRRI, Gazipur.	The growth duration of different developmental stages RLR has shown differences in changing temperature in the growth chamber. Egg hatching period was almost similar in 25ºC and 30ºC temperature but at 20°C it was longer.

	Ten pairs of adults were collected from rice fields and released for oviposition on 40 to 45-day-old plants covered with nylon mesh net cage (45 cm height and 14 cm diameter). Sufficient number of newly laid eggs were transferred to petridishes and kept them an environment-controlled growth chamber. In this study, response to temperature will be assessed by exposing C. medinalis eggs to 5 constant temperatures (20, 25, 30, 35, and 40°C) in separate experiments, one temperature at a time, and allowing the eggs to develop into adults.	Larval and pupal duration were higher in 20ºC compared to 25ºC and 30ºC. Total duration of egg to adult was longer at 20ºC. However, in 30ºC, adult longevity was higher.
22	**Project** X: **Vertebrate pest management** **Expt. 1. Study on the efficacy of different commercial rodenticides against rice field rats** **Progress:** Efficacy of four different rodenticides available in market namely Lanirat, Zinc phosphide, Rat killer and Phostoxin were evaluated to control rat in rice field of BRRI, Gazipur in T. Aman and Boro 2021-22. Rodenticide was applied from the tillering stage of rice when rat activity and rat pit was observed in BRRI rice farm. Rodenticides kept in small nylon net (potla) were placed in rat pit with new soil (live pit). The rat pit was covered with soil in case of placing phostoxin tablet in live rat pit. After seven days of application of rodenticide, soil status of the pit i.e.; live pit or dead pit was recorded. Thirty-five rat pits for each of the rodenticide were thus recorded in rice field of BRRI, Gazipur in T. Aman 2021 and Boro 2021-22.	Phostoxin treated rat pit had the maximum numbers of dead pits than other rodenticide treated rat pit (Fig.18). Zinc phosphide showed less effective than other three rodenticides. So, to control rice field rat Phostoxin was very effective followed by Rat killer, Lanirat and Zinc phosphide.
	Plant Pathology Division	
	Proposed Research Progress 2021-2022	
Sl No.	**Programme area/Project (Duration)**	**Majoutput**
1	Survey and monitoring of rice diseases in selected areas	Incidence pattern and severity of rice diseases over the locations and varieties were assessed. Bacterial blight (BB), sheath blight (ShB) and brown spot were observed predominant irrespective of season
2	Improvement of differential system for rice blast disease in Bangladesh using differential system and	Based on the pathogenicity and molecular analyses, new differential isolates will be

	molecular marker	selected
3	Studies on host range of blast pathogen	Rice blast isolate developed symptoms of blast disease on leaves of BRRIdhan28 excluding foxtail millet and wheat leaves.
4	Identification of the source of infection of rice false smut disease	Diseased seeds could be a source of natural infection in both blast and false smut disease.
5	Exploring new sources of resistance and pyramiding blast resistant gene into susceptible rice varieties	Seven blast resistance advanced lines introgressed with Pi9 gene was screened along with blast susceptible rice nvarieties and found resistant reaction
6	Observational trial of multiple disease resistance (blast and bacterial blight)	Among the BB and blast resistant advance lines genotypes BR (Path) 13800-BC3-134-252 produced the highest average yield (7.80 t/ha)
7	MLT of multiple disease resistance for advance lines in the background of BRRI dhan28, BRRI dhan29, BRRI dhan63 and BRRI dhan81	In the background of BRRI dhan63, BR(Path)13811-BC_3-8 produced the highest average yield (7.2 t/ha) while in the background of BRRI dhan81, BR(Path)13811-BC_3-12 and BR(Path)13811-BC_3-60 produced the highest average yield (6.9 t/ha)
8	Screening of advanced breeding lines and INGER against blast disease	Among the tested 19 INGER materials, 8 entries showed moderate resistant reaction against leaf blast disease
9	Screening of advanced breeding lines against sheath blight disease	All the rice genotypes (140 lines) of advanced breeding lines were susceptible to highly susceptible to sheath blight disease
10	Screening of rice germplasms against Bakanae disease	Hundred germplasms were screened out and five (Acc.127, Acc.1934 (HR), Acc.1931, Acc.1933, Acc.1998) were found resistant against bakanae disease of rice.
11	Development of Early Warning System of rice blast disease	A model of Early Warning System of Rice Blast has been developed based on wheat blast model with the collaboration of CIMMYT
12	Sustainable Management of Blast, Sheath Blight and Bacterial Blight Diseases of Rice through Nano-particles (NPs)	Six different nanoparticles against blast, sheath blight and bacterial blight pathogen revealed that AgNPs has the potentiality of mycelial growth inhibition of Magnaporthe oryzae and Rhizoctonia

		solani over control at ~20ppm concentration
13	Bio-synthesis and characterization of silver nano-particles from available organic sources in Bangladesh.	Green synthesized K and CuONPs created 1.7±0.023cm and 2.0±0.033cm inhibitory zone respectively on bacterial growth at the concentration of 0.25M.
14	Efficacy of nanoparticles against bacterial blight disease management in rice	Nano particles successfully controlled bacterial growth comparing with control.
15	Efficacy of nanoparticles against blast disease management in rice.	M. grisea. mycelial growth were inhibited by nano particles
16	Management of Sheath blight disease utilizing Trichoderma harzianum	Trichoderma harzianum formulated compost reduced sheath blight disease incidence and yield become increased
17	Isolation of effective bacterial isolates for management of sheath blight disease	Antagonistic bacteria effective against sheath blight pathogen was evaluated for Phosphate solubilizing capacity, catalase activities and hydrogen cyanide (HCN) production abilities
18	Evaluation of commercial biopesticides against sheath blight disease	A total of 3 formulated commercial bio-fungicides and one plant nutrient solution along with a standard check fungicide were tested against sheath blight disease
19	Bakanae disease control with integrated approach	Yield was increased in T Aus in different treatments with biocontrol agents compared to control in both Habigonj and in Cumilla
20	Formulation of nano particles and in vitro test of nano particles derived from plant products for controlling bakanae disease	Highest plant height was increased in diseased control (8.2%) followed by AgNo3 (1mM) (5.2%) treated seeds. Root length was somewhat increased (6.4%) in silver nano (neem leaf) treated plants compared with healthy control plants
21	Identification of potential bio-control agents and formulation of biopesticides against bakanae disease of rice	Bacterial biopesticide in formulation-1 could survive up to 12 months or more whereas, in formulation-2 could survive up to 6 months or more in liqiid form.
22	Efficacy of biocontrol agents to manage bakanae disease in field condition.	In Habigonj Tricho-compost (1.5 t/ha) resulted higher yield followed by Tricho-compost (1.5 t/ha)+Bacteria (spray)
23	Residual effect of Axoxystrobin and difenocanazole on microbial community in phylloplane and phyllosphere of rice plant	The toxic effects of the fungicides were more pronounced immediately after the application of fungicides
24	Digitalization of Pesticide Register Notebook	Regularly updated pesticide note book based on submission of new chemicals

		and registered chemicals.
25	Evaluation of new chemicals against blast, bacterial blight, sheath blight and diseases of rice	Total 20 new chemicals were evaluating against Sheath blight disease of rice. Among them 9 (nine) were found effective
26	Training on integrated management of major rice diseases.	Seven batches of a 'day-long' training program on integrated rice disease management were conducted at Gazipur, Sirajgonj, Cumilla and Habigonj districts.
	Farm Machinery and Postharvest Technology Division & Workshop Machinery and Maintenance Division	
	Research Progress 2021-22	
	Programme Area: Farm Mechanization and Postharvest Technology	
Sl. No.	**Research Progress**	**Expected/major output**
1.	**Programme area /Project title (Duration): Development of Agricultural Machineries**	
1.1	**Experiment: Development and fabrication of a whole feed combine harvester** (2017 -Continued) **Progress:** ❖ An initiative was taken to fabricate a prototype of a whole feed combine harvester in the Farm Machinery and Postharvest Technology (FMPHT) divisional workshop. ❖ The first version of the whole feed combine was developed and some problems were identified in this version. Material selection was not good enough and frequent troubles were observed during field operations. Therefore, an initiative was taken to fabricate the second version of the whole feed combine harvester considering the problems which were identified in the previous version of the machine. ❖ The performance test was done in different locations. Firstly, it worked satisfyingly but after working for a few hours the machine stopovers due to the clogging which occurred at the inclined augur/screw. After removing the congested grain from the auger/screw, the machine again worked very courteously. Trying to solve this problem in the divisional research workshop and as early as possible this problem will be solved.	• Prototype of a whole feed combine harvester will be available for Bangladesh conditions. • The machine will help to harvest at the proper stage of crop maturity and reduce drudgery.

	❖ After solving this problem, the performance test will again be organized in the upcoming season. ❖ The harvesting capacity and fuel consumption were 0.318~0.332 ha/h, and 3.78~3.97 l/h respectively. The performance test will be conducted again in the coming season after these issues have been resolved.	
1.2	**Experiment: Design and development of a whole feed combine harvester (developed by SFMRA project)** (2020 -Continued) **Progress:** ❖ A whole feed combine harvester was developed under the SFMRA project of BRRI considering the factors of engine power, ground pressure, cutting width, harvesting capacity, harvesting loss, plot area and land condition, ease of operation, plot size, land condition, and business viability of the imported combine harvester. ❖ Prototype of the harvester was fabricated in the Janata Engineering Workshop, Chuadanga as per BRRI design providing financial and manpower support. ❖ Locally available raw materials were used to fabricate the machine except for the crawler (400 x 90 x 51mm), gearbox, engine (87-hp), Walking section, power section, operating system, hydraulic mechanism (2000kg), grain cleaning section (2130×895mm), threshing section (2085×1600mm), paddy conveying section, cutting section, grain conveying section and grain tank (600kg) were designed separately using Auto-CAD tools for fabrication. Separate sections are assembled according to the desired plan. ❖ B and C type belts, V-groove pulley, and chain sprocket were used to transmit power from the engine to the gearbox, then to the crawler and conveyor belt, cutting section, threshing and winnowing unit sequentially from gearbox. The basement dimension of the machine is 2705×1600 mm. It holds the crawler, engine, and main body to connect the cutting section of the harvester.	• Prototype of a whole feed combine harvester will be available for Bangladesh conditions. • The machine will help to harvest at the proper stage of crop maturity and reduce drudgery. • The machine manufacturing ability or skills of the local workshop will be developed

	❖ The developed prototype was evaluated during Aman, 2021, and Boro 2022 at Chuadanga and Rangpur in the presence of different stakeholders. The average of two locations, forward speed (km/hr), harvesting capacity (acre/hr), fuel consumption, and threshing loss (%) were obtained 3-4, 1.0-1.2, 10, and <1.0, respectively were obtained during the study. The overall weight and traction load of the machine of the developed machine are 3000 kg and 20.7 kN/m2. ❖ Detail study under different soil and crops condition will be conducted in the next Aman season.	
1.3	**Experiment: Design and development of a head feed power thresher** (2019 -Continued) ❖ A head feed thresher was fabricated by using locally available materials in Nayem Engineering workshop, Modan, Netrakona. BRRI provided design, drawing, technical and financial support to develop and manufacture the machine in that workshop. The preliminary test of the machine was done in Aman 2020 season at Modan, Netrakona to find out the mechanical faults of the machine. At that time, it was found that the machine had no major faults. After that, the machine was carried to the FMPHT division for a thoroughly test. ❖ The machine performance test was organized at the BRRI threshing yard in Boro 2021 season. A few faults were found and modifications were done for eliminating that faults. Machine capacity was not adequate due to the low speed of the feeder chain and feeding mechanism. ❖ Some modification was done and a thoroughly test will be organized in the upcoming season. Another prototype is needed to be developed for the upgrading of the capacity and other functions up -gradation of the machine.	• Head feed thresher will be available and straw will remain intact in threshing.
1.4	**Experiment: Design and development of a semi-automatic rice transplanter (developed by the SFMRA project, BRRI)** (2020 -Continued) **Progress:** ❖ A research was conducted to design and	• Prototype of a semi-automatic rice transplanter will be available for Bangladesh conditions. • The machine will help to transplant rice

	fabricate a semi-automatic rice transplanter utilizing locally accessible materials at RK Metal in Faridpur. ❖ For the development and fabrication of this machine, BRRI offered design, drawing, technical, and financial support through the SFMRA project of BRRI. ❖ The study was aimed at designing, fabricating, and testing the performance of the prototype. The machine has already been manufactured by the local workshop. A preliminary test of the machine was done at BRRI regional station, Bhanga to find out the mechanical faults of the machine. ❖ It was found that the machine has no major faults. Fine-tuning is going on. The performance test of the machine will be done thoroughly in the upcoming season.	seedlings and reduce drudgery. • The machine manufacturing ability or skills of the local workshop will be advanced
1.5	**Experiment: Design and development of a manual seed sower machine for raising mat-type seedlings (developed by the SFMRA project, BRRI)** (2020 -Continued) **Progress:** ❖ A study was conducted to design, fabricate, and performance evaluation of the BRRI manual seed sower machine in the FMPHT research workshop. ❖ The fabrication of the designed machine was completed using AutoCAD tools. A seed hopper, seed metering device, and rubber wheel were fabricated using dice. The machine was fabricated using locally available material considering accurate metallurgy. ❖ It was calibrated for different sizes of grains. The performance of the prototype is tested primarily in the research workshop. The result of the primary test was satisfactory.	• Prototype of a manual seed sower machine for raising mat-type seedlings will be available for Bangladesh condition. • Sowing in tray will be ease • Farmers will save time and costs for mat-type seedling raising
1.6	**Experiment: Design and Development of a Power-Operated Automatic Seed Sower Machine for mat-type seedling** (2020 -Continued) **Progress:**	• Prototype of a Power-Operated Automatic Seed Sower Machine for mat-type seedling for raising mat-type seedlings will be available for

	❖ The power-operated automatic seed sower machine was designed and fabricated at Farm Machinery and Post-Harvest Technology (FMPHT) divisional research workshop in BRRI and Alam Engineering works, Wari, Dhaka as well. ❖ This machine was developed under the SFMRA project of BRRI. At first, engineering design was done with the help of AutoCAD Engineering drawing tools and a prototype will be fabricated according to the design. About more than 50% of the machine was manufactured by workshop personnel and using locally available materials. ❖ Thoroughly test program will be executed after fine-tuning and modification of the machine.	Bangladesh condition. •Sowing in tray will be ease •Farmers will save time and costs for mat-type seedling raising
1.7	**Experiment: Design and development of double row skid type power weeder for wetland paddy field (developed by the SFMRA project, BRRI) (2020 -Continued)** **Progress:** ❖ A prototype of a double-row skid-type power weeder for a wetland paddy field was fabricated in FMPHT divisional research workshop, BRRI. ❖ Locally available SS sheet, SS square bar, SS pipe, MS shaft, Teflon plastic, Nuts, and Bolts were used to fabricate the weeder and a petrol engine was the power source of the weeder. The average forward speed and field capacity of the developed power weeder were found 1.33km/hr and 0.06 ha/hr respectively. ❖ Field capacity increase with the increase of forwarding speed. The average fuel consumption during the lab test (No load condition) and field operation was found 550 ml/hr and 675 ml/hr respectively.	• Prototype of a double row skid type power weeder for wetland paddy field will be available for Bangladesh conditions. •Weeding in rice fields will be easy •Farmers will save time and costs for weeding
1.8	**Experiment: Design and development of rice straw rope maker (developed by the SFMRA project, BRRI) (2020 -Continued)** **Progress:**	• Prototype of a rice straw rope maker will be available for Bangladesh conditions. •Rope making with rice straw will be

	❖ Rice straws are the most prevalent and plentiful of the five rice-related products. Heavy rainfall during the wet season reduces the quantitative and qualitative availability of straw significantly. ❖ Hand tools or a machine designed for the purpose can be used to twist straw into rope. To improve the quality and efficiency of rope production, a straw rope maker was designed and developed. ❖ The designed hypothesis was a rope with a helix angle of 250 to 300 and a diameter of 4 to 20 mm. Test the developed rope maker in the laboratory and on the farm. A-frame, a wool basket, a rope divider, two twisting funnels, two small stone pounds, a reel, and a gear mechanism make up the rope maker. The rope maker was constructed with an MS angle bar, cast iron, nylon plastic, and plain sheet. ❖ The twisting mechanism consists of two twisting funnels made of plain sheet, a wool basket rope divider, a rope mouth, and a small cast iron stone pound. The ropemaker allows for simple rope gathering and unloading. With, the effective capacity was 3.23 m/min. The machine was simple to operate, with a mean power consumption of 64 Watt.	easy • Farmers will save time and costs for straw rope making
1.9	**Experiment: Mitigation of biotic and abiotic stress for mat-type seedlings raising in the Boro season** (2020 -Continued) **Progress:** ❖ Rice is very sensitive to prolonged exposure to lower temperatures. Cold mitigation mechanism at the seedling stage is a primary requirement during the Boro season as seedlings are raised during the cold months of November and December. The purpose of this study is to mitigate the biotic and abiotic effects on germination and mat-type seedling growing during the Boro season. ❖ A total number of six treatments were taken under two different thicknesses (0.04 mm and 0.08 mm) of white polythene shed covered daytime only (12 hours) and day and night time	• Mitigation of biotic and abiotic stress for mat-type seedlings raising in the Boro season will be optimized • Farmers will save time and costs for seedling raising in stressful conditions

	(24 hours) as abiotic stress control factors. Along with that two fungicides (Atavo and Austin) and MoP fertilizer were used to control biotic stress on young seedlings raised in the plastic tray. Plant height, number of leaves, leaf length, stem length, stem thickness, rolling resistance, and density was measured after 30 days. The highest temperature (40˚C) was observed inside 8 grade (0.08 mm thickness) polythene shed covered day and night time (24 hours). ❖ The combined effect of 0.08 mm thick polythene shed and MoP treatment showed the highest value for seedling height (167.3 mm), the number of the leaf (4), leaf length (99.8 mm), stem length (73.5 mm), stem thickness (1.1 mm), seedling density (18/cm2). Fungal infection was found lowest in 0.08 mm polythene covered day and night time. ❖ Seedling-raised plastic trays are much more effective than the conventional way in terms of germination and quality. Hence, 0.08 mm thick white polythene was recommended as a covering mechanism, and MoP as a treating mechanism for seedling raising in Boro season.	
1.10	**Experiment: Attachment of binding facility in BRRI self-propelled reaper** (2020 -Continued) **Progress:** ❖ AMEI reaper binder was tested in harvesting rice and its capacity was found 0.15 ha/hr. It cannot make rice bundles. Then the problems of the binding mechanism of the reaper binder were identified and solved. It is found suitable for cutting thread and rice bundle making. ❖ Therefore, the AMEI reaper binder makes a bundle of two rows of rice plant well. It was tested at clay loam soil in BARI wet byde, Gazipur. Its' moisture content ranged from 23-25%. The effective field capacity of the reaper binder was obtained at 0.03 ha/hr. Its' fuel consumption ranged from 0.95-1.05 liter/hr.	• Binding facility or mechanism will be developed for self-propelled reaper
	Experiment 1.11: Validation of hermetic	• Proper hermetic technologies in rice

	technologies in rice storage (2018 -Continued) **Progress:** A comparative study of traditional storage systems along with hermetic bag (HB) was conducted in completely randomized design (CRD) with three replications and five treatments Motka, Plastic drum, Polythene bag, HB i.e. PICS bag, and GrainPro bag. Changes in moisture content (MC), insect infestation, storage loss, and germination percentage were observed throughout storage in Bororice seed. Moisture content remained constant (12.2%) in GrainPro and PICS bags during six months of storage. Because these were airtight and stored rice in these did not absorb moisture from the atmosphere. The highest insect infestation of stored rice was found in Motka followed by Plastic bags undoubtedly due to the persistence of high moisture content and high level of oxygen whereas no insect infestation was observed in GrainPro and PICS bags during storage. The porous behavior of Motka permits more serious loss by insects than that in other structures. Average germination capacity was fall down up to 75% in Motka, and≥ 91% in HB. HB can reduce germination and storage loss, and maintain seed viability	storage will be validated
2	**Project Title**: **Milling and Processing Technology**	

2.1	**Experiment: Test, evaluation and modification of rubber roll de-husker and friction type polisher** (2016 -Continued) **Progress:** ❖ The commercial value of the rice milling parameter for BRRI dhan90 was evaluated by a BRRI-modified rubber roll husker and MN-15 polisher. The husking efficiency of the modified rubber roll de-husker was around 90.67% for BRRI dhan90. Milling recovery of BRRI dhan90 was 65.7 % polished in MNMP - 15 type polisher. The average head rice recovery based on input paddy was 60.7 %, which is promising for the processing of quality rice. Steel engelberg huller may replace with one rubber roll de-husker and a polisher for better quality rice. Besides this, rubber roll de-husker separates husk, and friction type polisher separates bran. Separately collected husk and bran is suitable for briquette and edible oil production	The combination of de-husker and polisher will be an alternate milling system of auto rice milling.
3	**Project Title**: **RENEWABLE ENERGY TECHNOLOGY**	
3.1	**Experiment: Design and development of a small-scale recirculating type dryer** (2019 -Continued) **Progress:** ❖ The experiment of recirculating dryer was conducted during Boro season 2020 at the FMPHT divisional workshop using BRRI dhan28 with different load capacity. ❖ The modified dryer was run in no load, half load and full load conditions. Drying air temperature distribution through the grain bin was uniform throughout the dryer during the drying operation. ❖ The paddy was dried from 28.7 to 18.9%, 28.5 to 14.2% and 29.4 to 13.6% during Boro season 2020 within the range of 4.5 to 10.0 hrs respectively. ❖ The drying rate was found to be varied between 1.6 to 2.2% which directly depends on the initial moisture content of the paddy and drying air temperature. The range of drying efficiency	• The best model of drying characteristics will be identified for premium quality rice. • Head rice recovery and milling yield will be increased significantly. • Appropriate drying process and tempering period will be identified for premium quality rice

	ranged from 24.9% to 51.6% during Boro season for different dryer capacities.	
4	**Project Title: Industrial And Farm-Level Extension Of BRRI Machinery**	
4.1	**Experiment: Training on Operation and Maintenance of Farm Machinery to the Machinery Operators and Mechanic** (2020 - Continued) **Progress:** ❖ A total of 93 batches of a two-day-long residential training program were conducted under the financial and technical support of the SFMRA project of the FMPHT division from 2020 to 2021. Participants of the training program were attended from all BRRI R/S and its adjacent area and total 1865 numbers of participants were trained among them1836 were male and 29 were female. ❖ Participants were trained on the operation, repair, and maintenance of different agricultural machinery and technologies like; transplanters, combine harvesters, diesel engines, Power weeders, prilled urea applicators, self-propelled reapers, power tillers, tractors, etc theoretically and practically in the threshing floor and the main field. At the end of the training, a post-evaluation and trainees' reactions regarding the training were collected. Certificates, leaflets, and a set of tools were distributed among the participants. Trainees opined that they are now more confident about the use of agricultural machinery.	Skillness of machine operator and mechanic for agricultural machinery operation and maintenance will be developed
	Agricultural Statistics Division	
	Research Progress 2021-22	
S. N.	**Research Progress**	**Major Output**
	Program Area: Socio-economics and Policy	
1.	**Project 1: Statistical methodology** **Activity 1.2**: Develop analytical skills on the scopes of Bioinformatics in Rice Research (In collaboration with Plant Breeding, Plant Pathology, Plant Physiology and Biotechnology Division) **Progress**:	1. Identify the application fields of bioinformatics in rice research 2. Developed analytical skills on to manage and analyses of- DNA sequence data, bioinformatics database search, BLAST, phylogenetic tree, Sanger sequencing data, NGS data, check the quality of

	Review the literature on scopes of Bioinformatics in Rice Research some of our divisional scientist successfully completed and participated in some workshop and training on Bioinformatics arranged by BRRI and other organization.	NGS data, Genome assembling etc., bioinformatics related topic.
	Activity 1.2: Improvement of BRRI Stability model by incorporate multiple factors **Progress**: Based on the values for the MTSI presuming at 30% selection intensity and have been selected four varieties BRRI dhan48, BRRI dhan82, BRRI dhan98 and BRRI hybrid dhan7 as highly stable variety based on multi-trait stability index (MTSI). Among the six attributes were clustered into the three different factors as: FA1: (PH, TGW and GD); FA2: (Yield, TN, PN and PL); FA3: (GPP and UGP).	Best model selection for BRRI stability model improvement.
	Activity 1.4: Comparative study for rice yield estimation by adjusting moisture content **Progress**: Most of the variety found a significant variation of the overestimation both methods. The highest and lowest overestimations observed were 6.51 and 18.16%, respectively for sundry methods. In oven dry method samples, the highest and lowest overestimations (%) were 4.95 and 23.51 among the evaluated forty-six (46) Boro rice varieties.	1. To determine the adjustment factors for rice yield estimation. 2. To develop a criterion for performing a reliable estimation.
2.	**Activity 2.1:** Genotype X Environment Interaction of BRRI Varieties **Progress**: The highly significant genotype × environment interaction effects for grain yield confirmed that genotypes responded differently to the variation in environmental conditions for long, medium and short duration Aman varieties was identified	Genotype x Environment Interaction effect of BRRI varieties
3.	Minimizing agro micro climatological risk factors for maximizing sustainable rice production in Bangladesh Progress: Completed	Yield enhancement, reduce cost of production and increase farmers income through efficient crop management.
5.	**Utilization of geographical information system (GIS) in rice research**	
	Study 5.1: Suitability (Edaphic) Mapping of BRRI dhan93-95	Maps indicating suitable area for cultivation for respective varieties.

	Progress: Edaphic suitability maps of BRRI dhan93-95 completed.	
	Study 5.2: Climatic Mapping of Temperature (Maximum & Minimum) and Rainfall **Progress**: Maximum and minimum temperature, total rainfall maps of 2020 has been completed.	Maximum and minimum temperature, total rainfall maps of Bangladesh for the year 2020.
	Study 5.3: Zoning of BRRI released rice varieties **Progress**: Zoning maps of BRRI dhan90 and BRRI dhan92 has been completed.	Maps indicating upazila wise suitable area for cultivation for respective varieties.
	5.4 Season wise rice area mapping of Bangladesh **Progress**: Rice cultivated area map of Bangladesh for Aman 2021 and Boro 2021-22 has been done	Rice cultivated area of Aman 2021 and Boro 2021-22.
	5.5 Favourable and Unfavourable Rice Cultivation Area Mapping of Bangladesh **Progress**: Cold, drought, saline, flood, haor, charland and Non saline tidal area of Bangladesh maps has been done.	Area of Cold, drought, saline, flood, haor, charland and Non saline tidal area of Bangladesh.
6	**Project 6: Computer Programming and Digitalization**	
	Activity 6.1: Develop a computer program using R to calculate the Stability Index for BRRI stability model **Research Progress**: Already developed a computer program using R to calculate the stability index for BRRI developed stability model.	A computer program using R to calculate the stability index for BRRI developed stability model.
	Activity 6.2: Digitalized budget management system of BRRI **Research Progress**: Already developed digital budget management system for BRRI	A digital budget management system for BRRI
	Activity 7.3: Digitalized quota management system of BRRI **Research Progress**: Already developed digital quota management	A digital quota management system for BRRI

	system of BRRI	
	Activity 7.4: Digitalized salary management system of BRRI **Research Progress**: Updated the developed digital salary management system for BRRI HQ	An updated version of the developed digital salary management system for BRRI HQ
	Activity 7.5: Digitalized Labour management system of BRRI **Research Progress**: Updated the developed digital Labour management system for BRRI HQ	An updated version of the developed digital Labour management system for BRRI HQ
	Activity 7.6: Digitalized casual leave application system **Research Progress**: Updated the developed digital casual leave application management system for Agricultural Statistics Division of BRRI	A updated version of the developed digital casual leave application management system for Agricultural Statistics Division of BRRI
8.	**Activity 8.1**: Sensor-based rice pest management through Artificial Intelligence (AI) technology of BRRI. **Research Progress**: Already, 65% development of this program has been completed. Automatically provide the necessary solutions to rice disease and pest related problem with proper management within one to one and a half minutes;	• Time, Cost and Visit (TCV) will be less and quality (Q) will be increased. • Adopt precision agriculture and automations solutions to close rice yield gaps.
	Activity 8.2 **Develop a new website for BRRI** **Research Progress**: • Develop of the new website is going on.	• A new website for national and international seminars and symposiums. • Domain or sub-domain for the new website.
	Activity 8.3: "BRRI Alapon" Telephone Directory Mobile App of BRRI. **Research Progress**: Already database has been developed. All types of data have been collected from divisions, sections and regional stations of BRRI for developing the telephone directory mobile app.	• Digitalize internal communication system to each other of BRRI. • Minimize time, cost and visit (TCV) for sharing instant information using the app.
	Activity 8.4: Vehicle Requisition Management System of BRRI.	• Digitalize Transport division using SMS based VRMS service.

	Research Progress: The database has already developed and architecture design has been finalized. The information of all vehicle of BRRI (driver's name, mobile no, vehicle reg. no etc.) has been collected from transport section.	• Manage and maintain the VRMS system.
	Activity 8.5: Training on Innovation, Service Process Simplification (SPS) and e-Nothi system for enhancing capacity of BRRI employee. **Research Progress**: Day-long 'e-Governance and Vision 2021 & 2041' workshop has already completed on 17 February' 2022 in spite of Covid-19 situation following social distance and health rules. Two day-long 'Public Service Innovation' training has completed on 28-29 May' 2022 at BRRI premises.	• Enrich capacity of BRRI scientists and officers through various PSI and SPS training. • Skills of implementation process will be developed through innovative approach.
	Activity 8.6: "BRRI Rice Doctor" Apps for BRRI. **Research Progress**: Developed final version of BRRI rice doctor mobile app and web application. Included diagnosis tool technique on BRRI Rice doctor mobile and web application.	• Manage and maintain rice doctor.
	Activity 8.7: **Strengthen and dissemination of modern rice technology and its management information at the farmer door step through RKB Mobile Apps** **Research Progress**: • For dissemination, we have trained sixty (60) DAE officers in two batches. We have also developed a web page to get feedback from those DAE officers. All officers gave their feedback through the web page. DAE officers are using the RKB mobile apps and they are encouraging farmers to use the mobile apps. RKB is regularly updating with the latest information. It has included rice cultivation methods, rice production methods, soil and fertilizer management, insects and their management, diseases and their management, irrigation & water management and call center.	• Disseminate RKB at all regional stations of BRRI as well as in almost all corners of Bangladesh. • Extend and update regularly as routine work.

	Activity 8.8: **BRKB Website Management** **Research Progress**: • In this reporting year we have developed sixty-seven web and mobile based fact sheets. And all fact sheets have been uploaded into BRKB website. • Updated with the latest information of Aman, Aus and Boro rice varieties included the latest variety of BRRI dhan99, BRRI dhan98 and BRRI dhan97. • All types of information i.e. soil and fertilizer management, insects and rice diseases management etc. also updated regularly. It is routine work.	• Provide more benefit to all users specially farmers, extension workers, researchers etc. • Include more information as well as national issues associated with rice production and training.
	Activity 8.9: **Dynamic view connectivity system, Bangla searching system and inner banner system for BRKB Website** **Research Progress**: • In this reporting year we have developed an inner banner system and also integrated in BRKB website. • We have developed a dynamic view connectivity system in BRKB. That helps us about our present activities and actions. • We also developed the Bangla Searching system in BRKB. Now anyone can search using both Bangla and English content.	• Dynamic view connectivity system in BRKB. • Bangla searching system in BRKB. • Inner banner system in BRKB.
	Activity 8.10: **BRRI Web Mail and Group Mail** **Research Progress**: • We have updated the BRRI mail server from 8.8.12_GA version to 8.8.15_GA version. Now our mail server is more secure than the previous one. • We provided 120 webmail related solutions in this reporting year. • 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,	• Create web mail ID and group mail as per requirement of BRRI scientists and officer's usage. • Manage, maintain and update regularly web mail ID, password and group mail for security purpose.

	officers and regional stations as per requirement of BRRI scientists.	
	8.11 Activity: **Developing secure system for BRRI Web Mail and Group Mail** **Research Progress**: • In the reporting year we have developed spamming filtering system in mail server. • We incorporated Secure Sockets Layer (SSL) system in BRRI web mail, now our web mail is more secure. • Automatic Active & Close System (AACS) has been developed in BRRI web mail.	• Spamming filtering system (SFS) in BRRI web mail and group mail. • Automatic active & close system (AACS) in BRRI web mail and group mail. • Secure Sockets Layer system in BRRI web mail and group mail.
	Activity 8.12: Online Application System of BRRI **Research Progress**: Started first time online application system from 23rd May to 12th June'2019. Already completed another online application process from 20.6.2022 to 03.07.2022. Applicants completed their application through this system and got admit card, written test date notification, result and all kinds of information through this online system and SMS based application.	• Digital and paperless recruitment system for BRRI. • Manage and maintain online application system of BRRI.
	Activity 8.13: e-Nothi System of BRRI. **Research Progress**: BRRI has taken initiative to ensure a paperless office management system through e-Nothi system on 24 September 2016. At present, BRRI obtained 1st position among all govt. organizations and departments for using e-Nothi System. Now e-Nothi system 100% is being used in all divisions and sections of BRRI as well as regional stations.	• Establishing uninerrupt and paperless office system. • Manage and maintain e-File (Nothi) system of BRRI.
	8.14 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, Cumilla, Rangpur, Barishal and Habigonj.	• Manage and maintain Internet connectivity of BRRI regional station • Manage and maintain local Area Network of BRRI regional station.

	• Increased 2 Mbps full duplex, dedicated and 3.5G (3.5 Generation) internet bandwidth at four regional stations. At present, we have increased the internet speed of sonagazi from 2 Mbps to 7 Mbps. Established WiFi connection at five regional stations i.e. Rangpur, Barishal, Sonagazi, Cumilla and Habigonj.	
	8.15 Activity: **BRRI Web Portal Management** **Research Progress**: • In this reporting year we updated about 1000 (one thousand) pages and uploaded about 5000 (fine thousand) documents like PDF, JPG, report, Word and other files on the BRRI website. • We sent twelve website reports to the ministry of agriculture (MoA). • 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.	• New features for BRRI web portal. • To increase hosting spaces gradually
	8.16 Activity: **Management of BRRI HQ Local Area Network and Internet Connectivity** **Research Progress**: • We have increased our Digital Data Network (DDN) bandwidth connectivity from 120 Mbps to 157 Mbps. Now our internet speed is faster than previous once. • Established new and high configured Router where internet speed capacity increased 1000 Mbps; the internet speed capacity was 25 Mbps previous device. • We have already given internet connection in 360 computers. But we want to increase more internet connection. So we have started to increase our bandwidth connectivity as per requirement of BRRI scientists and officers. Hopefully, within short time all the BRRI scientists and officers will get more speed for internet access with smooth communication and they will be benefited to pass information	• High speed internet connectivity for BRRI. • Secure Local Area Network for BRRI.

	internally as well as globally.	
	Activity 8.17: BRRI Networks Update, Maintenance and Extension. **Research Progress**: To build a linkage among all scientists, officers and staffs, where BRRI Networks (Fig. 42) play an important role. At present, more than 33k user like the facebook page (Fig. 43) of BRRI and 4000 members are joined the 'BRRI Networks' facebook group. It's gradually increasing.	• Store more research related activities post and necessary documents. • Boost and extend the group with adding more members and introducing more new feature for noble purpose.
	8.18 Activity: **Personal Data Sheet of BRRI** **Research Progress**: • Created Personal Data Sheet (PDS) database including various information fields for all scientists, officers, staffs as per requirement of the Ministry of Agriculture (MoA). • We have distributed 360 user ID and password to all scientists, officers & stuffs personal mail and published user id list into BRRI website.	• Creating Personal Data Sheet (PDS) database including various information fields for all scientists, officers, stuffs as per requirement of the Ministry of Agriculture (MoA).
	8.19 Activity: **Video Conference System of BRRI (skype system)** **Research Progress**: • We have established video conferencing system at BRRI to communicate with MoA and others government organization. • ADP, Monthly co-ordination Meeting, Sunday seminar, In-house training and workshop have been conducted by video conference system. Also maximum meeting is being conducted by video conference system using Zoom Platform System. • Bangladesh Research and Education Network (BDREN) funded by University Grant Commission (UGC) have established video conferencing system at BRRI.	• Creating Skype account for all scientists.
	8.20 Activity: **New version of management Information System (MIS) of BRRI**	• Establishing e-Governance.

	Research Progress: • Ten workshops have been completed at Bangladesh agricultural research council (BARC). • Feedback workshop has been completed. • Tender documents have been prepared.	• Setup management information system at BRRI
	Activity 8.21: **Rice Pest Corner** **Research Progress**: We have developed 'Rice pest corner' with the information of insect and pest and disease management. Rice pest corner has been developed for farmers, extension workers, scientists, researches, teachers, students and other users who want to learn and control insect and disease and other problems that can occur in rice.	• Web Application for Rice Pest Corner to identify timely pest problems in rice and control to manage them.
	Activity 8.22: **Heritage of BRRI** **Research Progress**: • We have developed Heritage for all scientists, officers, staffs, and workers of BRRI as per requirement of the BRRI authority. • We have developed individual webpage including picture of all scientists, officers, staffs and workers of BRRI • Heritage is updated regularly. It is a routine work.	• Managing and maintaining BRRI heritage. • Adding all ex. Scientists, ex. officers and ex. Stuffs in BRRI heritage.
	Agricultural Economics Division	
	Research Progress 2021 – 2022	
Sl. No.	**Research Progress**	**Major output**
1	**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 • To determine the socio-economic and varietal constraints to the adoption of MV rice in different regions.	Overall adoption of modern variety was 93.27, 88.02, and 99.52 percent in the Aus, T. Aman, and Boro seasons, respectively, with BRRI varieties covering around 74.48, 55.18, and 61.76 percent. BRRI dhan48 placed first (49.41 percent) in the Aus season in terms of area coverage, followed by BRRI dhan28 (6.7 percent). T. Aman season had a 20.11 percent coverage of Indian varieties. The Boro season's most adopted varieties were BRRI dhan28 and BRRI dhan29, which

	Duration: Routine work **Research site/ Location:** Fourteen Agricultural Regions of Bangladesh **Status: Completed**	covered 41.25 percent of the area. In the Aus season, BRRI dhan82 produced the maximum yield (4.33 ton/ha), whereas, in the T. Aman and Boro seasons, it was BRRI dhan87 (4.72 ton/ha) and BRRI dhan92 (6.69 ton/ha), respectively. In the Boro season, Hybrids produced 7.27 tons per hectare on average.
2	**Estimation of Costs and Return of MV Rice Cultivation at the Farm Level** **Objectives:** • Delineate input use pattern in modern Aus, T. Aman and Boro rice cultivation; • 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**	Per hectare, the gross margin of rice cultivation in the T. Aman season (Tk. 64,650) was higher, followed by Boro (Tk. 54,573) and T. Aus season (Tk. 34,064). Similarly, per hectare net returns for T. Aman (Tk. 32,391) was higher, followed by Boro (Tk. 18,182) and Aus paddy (Tk. 3,338). Overall, rice cultivation was profitable at the current year due to the higher yield and market price. The gross profit ratio is 28 for T. Aman, for T. Aus is 23, for Boro is 26.
3	**Drivers Influencing Adoption Decision of Aromatic Rice in Some Selected Areas of Bangladesh: An Econometric Approach** **Objectives:** • To assess the profitability of aromatic rice cultivars; and • To identify the factors influencing the adoption decision of aromatic rice varieties. **Duration:** July, 2021 - June, 2022 **Locations:** Jashore and Naogaon **Status: Completed**	The farmers in Naogaon (Tk. 1,69,917.5/ha) had greater gross returns than the farmers in the Jashore area (Tk. 1,65,099/ha). Similarly, the average net return per hectare is Tk. 43753.75; thus, farmers in the Nagaon district have a larger net return than those in Jashore. While the adoption of aromatic cultivars is severely impacted by occupation-only farming and yield differences.
4	**Understanding Climate Variability, Adaptation and Market Insights of Rice in Haor Ecosystems** **Objective:** • To dig out the perception of farmers about climate change • To figure out farmers' coping and adaptation strategies to climate change • To derive policy implication. **Duration:** July, 2021 - June, 2022 **Locations:** Sunamganj and Netrokona **Status: Completed**	Though the farmers are well aware about the climatic hazards they are facing since very beginning but most often they are not able to figure out the exit plan to avoid or recover the losses. Rice farming is a profitable endeavor in the haor areas if the farmers can escape from early flash flood. Even though they are trying to make some adaptation practices but utmost success is yet to come due to lack of effective technologies and inclusive extension and marketing services.
5	**Adoption Determinants and Profitability of**	The finding of this study revealed that in

	Stress Tolerant Rice in Selected Areas of Bangladesh **Objectives:** • Determine the adoption status of climate-resilient rice varieties in the Boro season; • Comparing profitability between climate-resilient rice varieties and other rice cultivars; and • Identify the factors affecting the adoption decision of climate-resilient rice varieties **Duration:** July, 2021 - June, 2022 **Location:** Satkhira **Status: Completed**	Satkhira district, almost 9.25% area of the dry season was cultivated salinity-tolerant rice cultivars, and the rest of the area cultivated other varieties. Whereas, it was 1.6 percent of Bangladesh's total dry area rice cultivation. Results also revealed that the yield of salinity-tolerant cultivars was lower than the other cultivars. The BCR of salinity-tolerant rice cultivars was 1.12, and 1.18 for other cultivars.
6	**An Economic Investigation of Rice Seed Production Status in A Selected Area of Bangladesh** **Objectives:** • To find out the economics of TLS production of rice of both contract and non-contract growers • To document the constraints of TLS production of rice. **Duration:** July, 2021 - June, 2022 **Status: Completed**	Total cost of contract growers and non-contract growers was Tk 2,05,237and Tk 2,07,054 respectively in Boro season while in Aman season it was Tk 1,94,965 and Tk 1,80,018 respectively. In Boro season, per kg cost of rice seed production was Tk 30.33 for CGs and 29.93 Tk for non-CGs while it was Tk 34.54 for CGs and Tk 32.27 for non-CGs in Aman season.
7	**Spatial Price Dynamics of Rice in Bangladesh: An Evidence from Time-Series Analysis** **Objectives:** • To analyze short-run and long-run spatial price relationships including market integration, price transmission and volatility among 12 major wholesale rice markets in Bangladesh. **Duration:** July, 2021 - June, 2022 **Study Locations:** Secondary data of 12 major wholesale rice markets in Bangladesh **Status: Completed**	Though the studied major domestic wholesale markets across the country are co-integrated in long-run but that does not allow us to consider this system as an efficient one because of the presence of poor price transmission and high volatility in recent periods. Effective government intervention i.e., estimating demand and supply precisely, act with vibrant rules & regulations, effective import and procurement policies, assist in commercialization etc. might play important role in that case.
8	**Resilience of Rice Value Chains in Jashore: Recent Transformation and Vulnerabilities** **Objectives:** • Revisiting rice value chains in the face of recent transformations and disturbances in Jashore region • Scrutinizing the resilience and	The overall findings showed that, value chain operation in general was lengthy and involved more actors. farmers mostly market their products with the help of Bepari and Arardar. Farming operations were managed inefficiently depending on nature. Price of paddy was set in the

	vulnerabilities of the rice value chain actors. **Duration:** July, 2021 - June, 2022 **Study Locations:** Jashore **Status: Completed**	midstream of rice value chains and storing paddy for short time was the only practice to get a good price at farm level. Local rice millers reported an inclusive use of sorting, whitening and polishing rice to acquire the expected grain qualities which had higher market demand. Furthermore, lesser evidence of transformation in rice value chain was found at downstream where a single trading company was controlling wholesale market alone.
9	**Market Concentration of Popular Rice Brands in Bangladesh** **Objectives:** • To identify different types of rice brands available in the market and their concentration. **Duration:** July, 2021 - June, 2022 **Study Locations:** Sylhet, Jamalpur, and Kurigram districts and two city markets (Dhaka and Gazipur) **Status: Completed**	The findings reveal that both Upazila and city markets were highly concentrated and the competition among the traders with rice brands was very low. The popular rice brands in Bangladesh are BR28, Minikit, Zira, Nazir, and BR29. The rice processors are highly concentrated to produce the top 4 brands that captured more than 95% share of the market.
10	**Comparative Advantage of Export Potential Aromatic Rice (BRRI dhan50) Variety in Selected Areas of Bangladesh** **Objectives:** • To examine the prospect of production of export potential aromatic rice (BRRI dhan50) variety in terms of import and export parity basis; • To review of international standard for rice export and way-out the link to export policy; and, • To draw some policy guidelines. **Duration:** July, 2021 - June, 2022 **Study Locations:** Jashore **Status: Completed**	Bangladesh has a comparative advantage for producing export potential aromatic rice (BRRI dhan50) at import substitution. On the other hand, Bangladesh has a comparative advantage in exporting the likely fragrant rice like BRRI dhan50 at export substitution with head rice recovery at 56%. When head rice recovery has 52%, and below, BRRI dhan50 does not have a comparative advantage at export substitution. It means BRRI dhan50 rice production is not sustainable at export parity basis in Bangladesh.
	Farm Management Division	
	Research Progress 2021-2022	
SL. No.	**Research Progress**	**Major Outpur**
	Program Area: Socio-Economics and Policy	
	3.1.Project : Rice production management	

1	Expt. 1. Yield maximization of rice through integrated nutrient management Progress: Grain yield, tiller number, panicle number, plant height and grain number were significantly affected by the different Integrated nutrient management during both T. Aman and Boro season. Every parameter, Poultry manure treatments have been performed the best. This study indicates STB dose with one t ha^{-1} Poultry manure is better for maximization of rice yield. Further research may be needed to find out the suitable integrated fertilizer management to maximize rice yield.	This study indicates STB dose with one t ha^{-1} Poultry manure is better for maximization of rice yield among different nutrient management treatments.
2	Expt. 2. Efficacy of mechanical seedling transplanter and deep placement of mixed fertilizer on rice yield Progress: It may be concluded that no significant differences among the treatmets was found in growth parameters. Significant variations were recorded in case of yield and BRRI recommended practice and mechanical transplanting with 80% urea with other fertilizers were produced very similar grain yield. From these results, it might be said that mechanical transplanting with 80% urea fertilizer is recommended with BRRI recommended hand transplanting practice. Urea saving is additional benefit with low transplanting cost when transplanted with rice transplanter and fertilizer applicator.	From these results, mechanical transplanting with 80% urea fertilizer is recommended with BRRI recommended hand transplanting practice. Urea saving is additional benefit with low transplanting cost when transplanted with rice transplanter and fertilizer applicator.
3	Expt. 2. Effect of Foliar Application of Silicon on Yield of Aromatic Rice Progress: No significant variation was observed in the yield of BRRI dhan50 in different treated plots. Yield ranged from 4.27 t ha^{-1} to 5.30 tha^{-1}. Other growth and yield contributing parameters were also statistically similar among the treatments. Therefore, we can say that silicon application might not have so significant effect on growth and yield of rice in Bangladesh situation.	Silicon application might not have so significant effect on growth and yield of rice in Bangladesh situation. But this might be repeat more times for confirmation.
	3.2. Project: Labor Management System	
1	Expt. 1. Monitoring labor wage rate at different locations of Bangladesh Progress: Laborer's wage rate differs according to	Labourers' wage rate is increasing day by day and farm mechanization is the need of time now-a-day.

	the location of the work ranging 450-500 Tk to 800-850 Tk per day. The highest wage rate of labourers was in May due to harvesting and post-harvest operations of Boro rice and transplanting of Aus rice. Another higher rate was during July-August due to harvesting and post-harvest operations of Aus rice and transplanting of Aman rice. The third higher wage rate was observed during December-January due to the peak period for harvesting and post-harvest operation of T. Aman rice and transplanting of Boro rice.	
	3.3. Project: Rice Seed Production.	
1	Expt. 1. Performance of Boro varieties in seed production plots during 2020-21 Progress: Yield of the varieties ranged from 3.69 tha^{-1} to 7.46 t ha^{-1} and 4.86 t ha^{-1} to 7.72 t ha^{-1} in T. Aman and Boro varieties, respectively. Among T. Aman varieties, BRRI dhan49 (7.46 t ha^{-1}) yielded the highest where as BRRI dhan89 (7.72 t ha^{-1}) yielded the highest among Boro varieties.	BRRI dhan49 and BRRI dhan89 might be better yielder in T. Aman and Boro seasons, respectively.
	3.4. Project: Management and utilization of resources.	
1	Expt. 1. Management and utilization of land, labour and other resources. Progress: Data of T. Aman season has collected and is being under process.	
	Adaptive Research Division	
	Research Progress 2021-2022	
Sl. No.	**Research Progress**	**Expected Output**
	A. TECHNOLOGY VALIDATION	
	1. Title: Advanced Lines Adaptive Research Trial (ALART)	
1.1	**Early T. Aman 2021, ALART Stagnant Water (SW):** Two advanced breeding lines for stagnant water condition (50-100 cm water depth) i.e., BR10230-7-19-B and BR9390-6-2-1B along with BR23 and BRRI dhan91 as checks were tested in ten different locations. The plots were selected at representative growing area where flood water depth was expected to be around 50 to 100 centimeters. Considering the phenotypic and overall performances, ALART monitoring committee was not agree with any of the materials for PVT.	Considering Phenotypic acceptance, disease reaction and farmers' opinion, none of the advanced lines were found suitable for PVT.

	Farmers either didn't show interest about the advanced lines due to their lower yield, higher lodging tendency and severe rat damage. All the tested BR lines were severely attacked by rat whereas the local varieties were rat free.	
1.2	**T. Aman 2021, ALART, Insect Resistant Rice-Brown Plant Hopper (IRR-BPH):** Two advanced lines BR9880-40-1-3-34 and BR9880-27-4-1-18, along with the check varieties BRRI dhan87 and BRRI dhan93 were tested at farmers' field in ten locations. Among all the entries, check variety BRRI dhan93 produced significantly highest grain yield (4.69 t ha-1) followed by the advanced line BR9880-40-1-3-34 (4.38 t ha-1) and BR9880-27-4-1-18 (3.83 t ha-1) (Table 2). Farmers didn't prefer the advanced line BR9880-40-1-3-34 and BR9880-27-4-1-18 compared to BRRI dhan93 (ck.).	Considering all the necessary characteristics and farmers' opinion, no advanced line was found suitable for PVT.
1.3	**T. Aman 2021, ALART, Salt tolerant rice (STR):** Three salt tolerant advanced lines: IR108158-B-2-AJY1-1, IR15T1464 and TP30649 along with BRRI dhan73 (Tol. ck.) and BRRI dhan87 (Sus. ck.) were evaluated in ten locations. Across the locations, water salinity records were taken in different dates. But no significant salinity was observed in the selected locations during Aman season. Among the genotypes, the highest mean grain yield (5.49 t ha-1) was obtained in BRRI dhan87 (Sus. ck.) followed by TP30649 (5.33 tha-1), IR15T1464 (5.23 t ha-1), IR108158-B-2-AJY1-1 (5.15 t ha-1) and BRRI dhan73 (Tol. ck.) (5.01 t ha-1). The mean growth duration of Tolerance check variety BRRI dhan73 was almost similar to the tested genotypes ranged from 120 to 125 days.	Considering overall performance, none of the lines was found suitable for proposed variety trial (PVT).
1.4	**T. Aman 2021, ALART for submergence tolerance rice; Short duration (SubTR-SD):** One advanced line: IR16F1148 with BRRI dhan71 (Sus.ck.) and Binadhan-11 (Tol. ck.) as checks were tested at farmers' field in 10 locations. Across the locations, water level records were taken in different dates except Rangpur (RS RF) and Gazipur (WB) because those locations were not located in submergence prone areas. In Rangpur (Kaunia) the plot was completely damaged due to longer submerged condition for 25 days. Irrespective of genotypes and locations, the advanced line (IR16F1148) gave higher mean yields (4.98 t ha-1)	Considering all traits, the advanced line IR16F1148 was recommended for PVT.

	than the two check varieties BRRI dhan71 (4.02 t ha-1) and Binadhan-11 (4.06 t ha-1) (Table 4). Farmer also preferred advanced line (IR16F1148) compared to both of the check varieties.	
1.5	**T. Aman 2021, ALART for submergence tolerance rice; Long duration (SubTR-LD):** Two advanced lines: BR9158-19-9-6-50-2-HR1 and IR13F441along with BRRI dhan44 (Sus. ck.) and BRRI dhan52 (Tol. ck.) as checks were tested at farmers' field in 10 locations. Irrespective of genotypes and locations, both the advanced lines (BR9158-19-9-6-50-2-HR1 and IR13F441) gave similar higher yields (5.00 t ha^{-1}) than the two check varieties BRRI dhan44 (4.16 t ha^{-1}) and BRRI dhan52 (4.72 t ha^{-1}). Farmers did not prefer both of the tested entry compared to the check varieties.	Based on overall performances and farmers' preference, none of the genotypes was found suitable for proposed variety trial (PVT).
1.6	**T. Aman 2021, ALART, Zinc enriched rice (ZER):** One zinc enriched advanced rice genotype BR9674-1-1-5-2-P4 along with BRRI dhan49, BRRI dhan72 and BRRI dhan87 as checks were tested at farmers' field in ten locations. Among all the entries including checks, the only advanced line gave the lowest yield (5.02 t ha^{-1}). In this trial, check variety BRRI dhan49 produced higher grain yield than the genotype (BR9674-1-1-5-2-P4) and other check variety BRRI dhan72 and BRRI dhan87. Farmers didn't prefer BR9674-1-1-5-2-P4 entry compared to check varieties.	Based on results, evaluation committee report and farmers perspective, BR9674-1-1-5-2-P4 entry was not recommended for PVT.
1.7	**Boro 2022, ALART, Premium Quality Rice (PQR):** Two premium quality advanced lines: BR9930-2-3-2-2 and BR9930-2-3-3-1 along with three check varieties BRRI dhan50, BRRI dhan63 and BRRI dhan81 were evaluated in ten locations. Both the advanced lines and the check variety BRRI dhan63 almost gave similar mean yield. Farmers did not prefer the advanced lines compared to the check varieties.	Considering all the necessary attributes, none of the lines was recommended for PVT.
1.8	**Boro 2022, ALART, Salt tolerant rice (STR-1):** Three salt tolerant advanced lines: BR11715-4R-186, BR11723-4R-27 and BR11723-4R-12 along with BRRI dhan67 (Tol. ck.) and BRRI dhan92 (Sus. ck.) were evaluated in ten locations. No yield advantages of the advanced lines were observed compared to check variety BRRI	Considering all the characteristics, none of the lines was found suitable for proposed variety trial (PVT).

	dhan92. Regarding other phenotypic and yield components parameter, there were no significant advantages observed in lines compared to check varieties.	
1.9	**Boro 2022, ALART, Salt tolerant rice (STR-2):** Three salt tolerant advanced lines: BR11712-4R-227, BR11716-4R-105 and BR11716-4R-102 along with BRRI dhan67 (Tol. ck) and BRRI dhan92 (Sus. ck.) were evaluated in ten locations. Among the genotypes highest mean grain yield was obtained in BRRI dhan92 (Sus. ck.) followed by BRRI dhan67 (Tol. ck), BR11712-4R-227(5.91 t ha^{-1}), BR11716-4R-105 (5.65 t ha^{-1}) and BR11716-4R-102 (5.58 t $ha^{-1.}$ Regarding other phenotypic and yield components parameter, there were no significant advantages observed in lines compared to check varieties.	Considering all the characteristics, none of the tested lines found suitable for PVT.
1.10	**Boro 2022, ALART, Cold Tolerant Rice (CTR):** Three cold tolerant advanced lines IR100722-B-B-B-B-11, IR100723-B-B-B-B-61 and TP16199 along with BRRI dhan28 and BRRI dhan67 as checks were evaluated in ten locations. In this trial, the genotype (IR100722-B-B-B-B-11) produced slightly higher grain yield than the other genotypes (IR100723-B-B-B-B-61, TP16199) and check variety BRRI dhan67. But the mean growth duration of the advanced lines was 7-10 days higher than the check varieties which may not be suitable for Haor areas. The tested genotypes were not attractive to the farmers due to its poor phenotypic acceptance, higher pest and disease infestation and highly lodging susceptibility.	Based on ALART monitoring team report and farmer's perspective, none of the entries was recommended for PVT.
1.11	**Boro 2022, Favorable Boro Rice-Barishal (FBR-Barishal):** Four advanced lines developed by BRRI regional station Barishal: BRBa 1-4-9, BRBa 2-5-3, BRBa 3-1-7 and BRBa 3-2-4 were evaluated against two check varieties BRRI dhan58 and BRRI dhan89 in twelve different locations of the country. Farmers were not so much impressed about the tested entries compared to check varieties BRRI dhan58 and BRRI dhan89. However, the lines performed better in some locations which showed high potentiality of those lines. Moreover, several storm/cyclones occur during the maturity phase	Considering yield, growth duration and insect disease reactions, the tested lines were suggested for conduct re-ALART in next Boro season.

	which might have impact on yield.	
1.12	**Boro 2022, ALART, Blast Resistant Rice (BRR):** Four advanced lines, BR(Path)12452-BC3-42-22-11-4, BR(Path)12452-BC6-53-21-11, BR(Path)13784-BC3-61-1-6-HR3 and BR(Path)13784-BC3-63-6-4-HR6 were tested along with the check varieties BRRI dhan28 and BRRI dhan88 in 11 different locations such as Faridpur, Barishal, Rajshahi, Rangpur, Dinajpur, Sirajganj, Cumilla, Kushtia, Habiganj, Satkhira and Gazipur. Overall, none of the advanced line was preferred by farmers and extension personnel due to poor yield over check variety BRRI dhan88. All the tested materials showed some degrees of lodging tendency and blast disease was also reported in some locations by ALART monitoring team.	Since most of the tested sites were almost BLAST disease free, these ALART was recommended for Re-ALART.
1.13	**Boro 2022, ALART Superior High Yielding Rice (SHR):** Three advanced lines i.e., BRHII-9-11-4-5B, BRH13-2-4-6-4B and BRH13-7-9-3-2B, developed by Plant Breeding Division were evaluated against the check varieties BRRI dhan63 and Zirashail in 12 different locations of the country. Farmers and extension personnel showed their interest for entry no. 1 and 2 for their good morphological appearance, higher yield, fine grain shape and also medium growth duration compared to check varieties BRRI dhan63 and Zirashail.	Considering all the necessary attributes, any one of the advanced lines BRHII-9-11-4-5B or BRH13-2-4-6-4B may be recommended for proposed variety Trial (PVT).
1.14	**Head to Head Adaptive Trial (HHAT) during T. Aman 2021 under TRB:** A total of 200 Head to Head Adaptive Trials (HHAT) were conducted in Aman (wet season) 2021 throughout the country under TRB project. BRRI released varieties BRRI dhan51, BRRI dhan52, BRRI dhan71, BRRI dhan73, BRRI dhan75, BRRI dhan79, BRRI dhan80 and BRRI dhan87 as well as BINA released varieties like Binadhan-17, Binadhan-21 and Binadhan-23 were used in the HHATs	BRRI dhan87, performed excellent in the Rainfed lowland environment in all over the country during T. Aman 2021 BRRI dhan87 performed better in LD, BRRI dhan75 SD, Binadhan-23 and BRRI dhan73 in Coastal Ecosystem (CE) areas, BRRI dhan52 and an advanced line IR13F441 in Flash flood (FF) areas.
1.15	**Head to Head Adaptive Trials (HHAT) during Boro 2021-22 under TRB:** A total of 200 Head to Head Adaptive Trials (HHAT) with five categories according to rice eco-system were conducted in throughout the country during Boro 2021-22 under TRB project through public and private partnership (PPP). The trials were categorized in five different	BRRI dhan92 was found as best yield performer among all tested varieties during Boro 2021-22. Most of the farmers liked for its competitive yield. However, BRRI dhan74 performed better in SD, BRRI dhan92 in LD, BRRI dhan99 in SE, BRRI dhan96 in

	groups, SD, LD, SE, Haor, Hilly area. considering the agro-ecology and used rice variety. **Varieties**: BRRI dhan28, 29, 58, 67, 74, 81, 84, 88, 89 & 92, 96, binadhan-24 & Bangabandhu dhan100		Haor areas and Bangabandhu dhan100 in Hilly areas.			
	B. Technology Dissemination					
	2. Title: Seed Production and Dissemination Program (SPDP) of BRRI varieties with other technologies under GOB and Project (TRB**).**					
	Research Progress		**Expected Output/Output**			
	Expt. Title: Seed Production and Dissemination Program (SPDP)	**Locations and varieties/technologies**	**Total production through demo (ton)**	**Seeds retained by farmers (ton)**	**Farmers gained awareness through demo (no.)**	**Motivated Farmer (no.)**
2.1	Seed Production and Dissemination Program (SPDP) during B. Aus, 2021 under GoB	Locations: 6 upazilas (Bhola Sadar, Tazumuddin, Doulatkhan, Borhanuddin, Char Fasson and Monpura) of Bhola districts Varieties: BRRI dhan43 and BRRI dhan83	5.052	0.8	620	235
2.2	Seed Production and Dissemination Program (SPDP) during T. Aus, 2021 under GoB	Locations: 87 demo. Conducted in 25 upazilas of 12 districts Varieties: BRRI dhan48, BRRI dhan82 and BRRI dhan98	31.768	7.013	3320	1411
2.3	Dissemination of BRRI Hybrid dhan7 during T. Aus, 2021 under GoB	Locations: 14 upazilas of 5 districts (Chuadanga, Bhola, Borguna, Manikganj, Gaibandha) Varieties: Hybrid dhan7	21.854	-	1075	410

2.4	Special program of BRRI dhan98 during T. Aus, 2021	Locations: Three special-SPDPs were conducted in Sylhet (S. Surma), Manikganj (Harirampur) and Gaibandha (Palashbari)	5.870	1.030	460	125
2.5	SPDP in Jhum cultivation during Aus 2021	Locations: three upazilas of three districts of hill tracts Varieties: BRRI dhan48, BRRI dhan82 and BRRI hybrid dhan7	4.129	.22	385	70
2.6	SPDP in valley of hills during T. Aus 2021	Locations: three upazilas of three districts of hill tracts Varieties: BRRI dhan48, BRRI dhan82 and BRRI hybrid dhan7	6.21	0.290	480	125
2.7	Seed Production and Dissemination Program during T. Aman, 2021 under GoB	Locations: 270 demo in 68 upazilas of 26 districts Varieties: BRRI dhan78, 79, 80, 87, 93, 94, 95	13.6780	19.720	11229	3793
2.8	SPDPs of BRRI dhan71 and BRRI dhan75 in T. Aman-Potato-Boro cropping pattern during T. Aman 2021	Locations: 8 upazilas of 4 districts (Nilphamari, Thakurgaon, Joypurhat and Bagura) Varieties: BRRI dhan71 and BRRI dhan75	10.86	1.430	372	206
2.9	Dissemination of BRRI hybrid dhan4 and BRRI hybrid dhan6 in different locations during T. Aman 2021	Locations: 17 upazilas of 9 districts Varieties: BRRI hybrid dhan4 and BRRI hybrid dhan6	28.584	-	2463	687
2.10	SPDP of BRRI	Locations: 6 upazilas of	8.253	0.912	784	211

	dhan80 and BRRI dhan87 in hill tracts during T. Aman 2021	3 districts in hill tracts (Khagrachari, Rangamati and Bandarban) Varieties: BRRI dhan80 and BRRI dhan87				
2.11	Special SPDP (Muzibborsho) in T. Aman, 2021	Locations: 84 Special SPDPs were conducted in 14 upazials of 11districts Varieties: BRRI dhan75, BRRI dhan76, BRRI dhan79, BRRI dhan87, BRRI dhan90, BRRI dhan93 and BRRI dhan95	35.452	1.680	1876	464
2.12	Performance of BRRI dhan91 in different locations during Early T. Aman 2021	Locations: 39 SPDPs were conducted in low land areas of Manikganj, Narayanganj, Munsigang, Pabna and B.Baria districts Varieties: BRRI dhan91	8.525	1.07	590	150
2.13	Seed Production and dissemination Program (SPDP) during T. Aman, 2021 under TRB	Locations : 60 SPDPs were conducted in 16 upazila of 13 districts Varieties: BRRI dhan71, BRRI dhan73, BRRI dhan75, BRRI dhan80 and BRRI dhan87	44.244	5.465	3330	576
2.14	Seed production and dissemination program (SPDP) during Boro 2022 under GoB	Locations: 703 demonstrations were established in 27 upazilas of 13 districts Varieties: Eleven modern rice varieties (BRRI dhan50, BRRI dhan67, BRRI dhan74, BRRI dhan84, BRRI dhan88, BRRI dhan89, BRRI dhan92, BRRI dhan96, BRRI dhan99	216.747	21.606	11053	6120

		and Bangabandhu dhan100				
2.15	SPDP during Boro 2022 under TRB	Locations: 66 SPDPs were conducted in 16 upazila. Varieties: BRRI dhan74, BRRI dhan67, BRRI dhan81, BRRI dhan88, BRRI dhan89, BRRI dhan92, BRRI dhan96, BRRI dhan99 and Bangabandhu dhan100	49.914	3.7	3096	731
2.16	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 **7.730**-ton quality seeds of different BRRI varieties were produced at BRRI farm during the reporting period for conducting adaptive research trials. Total 5.230-ton quality seeds of 10 varieties were produced during T. Aman, 2021 whereas 2.500-ton TLS of 11 BRRI developed rice varieties were produced during Boro 2022 season. These seeds were used in different adaptive research trials and SPDPs for rapid dissemination of the varieties			

	C. Promotional activities **Farmers' training and field Day**	
Sl. No.	**Farmers' training and promotional activities**	**Expected Output/Output**
3.1	**Farmers training during 2021-22 under GoB and TRB** During the reporting period ARD conducted 113 farmer's training at different locations of the country.	A total of 3390 trainees including farmers and SAAOs of DAE participated
3.2	**Field Day/ Farmer's Rally under GoB, TRB** ARD conducted 81field days at different locations of the country under GoB and different projects (SPIRA, TRB) during Aus 2021, Aman 2021 and Boro 2022.	About 6600 participants including farmers, local leaders and DAE personnel were participated in the field days.
3.3	**Seed support to stakeholders under TRB project.**	A total of 1.50 tons of seeds were distributed among different stakeholders such as farmers, NGO workers and BRRI employees with free of cost under TRB project through Seed support program during T Aman, 2021
3.4	**Establishment of Farmers seed center (FC) under TRB project** Eight farmers' seed centers were established at Gaibandha Sadar and Palashbari.	48 plastic drums were supplied by project cost in each center. Around 80 kg seeds were preserved in each drum, as a result a total of 3800kg seeds were preserved

		properly by the farmers themselves
	Training Division	
	Research Progress 2021-22	
Sl. No.	**Research Progress**	**Expected output**
	Program Area: Technology transfer	
	1.Capacity Building and Technology Transfer	
	1.1. Training on modern rice production technlologies Duration: 2-month Batch: 1 No. of Participants: 34 Progress: Completed	Knowledge of the scientists on morern rice production technologies will be increased.
	1.2. Training on Scientific Report Writing Duration: 5 days Batch: 5 No. of Participants:78 Progress: Completed	Knowledge of the scientistson scientific report writing will be increased.
	1.3.Training on modern rice production technologies (Regular). Duration: 1 day Batch: 15 No. of Participants:3981 Progress: Completed	Knowledge of the Sub Assistant Agriculture Officer on modern rice production will be enriched.
	1.4.Training on Laboratory Accreditation for BRRI Scientists Duration: 7 to 10 days Batch: 5 No. of Participants: 59 Progress: Completed	Knowledge and skill of the trained personnel on the subject matters will be increased..
	1.5.Hands on training for using high throughput phenotypic system for C4 Rice Research Duration: 2 days Batch: 5 No. of Participants: 74 Progress: Completed	Knowledge and skills of the participants enriched.
	1.6. Training on Integrated Rice Disease	Knowledge about Integrated Rice Disease

	Management Duration: 1 day Batch: 2 No. of Participants: 51 Progress: Completed	Management of the trainees will be increased.
	1.7. Training on Transforming rice Breeding Duration: One week Batch:4 No. of participants: 79 Progress: Completed	Knowledgeof the BRRI SA/SSA about Transforming Rice Breeding will be enriched.
	Regional Station, Cumilla	
	Research Progress 2021-2022	
Sl. No.	**Research Progress**	**Major Output**
	Program area (01): Varietal Development Program (VDP)	
	Project 01: Development of new varieties and improved genotypes with high yield potential along with photoperiod sensitivity, acceptable grain quality and resistance to diseases and insect pests.	
	T. Aman 2021 and Boro 2021-22	
1.1	**Hybridization:** In T. Aman season, 25 crosses were made and in Boro season 31 crosses were made.	
1.2	**F_1 Confirmation** : In T. Aman 14 crosses and in Boro season 16 crosses were confirmed and registered in BRRI Cumilla.	High yielding new breeding lines will be done.
1.3	**Growing of F_2 population**: About 231 progenies in T. Aman and 13000 in Boro season were selected.	High yielding new breeding lines will be done
1.4	**Pedigree and FRGA Nursery (F_3, F_4, F_5 and F_6 generations):** In T. Aman season, 596, 120 and 100 plants were selected from F_3, F_4 and F_5 generation, respectively and 13 breeding lines were bulked from F_5 and F_6 generations. In Boro season, 2000, 14000, 25000 progenies were advanced in F_3, F_4 and F_5 and 44 lines were bulked from F_6.	High yielding new breeding lines will be done.
1.5	**Observational Yield trial (OYT):** In Boro season, 11 entries performed better than check varieties in OYT (Cum) based on high yield performance, disease reaction and other good agronomic characters.	High yielding with short duration new breeding lines will be developed.
1.6	**Preliminary Yield Trial (PYT):**	High yielding with desirable

	In Boro season, five and three entries were selected from PYT#1 (Cum) and PYT#2 (Cum) respectively.	characteristics new breeding lines will be developed.
1.7	**Secondary Yield Trial (SYT):** Three (3), 3 genotypes were selected from SYT#1 (Cum), SYT#2 (Cum) during Boro season.	High yielding with desirable characteristics new breeding lines will be developed.
1.8	**Advanced Yield Trial (AYT):** In T. Aman season no entry was selected from AYT-Cum (WS) and two entries were selected from AYT#1 (Cum) during Boro season.	High yielding with desirable characteristics new breeding lines will be developed.
1.9	**Regional Yield Trial (RYT) from HQ and RS:** In T. Aman season, 3, 2, 3, 5 entries were performed better than check varieties in RYT (RLR), RYT (ZER), RYT#1 (STR) and RYT#2 (STR). In Boro season, 2, 5,1, 4, 5, 3, 2, 2, 2, 2, 2, 1 entries performed better than check varieties in RYT_FBR_LD, RYT_FBR_MD, RYT_FBR_SD, RYT_AGGRiNET, RYT_Barishal, RYT (IRR_BPH), RYT#1 (STR), RYT#2 (STR), RYT#1 (SS), RYT#3 (LS), RYT(PQR), RYT(Biotech) and no entries performed better than check varieties in RYT (ZER). In Boro season, 4,6,4,5 entries showed better performance than standard check varieties in RYT#1 (DRR_BB), RYT#2 (DRR_BB), RYT#3 (DRR_Blast_on station), RYT#3 (DRR_Blast on Debidwar).	High yielding with desirable characteristics new breeding lines will be developed.
1.10	**Multi Location Yield Trial (MLT):** In T. Aman season, two (2) and 1 entries performed better and gave yield more than check varieties in MLT (DRR)-On station and MLT (DRR)-Debidwar, respectively.	High yielding with desirable characteristics new breeding lines will be developed.
	Program area (02): Pest Management	
2.1	**Survey and monitoring of rice diseases in selected areas of Cumilla during 2021-22:** During T. Aman 2021, neck blast disease was found predominant in the aromatic rice varieties of BRRI dhan34 27% DI, DS 9 and in kalijira 1% DI, DS 7. Rice tungro disease was found in BR22, BR23, BRRI dhan49, BRRI dhan71, BRRI dhan87, Binadhan-17, Hybrid Balia2, Hybrid oryzae, Hybrid Sonar Bangla varieties with % DI ranged from 10-72 and DS 5-7. The disease incidence of sheath blight, bacterial blight, false smut and brown spot were 20-90 (DS 3-9), 10-55 (DS 3-5), 1-11 (DS 1-3) and 27-43 (DS 1-2), respectively. During Boro2021-22 season, incidence of major rice diseases neck blast, sheath blight and bacterial blight diseases	Disease forecast model will be developed.

	were recorded ranged from 1-90 % (DS 5-9), 5-70 % (DS 3-5), 5-80 % (DS 3-9) in BRRI released and hybrid varieties respectively.	
2.2	**Validation of rice neck blast disease management technology under farmer's field condition:** Neck blast disease was obtained severe 95 % disease incidence (DI) in BRRI dhan34 at farmers practice compared to BRRI practice (2 % DI) at BRRI farm, Cumilla during T. Aman 2021 season. In the farmer's field condition % DI was obtained 70-90 with DS 9. Rice yield loss was saved 69-88 % by managing neck blast disease following BRRI developed blast disease management technology in all the areas. During Boro 2021-22 season, neck blast disease was obtained severe 5-80 % disease incidence (DI) in BRRI dhan81 at farmers practice compared to BRRI practice (1-5 % DI). Neck blast disease reduction was obtained 80-100 % by BRRI Practice.	Farmers awareness about the Blast disease management technology will be increased.
2.3	**Varietal reaction and recovering ability of BRRI released rice varieties:** Tungro disease was not observed naturally in BRRI farm Cumilla during Aus, T. Aman and Boro 2021-22 seasons.	Tungro recovering ability rice variety will be identified.
2.4	**Factors affecting rice tungro disease and its management in Cumilla region:** The main factors for tungro devastation in Cumilla region were revealed by weather data analysis and the field data. The factors are: 1. Presence of abundant GLH in the seedbed**,** 2. Intensive rice cultivation (Rice-Rice-Rice), 3. Low Rainfall, 4. High temperature 35 ^{o}C to 38 ^{o}C, 5. Susceptible rice cultivars including Indian varieties, 6. Percent Relative humidity and 7. Presence of source plants around the year. **Aus 2021:** The vector of tungro disease of rice GLH was controlled by chemical spray as BRRI recommendation and by hand sweeping along with light trap at 5 days' intervals in Debidwar and Nangalkot, Cumilla. Tungro disease was observed in some of the control plots where tungro vector management was not done. Tungro disease devastation was found in BRRI dhan48, hybrid Hera-2 Hybrid Balia-1 in Debidwar and Nangalkot, Cumilla during Aus 2021 season and about 15-70 % yield was reduced due to tungro devastation with	Tungro disease management technology will be developed.

	15-80 % DI and 5-9 DS. **T. Aman 2021:** The vector of tungro disease of rice GLH was controlled by chemical spray and by hand sweeping along with light trap at 5 days' intervals in Debidwar and Nangalkot, Cumilla during T. Aman 2021 season. Tungro disease symptom was observed in BR11, BR22, BRRI dhan49, BRRI dhan87 with 5-70% DI and 5-7 DS and approximately, 5-60 % yield was reduced due to tungro disease in Debidwar and Nangalkot, Cumilla during T. Aman 2021 season**.** **Boro 2021-22:** Due to fund crisis the experiment was not done.	
2.5	**Tracking the infection source(s) of rice false smut disease, T. Aman 2021:** False smut disease was not found in all the treatments. Therefore, the experiment is needed to repeat in the next T. Aman 2022 season. The false smut infected seeds along with healthy seeds of BRRI dhan49 have already collected from the BRRI farm for the next T. Aman 2022 season experiment.	Mode of infection of false smut disease will be determined.
2.6	**Effectiveness of formulated biopesticides and nano particles to control bakanae disease of rice in field condition:** Bakanae disease incidence was observed low in Tricho-compost (Basal 2 t/ha), Bacteria and Tricho-compost (Basal 2 t/ha) +Bacteria (spray). No significant differences were found among the treatments of yield parameters.	Biopesticides for Bakanae disease will be developed.
2.7	**Evaluation of new chemicals against rice blast disease during T. Aman and Boro 2021-22 seasons:** Among the 20 new fungicides, 9 (T. Aman), 7 (Boro) fungicides showed 80% more disease reduction during T. Aman 2021 and Boro 2021-22 seasons.	New fungicides will be registered for controlling blast disease of rice.
2.8	**Evaluation of new chemicals against sheath blight disease of rice during T. Aman and Boro 2021-22 seasons:** Test chemicals reduced sheath blight ranging from 44 to 94 % at Cumilla. Nine chemicals along with standard check reduced disease over 80 %. Highest reduction was obtained in Assurebin 32.5 SC (94 %) treated plot followed by Ace Gold 28SC (89 %), Marievo 75WDG (84%), Dinazole 32.5 SC (85%), Padmaster Top32.5 SC (83%), Cizophen 32.5 SC	New fungicides will be registered for controlling sheath blight disease of rice.

	(83 %), Tika Top 32.5 SC (84%), Focus 28 SC (83 %), Caramin 32.5 SC (82), Caramin 32.5 SC (81%).	
2.9	**Screening of tungro resistant advanced lines in tungro hot-spot area in Cumilla during T. Aman 2021:** Among 150 tungro resistance advanced lines, 50 lines which were showed good phenotypic performance were selected for seed multiplication	Tungro disease resistant rice variety will be released.
2.10	**Screening of tungro resistant VERDE lines in field condition, T. Aman 2021, Kabilpur, Debidwar, Cumilla:** Out of 50 lines only **3** lines IR 144468-1-3-1 (%DI 10, DS 7), IR 144468-1-3-2 (%DI 3, DS 7) and IR 144469-1-1-2 (%DI 7, DS 7) were infected by tungro disease. Yield was very low because lines are heavily damaged by insect's infestation and sheath blight infection. Insecticides and fungicides were not used.	Tungro disease resistant rice variety will be released.
2.11	**Multi-Location Trial (MLT) of Blast and BB resistant advanced lines in Debidwar, Cumilla during Boro 2021-22 season:** Five lines BR (Path) 13800-BC3-118-37, BR (Path) 13800-BC3-124-133, BR (Path) 13800-BC3-134-252, BR (Path) 13800-BC3-125-143, BR (Path) 13800-BC3-224-12 showed resistant against Blast and BB and yield ranged 7.64 to 8.93 t/ha.	Blast and BB disease resistant rice variety will be released.
2.12	**Multi-Location Trial (MLT) of Blast resistant materials in hot-spot area in Cumilla during Boro 2021-22:** Blast resistant lines HAH 210, HCP 245, HGB 21 and HGP 197 showed resistant against blast disease of rice.	Blast disease resistant rice variety will be released.
	Program area (02): Crop-Soil-Water Management	
3.1	**Effect of planting time on growth and grain yield of newly released BRRI varieties:** **T. Aman 2021:** All varieties produced higher yield in planting time of 05 August. After 20 Aug, the yield of all tested varieties decreased sharply. Among all the varieties, BRRI dhan87 produced higher grain yield (5.43 t ha^{-1}) upto 05 august planting. Because of photosensitive nature growth duration of BR22 became longer in case of early transplanting. The growth duration of tested varieties exhibited decreasing trend with the advancement of planting dates. Howerver, all the	Suitable sowing/ planting time of newly released rice variety will be determined.

	varieties except BRRI dhan90 displayed higher yield (t/ha) than BR22. **Boro 2021-22:** BRRI dhan89, BRRI dhan92 and BRRI dhan29 produced higher grain yield within 156-159 days in first two planting time. BRRI dhan88, BRRI dhan96 and BRRI dhan28 showed expected higher yield with varying range of planting time. It was observed that the best Planting time for long varieties (>140 days) was last week of December to first week of January.	
3.2	**Effect of Potassium Fertilizer Management at Different Growth Stages of BRRI dhan87:** During T. Aman 2021, effect of additional application of potassium @20 $kgha^{-1}$ in three different growth stages with varying combination, on plant height (cm), panicle per m^2, grains $panicle^{-1}$, thousand grain weight, grain yield (tha^{-1}), straw yield (tha^{-1}) and harvest index shown in Table 57. An increased application of potassium from 0 to 102 kg ha^{-1} increased the number of panicle m^{-2} and increased grain yield over the untreated control. Though the highest number of grains $panicle^{-1}$ was observed in split application of potassium in 15, 30and 50 DAT (T8), grain yield was also significantly highest (5.58 tha^{-1}) in this treatment. Potassium application significantly increased the number of filled grains $panicle^{-1}$, panicle m^{-2}, 1000-grain weight, grain yield and harvest index. Four split application of potassium showed superiority over split application of 1, 2 and 3 splits.	Suitable potassium fertilization time will be determined.
3.3	**Long-term missing element trial for diagnosing the limiting nutrient in soil:** **T. Aman 2021:** BRRI dhan87, BRRI dhan93 and BRRI dhan94 produced 5.39, 5.00 and 5.22 t/ha grain yield, respectively with NPKZnS fertilizers. However, yield differences of P missing plots were found significant among the tested three varieties viz. BRRI dhan87, BRRI dhan93 and BRRI dhan94. On the other hand, omission of N from complete treatment had a significant effect on grain and straw yield of tested varieties indicating that a soil test based dose of fertilizer is enough for these varieties. **Boro 2021-22:** In Boro 2020-21, BRRI dhan88 produced the highest grain yield (6.35 t/ha) with NPKZnS fertilizers and the lowest grain yield (3.82	Limiting nutrient factor on rice yield in rainfed and irrigated ecosystem will be determined.

	t/ha) with all missing element fertilizers. On the other hand, omission of N from complete treatment had a significant effect on grain yield (4.54 t/ha) and straw yield (5.57 t/ha) among the treatments indicating that a maintenance dose of fertilizer was enough for this variety.	
3.4	**Effects of P rates on the yield of BRRI released new variety in BRRI Farm Cumilla:** In T. Aman season, 20 kg/ha rate of P produced highest grain yield (6.01 t ha^{-1}) and 30 kg/ha rate of P produced highest grain yield (6.01 t ha^{-1}) during boro 2021-22 season. Grain yield was increased with the increasing rate of phosphorus up to a level and then produced the statistically similar grain yield.	Optimum P rate with maximum rice yield will be determined.
	Program Area (04): Socio-Economics and Policy	
4.1	**Stability Analysis of BRRI developed rice varieties:** In Aus, BRRI hybrid dhan7 (4.29 t/ha) gave highest yield followed by BRRI dhan85 (3.60 t/ha). In T. Aman, BRRI dhan87 (5.68 t/ha) gave highest yield followed by BRRI hybrid dhan6 (5.67 t/ha) and BRRI dhan52 (5.63 t/ha). In Boro, BRRI hybrid dhan3 gave highest yield (8.96 t/ha) followed by BRRI hybrid dhan2 (8.20 t/ha) and BRRI dhan92 (8.12 t/ha).	Adaptation model of BRRI released rice varieties will be developed.
	Program Area (05): Technology Transfer	
5.1	**Head to Head (HTH) Trial at different farmers' field, 2021-2022:** During T. Aman 2021 season, BRRI dhan71 performed better (average 5.09 t/ha) yield compared to other rice in HTH (SD) trial and BRRI dhan93 performed better (average 6.47 t/ha) yield compared to other rice varieties in HTH (LD) trial. During Boro 2021-22 season, BRRI dhan74 performed better (average 7.58 t/ha) yield compared to other rice varieties in HTH (SD) trial and BRRI dhan89 performed better (average 8.15 t/ha) yield compared to other rice varieties in HTH (LD) trial.	New high yielding rice varieties will be disseminated quickly and directly to the farmers.
5.2	**Field demonstration of BRRI rice varieties by BBRI Cumilla:** A total of 586 (T. Aus 45, T Aman 141 and Boro 400) field demonstrations (above 1 bigha each) of newly released BRRI varieties were conducted in Cumilla, Chadpur Brahmanbaria districts during T. Aus, T Aman and Boro 2021-22 seasons. Among	New high yielding rice varieties will be disseminated quickly and directly to the farmers.

	them **302** trials in Cumilla district, **110** trials in Chadpur district and **174** trials in Brahmanbaria district were conducted. The average yield of BRRI dhan85 and BRRI dhan98 were 4.36 and 4.45 t/ha respectively. The average yield of BRRI dhan75 and BRRI dhan87 were 4.45 and 4.63 t/ha respectively. Farmer's acceptance of BRRI dhan87 was found very high in those respective areas for its grain size panicle length and high yield. All the new rice varieties Including Bangabandhu dhan100 performed better during Boro 2021-2022 season.	
5.3	**Farmer's training, Field day and Fair:** Twenty-five farmers' trainings were conducted in different locations of Cumilla region. A total of 681 farmers and 69 Sub Assistant Agricultural Officers were trained up (Table 73). Two field days were conducted in the block demonstration areas at Cumilla region. About 300 farmers as well as extension personnel's were attended in the field days. Most of the farmers got interested to cultivate new rice varieties in their areas specially BRRI dhan87, BRRI dhan88, BRRI dhan89, BRRI dhan92 and BRRI dhan96. BRRI Cumilla also participated in development fair.	Farmers knowledge on modern rice cultivation and technologies will be enriched.
5.4	**Breeder and TLS seed production:** In T. Aman 2021 and Boro 2021-22 season 43,950 kg (43.95 ton) breeder seeds of different varieties were produced and sent to GRS division, BRRI Gazipur. During Aus 2021 season, 2.445 ton TLS seed (BRRI dhan82, 85, 98) and T. Aman 2021 season, 3.58 ton Breeder seed (BRRI dhan49, 93, 94, 95) and 7.812 tons TLS seeds (BR22, BRRI dhan48, 34, 49, 87, 91, 93, 94, 95, Bangabandhu dhan100) were produced. During Boro 2021-22, 40.35-ton Breeder seed (BR23, BRRI dhan28, 29, 58, 74, 88, 89, 92, 96, Bangabandhu dhan100) 7.23 ton TLS seeds (BRRI dhan28, 29, 58, 74, 81, 84, 86, 88, 89, 92, 96, Bangabandhu dhan100) were produced in BRRI Cumilla farm and 30.00 ton TLS seeds (BRRI dhan88, 96, 89, 92 and Bangabandhu dhan100) were purchased from Farmers funded by MoA and sent to BADC (SP), Cumilla.	Quality seed demand of the seed companies, dealers and farmers will be fulfilled.
	Regional Station, Habiganj	
	Research progress 2021-22	
Sl. No.	**Research progress**	**Expected output**

	Program area: Varietal Development	
	Project I: : Improvement of B Aman rice	
1	Advanced Yield Trial (AYT), B Aman	Three deep water rice genotypes BR7735-1-1-2B (1.32 t/ha), BR7733-2-1-2B (1.38 t/ha) and BR7737-1-2-2B (1.41 t/ha) produced the higher grain yield than the checks Hbj.A-IV and Hbj.A-I
2	Regional Yield Trial (RYT), B. Aman	One genotype BR7730-1-1-2B produced the highest grain yield at Habiganj (1.36 t/ha) and Cumilla (1.59 t/ha). The breeding line BR7919-1-1-3B gave the highest grain yield (1.93 t/ha) at Bhanga. In Gazipur, the standard check BRRI dhan91 produced the highest grain yield. Over the locations, one advanced breeding line BR7730-1-1-2B produced the similar grain yield but 10 days earlier than the standard check BRRI dhan91 and gave the higher grain yield than the local checks
	Project II: Improvement of Irrigated Rice (Boro)	
1	Regional Yield trial (RYT) (FBR)	One SD-FBR lines IR 17A1723 (6.37 t/ha, 144 d), one MD-FBR line SVINI09 (8.37 t/ha, 156d), three AGGRiNet lines IR 17A2241 (7.13 t/ha, 161d), IR 17A1694 (6.78 t/ha, 164d) and IR 12 A 173 (6.72 t/ha, 166d) showed significantly higher yield than the check varieties having similar growth duration.
2	Regional Yield trial (RYT) (PQR)	The two genotypes BR10247-4-7-4B (6.46 t/ha and 147 days) and BRH 11-2-4-7B (6.70 t/ha and 159 days) gave the higher grain yield and took 2-4 days longer than the check BRRI dhan28 (6.04 t/ha and 155 days)
3	Regional Yield trial (RYT) (CTR)	The two genotypes BR 11894-R-R-R-R-309 (6.72 t/ha) and BR 11894-R-R-R-R-80 (7.09 t/ha) gave similar grain yield with the check BRRI dhan67 (6.65 t/ha)
4	Regional Yield trial (RYT) (STR)	The genotype BR9904-1-3-3 (7.19 t/ha and 164 days) produced the higher grain yield but 8 days longer growth duration than the check BRRI dhan67 (6.69 t/ha and 156 days). The genotype BR9901-1-

		3-10 (7.27 t/ha and 156 days) gave the higher grain yield and similar growth duration with the check BRRI dhan67 (6.69 t/ha and 156 days). The genotype BR 10187-1-5-11 (6.82 t/ha and 157 days) produced the similar grain yield and growth duration with the check BRRI dhan67 (6.69 t/ha and 156 days)
5	Regional Yield trial (RYT) (DRR)	DRR (BB) line BR11600-4R-140 (6.98 t/ha, 157d) showed significantly higher yield than the check varieties having similar growth duration.
6	Multi-location Trial (MLT) of Disease Resistance Rice (DRR)	The genotype BR(Path)13800-BC3-109-181 performed better than all check varieties in the MLT # Blast+BLB trial and BR(Path)12454-BC2-69-97-39-5-44 produced the higher grain yield than the check BRRI dhan29 in the MLT#Blast trial. However, no disease incidence was observed in any entries including susceptible check varieties.
7	International Irrigated Rice Observational Nursery (IIRON)	The eight entries IRRI199, SV1084, SV0914, SV1072, SV1075, SV1074, SV2007 and SV2021 (6.95-7.20 t/ha) gave the similar grain yield with the check BRRI dhan28 (6.91 t/ha).
	Program Area: Pest Management	
1	Monitoring of insect pest and natural enemies abundance at BRRI Habiganj	GLH populations were found highest followed by YSB, WLH, GH and BPH. Highest peak of GLH and YSB observed in May- June. Another peak of GLH and YSB was found in the month of November-December. Abundance of natural enemies (particularly, lady bird beetle) comparatively low during the period from July – March.
	Program Area: Crop-Soil-Water Management	
1	Long-term missing element trial for diagnosing the limiting nutrient in soil.	Yield decrease was higher in NK and K omission plots followed by NPKSZn for long time (11 years).
2	Influence of nitrogen and potassium rates on performance of modern rice	Application of N @ 140 kg ha^{-1} with 50 kg K ha^{-1} BRRI dhan92 produced significantly higher grain yield of 8.49 t ha^{-1} than other combination of N and K

		fertilization during Boro in Habiganj Farm.
3	Greenhouse gas emission and global warming potential under organic amendment at Kushtia region	It can be concluded that the VC organic manure could be useful for soil management strategy to reduce about 28 % of GHGI, 24% of GWP and increase about 6% of rice yield than that of CD
4	Greenhouse gas emission and Global warming potential as influence by water management during T. Aman and Boro rice cultivation	In Boro season, among the irrigation system, AWD one of the key technique for reducing total CH_4 emission, and GWP and GHG intensity without sacrificing rice yield. Irrigation suspension by 20 days and 30 days saved irrigation compared to continuous standing water management during Boro season. However, it sacrificed significant grain yield than the control treatment. Therefore, it could be concluded that any kinds of irrigation system are suitable for sustainable yield production and reduce greenhouse gas emission and global warming potential.
5	Performance of grain yield and emission under newly rice verities at Sylhet regions.	BRRI dhan92 also reduce about 7-10% CH_4 emission than BRRI dhan29.
6	Effect of time of planting on growth, yield and yield contributing factors of some short duration rice varieties	With four different sowing times, all the tested advanced short duration genotypes gave higher yield in the sowing time of 5 December but BRRI dhan28 (ck) showed better yield in the 25 November.
7	Screening of Pre-Harvest Sprouting of Some Newly Released BRRI Varieties	BRRI dhan50, BRRI dhan60, BRRI dhan69, BRRI dhan86 and BRRI dhan89 were found highly susceptible to pre-harvest sprouting
	Program Area: Socioeconomic and Policy	
1	Stability Analysis of BRRI released Boro Varieties	The yield range for Boro varieties was 3.8 to 7.9 t/ha. BRRI dhan55 yielded the highest, which was 7.9 t/ha with a growth duration of 155 days. It was closely followed by BRRI dhan92 and BRRI dhan74. Both varieties produced 7.1 t/ha with a growth duration of 155 and 148 days, respectively.

	Program Area: Technology transfer	
1	Workshop	The station conducted one special workshop for high officials of MoA, DAE and NARS Institutes
2	Seed production and distribution	The station supplied around 17 tons of truthfully labeled seeds to BADC, NGOs and farmers as seed support. About 27 tons breeders seeds were also produced and transferred to the Genetic Resource and Seed Division for distribution among BADC, NGOs and SMEs for production foundation seeds.
3	Farmers training	480 farmers and DAE personnel of Sylhet Region were trained on rice production technology
4	Demonstration trial	327 demonstration trial was conducted with newly released varieties
5	Field days	Five field days were conducted at different places
	Regional Station Rangpur	
	Research progress, 2021-2022	
Sl. No.	**Research Progress Program area/Project (Duration)**	**Expected output**
	Program area: Varietal Development	
1.0	**Development of Second Generation Rice (SGR)**	
1.1	Germplasm collection and Hybridization	8 germplasm were collected and 3 crosses were made
1.2	F1 Confirmation	5 crosses were confirmed
1.3	Observational yield Trial (OYT)	100 genotypes were selected for further evaluation
1.4	Maintenance and seed increase of parents/lines/land races	To maintain local and modern rice variety as germplasm for breeding
2.0	**Breeding for standard rice varieties for Rangpur region**	
2.1	Field RGA (F4)	2058 individual plants were selected from Field RGA
3.0	**Development of Medium stagnation and submergence Tolerant Rice (MSSTR)**	
3.1	Germplasm collection and Hybridization	5 germplasm were collected from different sources and 3 crosses were made
4.0	**Breeding for Photoperiod-sensitive rice varieties (PSR) for lowland and Charland ecosystem**	
4.1	Germplasm collection and Hybridization	5 germplasm were collected and 5 crosses were made
	Program area: crop-soil-water management	
1.1	Yield maximization of BRRI dhan71 through	Higher yield was observed at 15 August

	adjustment of plant population and seedling age at variable time of planting	planting with all seedling age irrespective of spacing under yield maximization experiment of BRRI dhan71
1.2	Effect of polythene cover on seedling quality and it's carryover effect on field duration and yield	For quality seedling raising in boro season, there was no significant difference in grain yield among polythene cover treatments but day-night polythene cover (T_3) reduces growth duration by 2-3 days over other treatments. Treatment T_3 is farmers' friendly because it is hassle free, a few labor consuming (cost effective) and risk free.
1.3	Effect of aged seedling on yield of Boro rice in northern region of Bangladsh	In Rangpur region, BRRI dhan88 and BRRI dhan89 produced similar grain yield with all seedling age (35-65 days) in Boro season. Although total growth duration was higher in A_{65} but field duration was lower than younger seedling but produced similar grain yield.
	Regional Station, Sirajganj	
	Research Progress 2021-2022	
Sl. No.	**Research Progress Program area/Project (Duration)**	**Expected output**
1	Integrated nutrient management for growth and yield improvement of rice in Char land ecosystem	Higher grain yield of 6.14 and 5.78 tha^{-1} was achieved by application of **c**ow dung @ 5 tha^{-1} + 50% of recom. dose of fertilizer (RDF) followed by Poultry manure 3 tha^{-1} + 50% of RDF in T. Aman 2021. In Boro 2021-22, application of RDF (N-P-K-S @ 69-10.4-41-10.8 kg ha^{-1}) followed by Vermi compost @ 1 tha^{-1} + 50% of RDF produced significantly higher grain yield.
2	Improving soil-water availability for crop production in Char land by amendment practices	Amendment practices (compaction with clay soil at the layer of 20-30 cm) followed by cowdung added at the top soil (0-10 cm) @ 5 tha^{-1} is effective for higher grain yield (5.73 t/ha) followed by top soil (0-10 cm) mixed with 50% of clay soil.
3	Effect of biochar on rice yield and soil health on problem soil	Application of 30% less recom. fertilizer with biochar @ 2.0 and 4.0 t ha^{-1} produced similar yield with full recom. fertilizer in Aman season and biochar @ 4 t/ha with recom. fertilizer resulted in the highest yield of BRRI dhan89 in Boro season.

4	Effect of transplanting date and spacing on the yield of different short duration rice varieties.	In T. Aman 2021, BRRI dhan71 gave highest yield (6.79 t/ha) at 16 August planting. However, In Boro 2021-22 BRRI dhan81 gave highest yield (7.51 t/ha) at 01 January planting Plant spacing had no significant effect on yield in both season.
5	Response of latest BRRI varieties and management practices in Char land areas of Sirajganj	In both seasons, BRRI recommended practices gave statistical higher yield over the farmer's practices in Boro season. However highest yield was obtained from BRRI dhan52 & BRRI dhan92 in T. Aman & Boro season respectively among the tested varieties in both management practices.
	Regional Station, Kushtia	
	Research Progress 2021-2022	
Sl. No.	**Research Progress Program area/Project (Duration)**	**Expected output**
1.	**Project I: Vareital Development**	
	1.1 **Title:** ALART for Zinc Enriched Rice (ZER) (Including 1 entries against 3 standard checks) **Progress:** Trail completed **Duration:** One season (T. Aman 2021)	BR9674-1-1-5-2-P4, the line performed very poorly in regards to yield and other phenotypic considerations.
	1.2 **Title:** Regional Yield Trial **Saline tolerant Rice (STR-1)** (Including 8 entries against 2 standard checks) **Progress:** Trail completed **Duration:** One season (T. Aman 2021)	Yield performance of Salt tolerant line BR11716-4R-123 was better than tolerant check but lower than susceptible check in STR-1 trial.
	1.3 **Title:** Regional Yield Trial **Saline Tolerant Rice (STR-2)** (Including 8 entries against 2 standard checks) **Progress:** Trail completed **Duration:** One season (T. Aman 2021)	In STR-2 trial BR11716-4R-105 was found as an excellent genotype.
	1.4 **Title: Multi Location Trial (MLT-1)** (Including 3 entries against 3 standard checks) **Progress:** Trail completed **Duration:** One season (T. Aman 2021)	BR10397-3-2-1-1-8 (Xa21) and BR10393-4-1-1-1-1 out yielded in MLT-1 trial.
	1.5 **Title: Multi Location Trial (MLT-2)** (Including 3 entries against 3 standard checks) **Progress:** Trail completed	BR10397-3-2-1-1-8 (Xa21) and BR10393-4-1-1-1-1 failed to cross the yield line of checks in MLT-2.

	Duration: One season (T. Aman 2021)	
	1.6 **Title:** Regional Yield Trial **Extra Long Slender (ELS-1)** (Including 3 entries against 2 standard checks) **Progress:** Trail completed **Duration:** One season (T. Aman 2021)	The line BR238-5-1-4-2 (4.86 t/ha) at on-station and BRH11-2-4-7B at on-farm trial was marked as best Extra Long Slender type.
	1.7 **Title:** Regional Yield Trial **Extra Long Slender (ELS-2)** (Including 3 entries against 2 standard checks) **Progress:** Trail completed **Duration:** One season (T. Aman 2021)	
	1.8 **Title:** Regional Yield Trial **Long Slender (LS-1)** (Including 5 entries against 2 standard checks) **Progress:** Trail completed **Duration:** One season (T. Aman 2021)	Among Long Slender type lines BR9392-10-20-1B performed better in both on-farm and on-station condition.
	1.9 **Title:** Regional Yield Trial **Long Slender (LS-2)** (Including 5 entries against 2 standard checks) **Progress:** Trail completed **Duration:** One season (T. Aman 2021)	,,
	1.10 **Title:** Regional Yield Trial **Short Slender (SS-1)** (Including 4 entries against 3 standard checks) **Progress:** Trail completed **Duration:** One season (T. Aman 2021)	BRH13-7-9-3-2B yielded highest in on-station condition while all the tested line of short slender type performed better in on-farm trial.
	1.11 **Title: Short Slender (SS-2)** (Including 4 entries against 3 standard checks) **Progress:** Trail completed **Duration:** One season (T. Aman 2021)	,,
	1.12 **Title:** Identification and screening of prospective aerobic rice from local and BRRI developed rice varieties, Boro, 2020-21 (Including 10 entries against 3 standard checks) **Progress:** Trail completed **Duration:** One season (Boro 2021-22)	A screening program to identify prospective aerobic rice from local and BRRI developed rice varieties found six promising lines where IR18R1111a gave maximum yield.
	1.13 **Title:** Regional Yield Trial **Disease Resistant Rice for Blast (DRR-Blast)** (Including 7 entries against 2 standard checks) **Progress:** Trail completed **Duration:** One season (Boro 2021-22)	BR(Path)12454-BC2-69-97-39-5-44 as blast resistant materials found best yielder in both on-station and on-farm trial with no infestation of blast pathogen.

	1.14 **Title:** Regional Yield Trial **Disease Resistant Rice (DRR-BB-1)** (Including 12 entries against 2 standard checks) **Progress:** Trail completed **Duration:** One season (Boro 2021-22)	BR11607-4R-46 and BR11604-4R-128 in RYT, DRR(BB-1) were marked as potential advanced line.
	1.15 **Title:** Regional Yield Trial **Disease Resistant Rice (DRR-BB-2)** (Including 12 entries against 3 standard checks) **Progress:** Trail completed **Duration:** One season (Boro 2021-22)	BR11604-4R-129, BR11604-4R-52 and BR11604-4R-258 in RYT, DRR(BB-2) were marked as potential advanced line.
	1.16 **Title:** Regional Yield Trial **Premium Quality Rice (PQR)** (Including 2 entries against 3 standard checks) **Progress:** Trail completed **Duration:** One season (Boro 2021-22)	BR 10322-23-1-2-4 and BR 10322-23-6-3-7-B2 performed better among tested lines in PQR, RYT
	1.17 **Title:** Regional Yield Trial **Long Slender (LS)** (Including 3 entries against 1 standard checks) **Progress:** Trail completed **Duration:** One season (Boro 2021-22)	From the result of RYT, Long slender BRH11-2-4-7B genotype would be a promising line.
	1.18 **Title:** Regional Yield Trial **Faavorable Boro Rice (FBR-Barishal)** (Including 10 entries against 2 standard checks) **Progress:** Trail completed **Duration:** One season (Boro 2021-22)	NGR 1255-1 was the highest yielder (7.50 t/ha) among lines.
	1.19 **Title:** Regional Yield Trial **Favorable Boro Rice (FBR-Bio)** (Including 2 entries against 2 standard checks) **Progress:** Trail completed **Duration:** One season (Boro 2021-22)	Both the tested genotypes performed poor than checks in FBR Bio. regional trial
	1.20 **Title:** Regional Yield Trial **Insect Resistant Rice (IRR-BPH)** (Including 7 entries against 3 standard checks) **Progress:** Trail completed **Duration:** One season (Boro 2021-22)	BR 11593-5 R-44 was found highest yielder in IRR-BPH, RYT where no attack of BPH was noticed.
	1.21 **Title:** Regional Yield Trial **Favorable Boro Rice (FBR-MD)** (Including 13 entries against 2 standard checks) **Progress:** Trail completed	The lines BR10601-5R-74 performed better than the other lines and check varieties in RYT, FBR (MD).

	Duration: One season (Boro 2021-22)	
	1.22 **Title:** Regional Yield Trial **Favorable Boro Rice (FBR-LD)** (Including 9 entries against 2 standard checks) **Progress:** Trail completed **Duration:** One season (Boro 2021-22)	In RYT, FBR (LD) BR11318-5R-10 yielded significantly higher than all line and check variety.
	1.23 **Title:** Regional Yield Trial **Favorable Boro Rice (FBR-SD)** (Including 4 entries against 2 standard checks) **Progress:** Trail completed **Duration:** One season (Boro 2021-22)	BRRI dhan29-SC3-28-16-10-6-HR6(Com)-HR1(Gaz)-P8(Hbj) line performed better in RYT, FBR(SD).
	1.24 **Title:** Regional Yield Trial **AGGRiNET** (Including 7 entries against 4 standard checks) **Progress:** Trail completed **Duration:** One season (Boro 2021-22)	IR17A1694 found as remarkable line in FBR-AGGriNET trial.
	1.25 **Title:** ALART for **Premium Quality Rice (PQR)** (Including 2 entries against 3 standard checks) **Progress:** Trail completed **Duration:** One season (Boro 2021-22)	Among the supplied PQR breeding lines the yield of BR9930-2-3-3-1 (6.39 t/ha) was very similar to check varieties BRRI dhan50 and BRRI dhan63 but the yield was higher than BRRI dhan81.
	1.26 **Title:** ALART for **Faavorable Boro Rice (FBR-Barishal)** (Including 4 entries against 2 standard checks) **Progress:** Trail completed **Duration:** One season (Boro 2021-22)	BRBa2-5-3 (7.16 t/ha) and BRBa3-1-7 (7.17 t/ha) performed better than all checks in FBR-Barishal trial.
	1.27 **Title:** ALART for **Blast Resistant Rice** (Including 4 entries against 2 standard checks) **Progress:** Trail completed **Duration:** One season (Boro 2021-22)	In ALART for Blast Resistant Rice the grain yield of all the supplied advanced lines were lower than the check variety BRRI dhan88 and very similar to BRRI dhan28 with higher lodging tendency at maturity
	1.28 **Title:** ALART for **Superior High Yielding Rice (SHR)** (Including 3 entries against 2 standard checks) **Progress:** Trail completed **Duration:** One season (Boro 2021-22)	In ALART for Superior High Yielding Rice, the grain yield of the advanced line BRH13-7-9-3-2B was highest (7.06 t/ha) but flowering of this line was uneven.
	1.29 **Title:** Stability analysis of BRRI varieties, T. Aus, 2021 (Including 13 varieties) **Progress:** Trail completed	In T. Aus, 2021 the highest yielder was BRRI dhan98 and the lowest was BR24.

	Duration: Repeatedly in T. Aus season	
	1.30 **Title:** Stability analysis of BRRI varieties, T. Aman, 2021 (Including 47 varieties) **Progress:** Trail completed **Duration:** Repeatedly in T. Aman season	In T. Aman, 2021 the highest yield was scored by BRRI dhan87 and the lowest by BRRI dhan37. Several varieties lodged during T. Aman.
	1.31 **Title:** Stability analysis of BRRI varieties, Boro, 2021-22 (Including 47 varieties) **Progress:** Trail completed **Duration:** Repeatedly in Boro season	In Boro, 2021-22 season the highest yielder was BRRI hybrid dhan2 and the lowest was BRRI dhan35.
2.	**Project II: Rice Farming Systems**	
	2.1 **Title:** Improvement of Mustard- T. Aus - T. Aman cropping pattern with variety replacement for sustainable productivity in Kushtia region **Progress:** Trail completed **Duration:** Three years	The highest REY (15.98 t/ha) was recoded from the cropping pattern BARI Sorisha-14 (Relay)-BRRI dhan63-Fallow-BRRI dhan75.
	2.2 **Title:** Yield response of rice to different rates of Nitrogen and Potash fertilizer in Boro-Fallow-T. Aman cropping pattern in Kushtia (continue). **Progress:** Trail completed **Duration: Three years**	In T. Aman, 2021 Urea@STB-20% less and MoP@STB+30% additional was found best. The dose combination of Urea @STB+20% additional and MoP@STB+30% additional for BRRI dhan63 in Boro, was reported as best dose combination.
3.	**Project III: Crop-Soil-Water Management**	
	3.1 **Title:** Determining minimum irrigation water requirement of rice in different regions through water balance from on-farm demand and model simulation. **Progress:** Trail completed **Duration: Three years**	In Khustia, AWD treatment had the highest yield among the treatments, but irrigation application and yields of AWD and CROPWAT treatments did not have any major difference. Irrigation scheduling by CROPWAT model might be a potential approach to save irrigation water, but still needs in depth evaluation in terms of irrigation demand, irrigation received and yields.
	3.2 **Title:** Evaluation of drought tolerance ability of newly released BRRI variety (Aman) in drought prone area. **Progress:** Trail completed **Duration: Three years**	Another findings from the evaluation of drought tolerance reported that BRRI dhan71 gave highest yield (5.88 t/ha) when the perch water table went 35 cm below the soil surface during transplanted on 15th August. BRRI dhan87 also gave the highest yield (7.38 t/ha) when the

		water table went 35 cm below the soil surface. BRRI dhan71 and BRRI dhan87 can be grown up to 15th August with 35 cm below the surface area without sacrificing major yield loss.
	3.3 **Title:** Determination of optimum time of planting and seedling age for yield maximization of BRRI dhan87 at Kushtia region. **Progress:** Trail completed **Duration: Three years**	In case of transplanting time, the highest yield was observed at the 3rd transplanting time of 15 August, 2021 (T3) which was statistically similar to 1st & 2nd transplanting times of 15 July & 30 July (T1 &T2). On the other hand, in case of seedling age there is no significant yield different among the treatments. Highest growth duration was found at the 1st transplanting of 15 July, 2021.
	Regional Station, Bhanga, Faridpur	
	Research Progress 2021-2022	
SL. No.	**Research Progress Program area/Project (Duration)**	**Major output**
	Program Area: Varietal development, Farming Systems Research, Crop-soil-water management, Socio economics, Technology transfer	
1.	Breeding for developing high yielding Transplanting Aman rice varieties (Hybridization)	In *Aman* 2021 season, 8 crosses were made and 194 F_1 seeds were produced for developing high yielding transplanting *Aman* rice varieties with desirable characters with emphasis on water stagnation tolerance, anaerobic tillering, earliness, good grain quality.
2.	Breeding for developing high yielding shallow flooded Deep water rice varieties (Hybridization)	For deep water rice variety development, 13 crosses were made and 316 F_1 seeds were produced with desirable characters with emphasis on kneeing ability, nodal tillering, earliness and awnless good grain quality.
3.	Advancement of generation through FRGA	A total of 630 plants of F_4 generation were grown during *Boro* 2021-22 following Field RGA and 537 progenies of F_5 generation were harvested under breeding program for 'High yielding rice varieties for semi-deep water ecosystem.
4.	Proposed Variety Trial (PVT) for inbred rice variety, T. Aman 2021 and Boro 2021-22	**PVT (T. Aman):** One set (Set-1) of inbred trial (Aman 2021) was evaluated under PVT at BRRI Regional Station Bhanga. O**ne advanced breeding line** I-033 along with two checks (I-034 and I-

		035) was tested. The line no. I-033 produced 15.32% and 6.40% higher yield than the both check varieties coded as I-034 and I-035, respectively. **PVT (Boro):** Three sets (Set-I, Set-II, Set- III) of inbred trial (*Boro* 2021-22) were carried out at BRRI Bhanga, Faridpur. Set-I: In a proposed variety trial, o**ne advanced breeding line** I-036 along with check I-039 was tested. The line no. I-036 produced 7.46 t ha^{-1} which was 6.75% lower yield than the check variety coded as I-039 (8.00 t ha^{-1}). Line I-036 has much lower glycemic index than the check variety. The growth duration of line no. I-036 was 151 days which was 5 days late than the check variety coded as I-039 (145 days). Set-II: **One advanced breeding line I-**038 was evaluated along with check I-037. **The line no.** I-038 (7.29 t ha^{-1}) yielded 9.09% lower than the check I-038 (8.019 t ha^{-1}) with similar growth duration (151 days). The test entry I-038 is much long and slender and true basmati type than the test entry. Set-III: One advanced breeding line I-040 along with check I-041 were tested. The line no. I-040 (5.887 t ha^{-1}) gave 19.24% lower yield than the check I-041 (7.29 t ha^{-1}). Average growth duration of the tested line I-040 (152 days) was 7 days late than check I-041 (145 days).
5.	ALART (Aman-2021)	ALART (ZER) was undertaken using one advanced line BR9674-1-1-5-2-P4 along with BRRI dhan49, BRRI dhan72 and BRRI dhan87 as checks at on farm condition in Nagarkanda, Faridpur. Two replications of the advanced line BR9674-1-1-5-2-P4 were severely damaged due to rat infestation and very poor yield was obtained compared to the check entries. Mean growth duration of advanced line BR9674-1-1-5-2-P4 (117 days) was much earlier than the check varieties BRRI

		dhan49 (128 days), BRRI dhan72 (126 days) and BRRI dhan87 (122 days).
6.	ALART (Boro:2021-22) SHR, FBR Barishal, BRR	SHR: Three advanced lines BRH11-9-11-4-5B, BRH13-2-4-6-4B and BRH13-7-9-3-2B were evaluated along with BRRI dhan63 and Zirashail as checks at farmer's field at Krishnanagar, Nagarkanda, Faridpur. BRH11-9-11-4-5B out yielded (6.75 tha^{-1}) all other two entries as well as both the check entries BRRI dhan63 (6.54 tha^{-1}) and Zirashail (4.70 tha^{-1}). Yield of BRH11-9-11-4-5B was 3.1% and 30% higher than the check variety BRRI dhan63 and Zirashail respectively. FBR_Barishal: Four advanced lines BRBa 1-4-9, BRBa 2-5-3, BRBa 3-1-7 and BRBa 3-2-4 along with BRRI dhan58 and BRRI dhan89 as checks were evaluated at farmer's field at Krishnanagar, Nagarkanda, Faridpur. Check Variety BRRI dhan89 out yielded all test entries. Yield of BRBa 3-2-4 was reduced due to severe lodging (80%). BRR: Four advanced lines BR(Path)12452-BC3-42-22-11-4, BR(Path)12452-BC6-53-21-11, BR(Path)13784-BC3-61-1-6-HR3 and BR(Path)13784-BC3-63-6-4-HR6 with BRRI dhan28 and BRRI dhan88 as check were tested at farmers' field at Krishnanagar, Nagarkanda, Faridpur. BRRI dhan88 out yielded (8.17 t ha^{-1}) all test entries. . Mean growth duration of the all test entries was similar (146 days, 147 days) to the check varieties (145 days, 146 days). Uniform flowering and maturity were observed in these lines.
7.	Regional Yield Trial (RYT), Boro 2021-2022	RYT (STR_1): Six advanced lines were evaluated against three standard checks BRRI dhan67, BRRI dhan89 and BRRI dhan97 in RYT (STR_1). Advance line BR10187-1-4-12, BR10187-1-5-11, BR10188-10-1-18, BR9901-1-3-10 and BR9904-1-3-3 gave higher yield (7.89,

		7.86, 8.34, 8.2 and 8.3 tha^{-1}) than the check variety BRRI dhan67 (7.1 tha^{-1}). On the other hand, all advance lines produced lower grain yield than the check varieties BRRI dhan89 and BRRI dhan97 (9.34, 8.72 tha^{-1}) RYT (STR_2): RYT (STR_2) conducted using nine advanced lines. Advance line TP30642 gave higher yield (8.53 tha^{-1}) than check varieties BRRI dhan67 (7.88 tha^{-1}) and BRRI dhan97 (8.24 tha^{-1}). IR 108175-B-22-AJY 3-B-1 gave higher yield (8.19 tha^{-1}) than check BRRI dhan 67 (7.88 tha^{-1}). Advance line IR15T1399, TP24493 produced higher yield than check check BRRI dhan 67 (7.88 tha^{-1}). (Table 10) Check variety BRRI dhan89 produced highest yield (8.72tha^{-1}) than all advance lines. RYT (IRR): Seven advanced lines along with two susceptible check variety BRRI dhan58, BRRI dhan88 and one resistant check T27A were grown. Among seven, six advance lines BR11593-5R-44, BR11593-5R-55, BR11593-5R-70, BR11593-5R-73, BR11593-5R-79 and BR11595-5R-24 produced higher yield (9.15, 8.92, 9.23, 9.09, 8.9 and 9.21 tha^{-1} respectively) than all three checks BRRI dhan58 (7.85 tha^{-1}), BRRI dhan88 (5.59 tha^{-1}) and T27A (5.76 tha^{-1}). RYT (FBR_Barishal): Ten advance breeding lines along with two check varieties were evaluated. Two test entries NGR 1255-1 and NGR 522-1 out yielded (8.5 and 8.27 tha^{-1}) the check BRRI dhan89 (8.14 tha^{-1}). None of the test entries out yielded the check variety BRRI dhan58 (8.62 tha^{-1}). RYT (DRR_1): Twelve advance lines were evaluated along with one susceptible check and one resistant check. Four advance lines BR11600-4R-82, BR11607-4R-184, BR11607-4R-6 and BR11607-4R-79 gave higher yield (7.35,

		7.42, 7.4 and 7.03 tha^{-1}) than both the checks BRRI dhan88 (6.88 tha^{-1}) and IRBB60 (6.69 tha^{-1}). RYT (DRR_2): Fourteen advanced lines were evaluated against two susceptible check varieties, BRRI dhan58, BRRI dhan89 and one resistant check IRBB60. Seven advanced lines BR11604-4R-118, BR11604-4R-122, BR11604-4R-129, BR11604-4R-147, BR11604-4R-24, BR11604-4R-35, BR11604-4R-52, BR11604-4R-72 gave higher yield (6.95,7.47,7.41, 7.16, 7.14, 6.67, 7.79 (tha^{-1}) than the standard check BRRI dhan58 (6.5 t ha^{-1}) and IRBB60 (6.29 t ha^{-1}). All advance lines gave lower yield than check BRRI dhan89 (8.66 tha^{-1}). RYT (ZER): Two advanced lines along with two s checks BRRI dhan29, BRRI dhan74 and BRRI dhan84 were grown. Both advanced lines gave higher yield (7.48 and 7.33 t ha^{-1}) than checks BRRI dhan29 (6.3 t ha^{-1}), BRRI dhan74 (7.22 t ha^{-1}) and BRRI dhan84 (6.89 tha^{-1}). RYT (BRR_1): Five advanced breeding lines along with three checks BRRI dhan29, BRRI dhan89 and BRRI dhan92 were tested. Test entries BR(Path)1254-BC2-48-10-88-81-32 and BR(Path)1254-BC2-75-32-3139-7 gave higher yield (6.39 and 6.5 tha^{-1}) than check varieties BRRI dhan29 (5.83 tha^{-1}) and BRRI dhan92 (6.16 tha^{-1}). Check variety BRRI dhan89 gave higher yield (7.13 tha^{-1}) than all test entries. RYT (BRR_3): Five advanced breeding lines with three checks BRRI dhan29, BRRI dhan89 and BRRI dhan92 were tested. All advance lines gave lower yield (.19, 5.01, 5.53, 5.0 and 5.79 tha^{-1}) than the three check varieties BRRI dhan29 (6.3 tha^{-1}), BRRI dhan89 (6.71 tha^{-1}) and BRRI dhan92 (6.22 tha^{-1}). RYT (SHR_SS): Five advanced lines

		along with two checks BRRI dhan28 and BRRI dhan81 were tested. Three advance lines BRH10-1-14-2-6B, BRH13-1-9-7B and BRH13-2-4-7-2B produced higher yield (7.66, 7.43 and 7.65 tha^{-1} respectively) than both the two check entries BRRI dhan28 (6.85 tha^{-1}) and BRRI dhan81 (5.24 tha^{-1}). RYT (SHR_LS): Three advanced breeding lines along with one check BRRI dhan28 were tested. All advance lines BR10247-14-18-4, BR10247-4-7-4B and BRH11-2-4-7B gave higher yield (7.61, 7.02 and 7.51 tha^{-1}) than the check BRRI dhan28 (6.76 tha^{-1}). RYT (FBR_SD): Four advance breeding lines along with two checks BRRI dhan81 and BRRI dhan96 were evaluated. Two advance lines BRRI dhan29-SC3-28-16-10-6-HR6(Com)-HR2(Gaz)-P11-(Hbj) and IR17A1694 gave higher yield (6.66 and 8.44 tha^{-1}) than both the checks BRRI dhan81 (6.36 tha^{-1}) and BRRI dhan96 (5.89 tha^{-1}). RYT (FBR_LD): A total of seven advance lines were evaluated against two check varieties BRRI dhan89 and BRRI dhan92 were evaluated. Five among the seven advance lines BR11318-5R-84, BR10604-5R-10, BR10599-5R-375, BR11318-5R-106, BR11318-5R-148 produced higher yield (8.62, 7.48, 7.28, 7.14 and 6.97 tha^{-1}) than both the check entries BRRI dhan 89 (6.8 tha^{-1}) and BRRI dhan92 (6 tha^{-1}). RYT (FBR_MD): Twelve test entries along with two checks were grown. Among twelve entries four entries BR10317-5R-57, BR11318-5R-63, BR11337-5R-72 and SVIN109 gave higher yield (8.72, 8.91, 8.23, and 8.02 tha^{-1}) than both the check entries BRRI dhan81 (7.98 tha^{-1}) and BRRI dhan96 (7.67 tha^{-1}).

		RYT (FBR_Bio): Two advance lines were tested along with two check varieties. Both the check varieties BRRI dhan88 (6.88 tha^{-1}) and BRRI dhan96 (6.29 tha^{-1}) gave higher yield than the test entries BR (Bio) 10381-AC1-2 and BR (Bio) 10381-AC32-3 (5.1 and 5.26 tha^{-1} respectively). RYT (CTR): Seven advance breeding lines along with three check varieties were tested. Two advance lines BR11894-R-R-R-R-134 and BR11894-R-R-R-R-165 produced higher yield (5.51 and 5.47 tha^{-1}) than all three check varieties BRRI dhan67 (5.35 tha^{-1}), BRRI dhan89 (4.74 tha^{-1}) and BRRI dhan92 (5.2 tha^{-1}). Two entries BR11894-R-R-R-R-299 and BR11894-R-R-R-R-304 gave higher yield (5.01 and 5.27 tha^{-1}) than check BRRI dhan89. All other entries have lower yield than the check varieties. RYT (AGGRiNET): Seven breeding lines along with four check varieties were evaluated. Two lines IR08N134 and IR17A1650 gave higher yield (6.33 and 6.28 tha^{-1}) than all four check entries BRRI dhan63 (5.43 tha^{-1}), BRRI dhan81 (4.94 tha^{-1}), BRRI dhan89 (5.06 tha^{-1}) and BRRI dhan92 (5.18 tha^{-1}). All other entries gave lower yield than check variety BRRI dhan63 but higher than BRRI dhan81.
8.	Introduction of intercropping system in different farmer led cropping pattern for medium low land area in Faridpur region	In order to increase the cropping system productivity in Faridpur region, five farmer led cropping patterns were taken into account for modification through intercropping. Among the tested cropping pattern, the highest Rice equivalent yield (REY) was obtained from Potato+Maize-Jute-T.Aman (26.73 t/ha) followed by Mustard+Watermelon-Mungbean-Jute-T..Aman (25.58 t/ha). The turnover time in these two cropping patterns was 30 days and 20 days, respectively.
9.	Effects of planting time on *Aus* rice in Charland area of Faridpur, Bangladesh	The inbreed varieties BRRI dhan82 and BRRI dhan83 gave maximum grain yield

		compared to local varieties Porangi and Kalo shaitta in all the treatments. Considering all the treatments and weather condition, the experiment should run again to discover the optimum time range for Aus rice cultivation in Faridpur region.
10.	Development of weed control techniques in Boro-Fallow-Fallow cropping pattern	The highest grain and straw yield were found in pre-emergence herbicide at 5 DAT and hand weeding at 30 DAT and the lowest was observed in control plots. The maximum weed density and dry weight were recorded in BRRI rice weeder @ 20 DAT, 45 DAT and hand weeding @ 30 DAT. The experiment required further research to develop suitable and cost-effective weed control technology in a single *Boro* cropping system.
11.	Stability of yield of BRRI released Aman varieties	For short duration Aman varieties, BRRI dhan90, BRRI dhan73 and BRRI Hybrid dhan6 produced 3.43 t ha^{-1}, 3.28 tha^{-1} and 2.71 t ha^{-1} which was higher yield than other varieties like BRRI dhan33, BRRI dhan62 and BRRI dhan75. In medium duration *Aman* varieties based on yield BRRI dhan78, BRRI dhan80 and BRRI dhan51 gave the highest grain yield 3.59 t ha^{-1}, 2.84 t ha^{-1} and 2.66 t ha^{-1}. In long duration T. Aman varieties BRRI dhan46 yielded high (2.62 t ha^{-1}) followed by BRR dhan41 (2.07 t ha^{-1}) and BRRI dhan48 (1.83 t ha^{-1}).
12.	Stability of yield of BRRI released Boro varieties	In Boro season, for short duration Boro varieties BRRI Hybrid dhan2 yielded high (8.97 t ha^{-1}) followed by BRRI Hybrid dhan3 (8.41 t ha^{-1}) and BRRI Hybrid dhan5 (7.87 t ha^{-1}). For long duration, BRRI dhan59, BRRI dhan99 and BRRI dhan47 gave the highest grain yield 8.32 t ha^{-1}, 8.22 tha^{-1} and 7.98 t ha^{-1}.
13.	Activity 1: Demonstration of modern rice varieties in Aman and Boro seasons in greater Faridpur region	A total of 545 demonstrations (45 demo in T. *Aus*, 50 demo in T. *Aman* and 450 in *Boro* seasons) using modern rice BRRI

		varieties during T. *Aus*, T. *Aman* 2021 and *Boro* 2021-22 were carried out in different farmers' fields of 24 upazila of 4 districts (Faridpur, Madaripur, Rajbari and Shariatpur) under BRRI RS, Bhanga, Faridpur. Highest yield of different BRRI released modern Aus varieties were: 5.46 tha^{-1} for BRRI dhan48, 5.25 tha^{-1} for BRRI dhan82, 4.5 tha^{-1} for BRRI dhan83, 4.76 tha^{-1} for BRRI dhan85, 5.46 tha^{-1} for BRRI dhan98, 6.59 tha^{-1} for BRRI Hybrid dhan7. Mean grain yields with growth duration of *Aman* varieties were: 4.12 t ha^{-1} with 128 days for BRRI dhan79, 6.67 t ha^{-1} with 128 days for BRRI dhan87 and 6.83 t ha^{-1} with 121 days for BRRI Hybrid dhan4. In Boro 2021-22, mean grain yield of BRRI dhan58 was 6.56 t ha^{-1} with growth duration of 154 days, 7.80 t ha^{-1} with 159 days for BRRI dhan89, 7.91 t ha^{-1} with 162 days for BRRI dhan92, 6.91 t ha^{-1} with 152 days for BRRI dhan96, 7.39 t ha^{-1} with 151 days for BRRI Hybrid dhan5.
14.	Activity 2. Seed production and dissemination in BRRI Farm	BRRI RS, Bhanga farm produced ~31.0 ton of seeds of which about 13.75 tons of breeder seed of BRRI dhan29, BRRI dhan89 and BRRI dhan92 and the rest about 17.0 were TLS of *Aus* varieties like BRRI dhan48, BRRI dhan83 and BRRI dhan98, short duration *Aman* variety e.g. BRRI dhan75 as well as *Boro* varieties of BRRI dhan29, BRRI dhan50, BRRI dhan58, BRRI dhan81, BRRI dhan84, BRRI dhan88, BRRI dhan89 and BRRI dhan92 during *Boro* 2021 -22 season.
15.	Activity 3. Training /Agricultural Fair	Total 28 training programs where 880 participants consisting of farmers, DAE personnel and mechanics of greater Faridpur region took part in the training on 'modern rice production technologies; and farm machineries operation and maintenance with the cooperation of DAE

		under the financial assistance of GOB and SMPRA-BRRI. BRRI Regional Station, Bhanga arranged a 'Three-day Agriculture Fair' at office premises during 2021-22
	Regional Station, Gopalganj	
	Research Progress 2020-21	
Sl. No.	**Research Progress Progamme area/Project (duration)**	**Expected output**
1.	ALART (STR-1 and STR-2) T. Aman 2021	Three advanced lines IR108158-B-2-AJY1-1, IR15T1464 and TP30649) along with BRRI dhan73 and BRRI dhan87 as checks were tested at farmer's fieldin two locations. One advanced line IR108158-B-2-AJY1-1 gave an average higher yield (5.77 t ha^{-1}) than the standard checks BRRI dhan73 (5.12 t ha^{-1}) and BRRI dhan87 (5.64 t ha^{-1}) with similar growth durations.
2.	ALART (SHR) Boro 2021-22	Three advanced lines along with BRRI dhan63 and Zirashail as checks were grown at Neemtala, Haridaspur, Gopalganj sadar during Boro 2021-22. All the advanced lines gave a higher yield (6.77-7.58 t ha^{-1}) than the standard checks BRRI dhan63 (6.11 t ha^{-1}) and Zirashail (5.27 t ha^{-1}) with 16 days longer growth durations.
3.	ALART (FBR) Boro	Four advanced lines along with BRRI dhan58 and BRRI dhan89 as checks were grown at Neemtala, Haridaspur, Gopalganj sadar during Boro 2021-22. All the advanced lines produced higher yield (7.60-7.94 t ha^{-1}) than the standard checks BRRI dhan58 (6.59 t ha^{-1}) and BRRI dhan89 (7.48 t ha^{-1}) with 5-7 days longer growth durations.
4.	ALART (STR-1) Boro	Three advanced lines along with BRRI dhan67 and BRRI dhan92 as checks were tested at Babupara, Tungipara during Boro 2021-22. All the advanced lines produced higher yield (6.77-7.03 t ha^{-1}) than the standard checks BRRI dhan67 (5.80 t ha^{-1}) and BRRI dhan92 (6.65 t ha^{-1}).
5.	ALART (STR-2) Boro	Three advanced lines (BR11712-4R-227,

		BR11716-4R-105 and BR11716-4R-102) along with BRRI dhan67 and BRRI dhan92 as checks were tested at Babupara, Tungipara during Boro 2021-22. All the advanced lines produced higher yield (6.72-6.97 t ha^{-1}) than the standard checks BRRI dhan67 (5.51 t ha^{-1}) and BRRI dhan92 (6.61 t ha^{-1}). The mean growth duration of all the advanced lines is >160 days.
6.	RYT (STR-1) T. Aman	Eight advanced lines along with BRRI dhan73 and BRRI dhan87 as checks were grown at BRRI RS Gopalganj during T. Aman 2021.Five advance lines gave a higher yield (6.32-6.75 t ha^{-1}) than the standard checks BRRI dhan73 (6.01 t ha^{-1}) and BRRI dhan87 (6.23 t ha^{-1}) with similar growth durations except for BR11716-4R-120.
7.	RYT (STR-2) T. Aman	Eight advanced lines along with BRRI dhan73 and BRRI dhan87 as checks were tested. Five advance lines produced higher yield (6.64-7.08 t ha^{-1}) than the standard checks BRRI dhan73 (5.91 t ha^{-1}) and BRRI dhan87 (6.38 t ha^{-1}) with similar growth durations except BR11716-4R-129.
8.	RYT (ZER) T. Aman	Two advanced lines along with BRRI dhan72 and BRRI dhan87 as checks were grown. The advanced line BR10022-2-8-9-5-22 produced higher yield (6.81 t ha^{-1}) than standard checks (BRRI dhan72 and BRRI dhan87). The mean growth duration of advanced line BR10022-2-8-9-5-22 was similar to the check variety BRRI dhan87 and 6 days longer than the other check BRRI dhan72
9.	RYT (RLR) T. Aman	Five advanced lines along with BRRI dhan49, BRRI dhan71 and BRRI dhan87 as checks were tested. Two advanced lines produced higher yield (6.37-6.89 t ha^{-1}) than the standard three checks (BRRI dhan49, BRRI dhan71 and BRRI dhan87).On the other hand, five advanced lines gave higher yield (6.09-6.89 t ha^{-1}) than the two checks namely BRRI dhan49

		and BRRI dhan71.
10.	RYT (SS) Boro 2021-22	Five advanced lines along with BRRI dhan28 and BRRI dhan81 as checks were evaluated. The average grain yield of all advanced lines (6.85-7.00 t ha^{-1}) was higher than the checks BRRI dhan28 and BRRI dhan81 (5.97-6.35 t ha^{-1})
11.	RYT (LS) Boro	Three advanced lines were tested against one check variety BRRI dhan28. Three advanced lines gave a higher yield (6.30-6.90 t ha^{-1}) than the standard check BRRI dhan28 (5.98 t ha^{-1}) with similar and a few days longer growth duration
12.	RYT (FBR) Boro	Ten advanced lines along with BRRI dhan58 and BRRI dhan89 as checks were tested. One advanced lines produced higher yield (9.20 t ha^{-1}) than the standard two checks (BRRI dhan58 and BRRI dhan89).On the other hand, seven advanced lines gave higher yield (7.03-9.20 t ha^{-1}) than the checks BRRI dhan58 (6.99 t ha^{-1}).
13.	RYT (STR-1) Boro	Eight advanced lines along with BRRI dhan89, BRRI dhan67 and BRRI dhan97 as checks were grown. None of the tested genotypes gave higher yield (5.97-7.34 t ha^{-1}) than the check variety BRRI dhan89 (7.83 t ha^{-1}). But three advanced line gave higher yield (6.71-7.34 t ha^{-1}) than both checks (BRRI dhan67 and BRRI dhan97) with similar growth duration.
14.	RYT (STR-2) Boro	Nine advanced lines along with BRRI dhan89, BRRI dhan67 and BRRI dhan97 as checks were tested. None of the tested genotypes produced higher yield (6.02-6.92 t ha^{-1}) than the check variety BRRI dhan89 (7.87 t ha^{-1}). But three advanced line gave higher yield (6.70-6.92 t ha^{-1}) than both checks (BRRI dhan67 and BRRI dhan97) with similar growth durations.
15.	Germplasm collection and rejuvenation.	One hundred and twenty four Aman rice germplasm were collected from Faridpur region. This rice germplasm were rejuvenated to increase the seed for further evaluation and utilization.

16.	Morphological Characterization of rice germplasm	The present study exhibits high variability in most of the observed traits of pigmented Boro rice germplasm. The euclidean distance was calculated using quantitative data and a UPGMA dendrogram was constructed using 54 pigmented boro rice germplasm. Cluster analysis indicated that the 54 pigmented rice germplasm could be divided into four categories, using the Euclidean distance of 0.42 as the threshold value. Maximum 39genotypes were grouped into the cluster III and 11 in cluster II. The cluster I and IV contained the lowest (2) number of genotypes.
17.	Head to Head Trial: VRS (Variety Replacement Strategy)	During the reporting year, seven varietal replacements through Head to Head (HTH) demonstrations each of one bigha (33 decimal) of land, three in Aman season, 2021 and four in Boro season 2021-22 were conducted under the TRB-BRRI project.
18.	Breeder and TLS seed production	In the reporting year, 4.41 tons of breeder seeds of different BRRI varieties were produced. However, 11.07 tons of TLS of BRRI rice varieties were produced and free distributed for quick dissemination of BRRI released varieties.
19.	F_1 Seed Production of BRRI Hybrid dhan5	A total of 900 kg hybrid seeds were produced from BRRI Hybrid dhan5 (BRRI 17A/BRRI31R) at BRRI RS Gopalganj during Boro 2021-22
	Regional Station, Sagardi, Barisal	
	Research Progress 2021-22	
Sl. No.	**Research Progress**	**Expected output**
1	**Programme area: Varietal development**	
	T. Aman 2021	
	Development of varieties for tidal submergence ecosystem	
	i) Hybridization	A total of 19 crosses were made and 765 F_1 seeds were obtained.
	ii) F_1 confirmation of HYV/Local crosses (Tidal submergence)	Out of 27 crosses, 24 crosses were confirmed and registered in BRRI cross list with station code BRBa149 to BRBa172

	iii) Growing of F_2 generation	A total of 349 plant progenies were selected for advance further as F_3
	iv) Growing of F_6 generation (Tidal submergence)	A total of 213 plant lines were selected for Observational Yield Trial
	Yield Trial (YT)	
	i) Observational Yield Trial (OYT)	Sixteen (16), out of 130 lines were selected based yield compared with the checks.
	ii) Preliminary Yield Trial-1	The specific and general adaptability of the advanced lines as compared with standard checks was evaluated in on-station condition at Charbadna farm, Barishal.
	iii) Preliminary Yield Trial-2	Specific and general adaptability of the advanced lines as compared with standard checks in on-station condition at Charbadna farm, Barishal.
	iv) Advanced Yield Trial of Promising Genotypes during	The advanced yield trial was conducted to evaluate the specific and general adaptability of the advanced breeding lines compared with standard checks in on-station condition at Charbadna farm, Barishal.
	Boro 2021-22	
	Rice Breeding for Favorable Condition	
	i) Hybridization	A total of 39 crosses were made and 2407 F1 seeds were obtained
	ii) F_1 Confirmation	Out of 26 crosses, 22 crosses were confirmed and registered in BRRI cross list with station code BRBa173to BRBa194
	iii) Growing of F_3 population in Boro 2021-22	A total of 1624 plant progenies were selected for further generation advance as F_4
	iv) Growing of F_5 generation	A total of 1412 plant progenies were selected for further generation advance as F_6
	v) Growing of F_6 generation in Boro	A total of 245 plant progenies were selected for further evaluation
	Breeding for New Generation Rice (NGR)	
	a. Introgression of Dense and Erect Panicle in Indica Rice (*Oryza sativa* L.) to Improve Plant Architecture	
	i) Growing of F_5 (SCA hybrids)	Plant progenies were selected for further

	generation	generation advance as F_6
	Yield Trial (YT), Boro 2021-22	
	i) Observational Yield Trial (OYT)	Among the 137 lines 13 lines were selected based yield compared with the check BRRI dhan67.
	ii) Preliminary Yield Trial	the specific and general adaptability of the advanced lines as compared with standard checks was evaluated in on-station condition at Charbadna farm, Barishal.
	iii) Regional Yield Trial #AGGRInet	The regional yield trial was conducted to select the best performing advanced breeding lines with higher grain yield over the existing HYVs across multiple experimental sites.
	iv) Regional Yield Trial for favorable Boro of short duration genotypes	The regional yield trial was conducted to select the best performing advanced breeding lines with higher grain yield over the existing HYVs across multiple experimental sites.
	v) Regional Yield Trial for favorable Boro of medium duration genotype	The regional yield trial was conducted to select the best performing advanced breeding lines with higher grain yield over the existing HYVs across multiple experimental sites.
	vi) Regional Yield Trial for favorable Boro of long duration genotypes	The regional yield trial was conducted to select the best performing advanced breeding lines with higher grain yield over the existing HYVs across multiple experimental sites.
	vii) Regional Yield Trial for Salt Tolerant rice-1 (STR#1)	The regional yield trial was conducted to test the specific and general adaptability of the advanced lines as compared with standard checks under on-farm condition.
	viii) Regional Yield Trial for disease resistant rice against Bacterial blight (DRR#1)	The regional yield trial was conducted to evaluate the specific and general adaptability of the advanced lines as compared with standard checks in on-station condition at Charbadna farm, Barishal.
	ix) Regional Yield Trial for disease resistant rice against Bacterial blight (DRR#2)	The regional yield trial was conducted to evaluate the specific and general adaptability of the advanced lines as

		compared with standard checks in on-station condition at Charbadna farm, Barishal.
	x) Regional Yield Trial for insect resistant rice against BPH	The regional yield trial was conducted to test the specific and general adaptability of the advanced lines as compared with standard checks under on-station condition.
	xi) Regional Yield Trial for favorable rice	The regional yield trial was conducted to evaluate the the advanced lines for specific and general adaptability along with standard checks in different regional station and headquarter of BRRI.
	xii) Regional Yield Trial for Super high yielding short slender rice	The regional yield trial was conducted to select the best performing advanced breeding lines with higher grain yield over the existing HYVs across multiple experimental sites.
	xiii) Regional Yield Trial for Super high yielding long slender rice	The regional yield trial was conducted to select the best performing advanced breeding lines with higher grain yield over the existing HYVs across the multiple experimental sites.
	xiv) Regional Yield Trial for favorable Boro (Bio)	The regional yield trial was conducted to select the best performing advanced breeding lines with higher grain yield over the existing HYVs across multiple experimental sites.
	xv) Regional Yield Trial for Zinc enriched rice	The regional yield trial was conducted to evaluate the specific and general adaptability of the advanced lines as compared with standard checks in on-station condition at Charbadna farm, Barishal.
2	**Program Area: Pest Management**	
	i) Incidence of insect pest and natural enemies in light trap Appearance of insect pest was found lower than previous reporting year. Highest green leafhopper (GLH) followed by yellow stem borer (YSB), white leafhopper (WLH), and brown planthopper (BPH) was recorded in the reporting year. In case of	To find out To create a database on insect pests and their natural enemies to develop a forecasting system.

	natural enemy highest staphylinid beetle (STPB) followed by carabid beetle (CDB) and earwig (EW) was observed. Insect pest was trapped higher in the reporting year than natural enemy	
	ii) Development of a Rectangular hand net for insecticide free rice seedbed A new hand net consists of a rectangular frame was developed that includes 4 mm GI wire and the frame length and width is 50 cm and 20 cm, respectively. It also comprised with a plastic pipe which length is 100 cm, radious 1.90 cm and market available white color mosquito net, which length is 80 cm started from the frame. All the materials of RHN were locally available, farmers can easily make up.	Farmers can raise seedlings in rice seedbed without insecticides
	iii) Performance of Rectangular Hand Net in seedbed Insect caught efficiency using Rectangular hand net (48.33) performance found significantly better than round hand net (26.67). Harmful insect pest yellow stem borer, green leafhopper, grasshopper, rice hispa, thrips, leaf folder etc. were caught higher by RHN.	Farmers can raise seedlings in rice seedbed without insecticides with high efficiency seedbed
	vi) Rat caught efficiency of different rodenticides Zinc phosphate (4.5) bait was found highest effective for rat death compared to other treatments. Phostoxin gas tablet and bromadiolon performance found better compared to control (0.0) and rat-atom magic treatment (0.5)	Identified effective rodenticides for Barishal region
	vi) Performance of yellow stem borer pheromone lures in different varieties. Yellow stem borer caught was found no significant difference among different varieties. Higher average yellow stem borer caught was recorded in BRRI dhan82 (4.17) followed by BRRI dhan98 (4.08) and BRRI dhan48 (3.08) after seven (07) days interval. After 04 weeks yellow stem borer was caught in different varieties was as 37 in BRRI dhan48, 50 in BRRI dhan82 and 49 in BRRI dhan98.	Pheromone lure had moderate efficacy in controlling YSB.
	vii) Survey and monitoring of rice diseases in selected areas of Barishal region Average bacterial leaf blight incidence (29.9%) was predominant in T. Aman, 2021 at Barishal followed by brown spot and sheath blight and their incidence	Database would be created in order to develop forecasting models.

	were 24.3% and 19.5% respectively	
3	**PROGRAM AREA: CROP SOIL WATER MANAGEMANNT**	
	i) Long-term missing element trial for diagnosing limiting nutrient in tidal flooded soil The lowest yield was recorded in –P plot followed by –K plot. Thus, it is observed from the yield data that all the nutrients (N, P, K, S and Zn) should be applied during T. Aman season to maintain soil nutrient levels as well as for optimum yield of BRRI dhan52.	Optimum rate of fertilizer could be identified
	ii) Exploring sediment deposition from tidal water in Barishal regional station The good quality of sediment with plant nutrients indicated that the soils of the farm were enriched. The sediment was slightly alkaline (pH=7.8) and organic matter was high in amount (3.27%). Among inorganic nutrients the amount of sulphur (15.33 µg g^{-1}) was quite noticeable.	Sedimants nutrients could be identified.
4	**Socio Economic policy**	
	i) Stability analysis of BRRI released variety in Aus 2021: Among the tested 12 varieties BRRI hybrid dhan7 gave highest yield (4.77t/ha) followed by BRRI dha82 (4.56 t/ha), BRRI dhan98 (4.54 t/ha) and BRRI dhan85 (4.03 t/ha). The lowest yield was observed in BR 21 (2.76 t/ha)	To find out the suitable rice cultivars in Barisal region.
	ii) Stability analysis of BRRI released variety in Aman 2021: Among the tested of short duration variety, the highest yield was observed in BRRI dhan71 (5.50 t/ha) followed by BRRI dhan95 (5.38t/ha), BRRI dhan73 (4.83 t/ha), BRRI dhan87 (4.80 t/ha) and BRRI hybrid dhan6 (4.80 t/ha). The lowest yield was found in BRRI dhan62 (3.62 t/ha). In medium duration varieties, the highest yield was found in BRRI dhan54 (5.69 t/ha) followed by BRRI dhan94 (5.61 t/ha) and BRRI dhan49 (5.36) t/ha). The lowest yield was observed in BR3 (4.09 t/ha). Finally, in the long duration varieties, the highest yield was in BRRI dhan76 (5.92 t/ha) followed by BRRI dhan46 (5.79 t/ha) and the lowest yield was in BRRI dhan91 (3.89 t/ha)	To find out the suitable rice cultivars in Barisal region.
	iii) Stability analysis of BRRI released Boro	To find out the suitable rice cultivars in

	varieties, Boro 2021-22: Among the tested short duration variety, the highest yield was observed in BRRI hybrid dhan5 (7.05 t/ha) followed by BRRI dhan74 (6.66 t/ha) BRRI dhan68 (6.62 t/ha) and BRRI dhan96 (6.62 t/ha). The lowest yield was found in BRRI dhan36 (5.07 t/ha). In case of the long duration varieties, the highest yield was in BRRI dhan92 (6.30 t/ha) followed by BRRI dhan89 (6.05 t/ha) and BRRI dhan69 (5.98 t/ha). The lowest yield was observed in BR 17 (3.51 t/ha)	Barisal region.
5	**Program Area: Technology Transfer**	
	A. ALART Zinc Enriched Rice (ZER), T. Aman 2021	Evaluated best entry for proposed variety trial
	i) ALART, Favorable Boro Rice-Barishal (FBR-Barishal), Boro 2021-2022 ii) ALART, Blast Resistant Rice (BRR), Boro 2021-2022 iii) ALART, Superior High Yielding Rice (SHR), Boro 2021-2022 iv) ALART, Salt Tolerant Rice-1 (STR-1), Boro 2021-2022 v) ALART, Salt Tolerant Rice-2 (STR-2), Boro 2021-2022	Evaluated best entry for proposed variety trial
6	**Proposed variety evaluation trail of hybrid rice, Boro 2021-22** In Set A, the highest grain yield was obtained from H1527 (9.79 t/ha) having 141 days growth duration while lowest yield from H1545 (6.18 t/ha) with 147 days growth duration. In Set B, test entry H1560 gave the highest yield (9.21t/ha) having 144days growth duration while H1561 gave the lowest yield (7.28 t/ha) with 132 days growth duration. Irrespective of different sets, test entries H1532, H1533, H1534, H1535, H1543, H1544, H1545, H1560, H1562, H1566 and H1572 produced more than 9 t/ha grain yields. Average grain yield of test entries was 8.57 t/ha in Set A and 8.55 t/ha in Set B.	Find out high yielding hybrid entry
7	**Demonstration, seed production and scaling up of BRRI rice varieties under GOB, and other**	Increase quality seed production and

	Projects during T. Aman 2021 From the demonstrated varieties, BRRI-Barishal tried to motivate farmers to replace farmers' local varieties to BRRI released latest Aman varieties. The highest yield was obtained by BRRI dhan76 (4.17t/ha) followed by BRRI dhan72 (4.03 t/ha) and BRRI dhan87 (3.94 t/ha). As Barishal region is low tidal submergence land so suitable land for BRRI dhan87 was difficult and its growth duration was about 125-130 days only. However, it was chosen by those farmers who wanted to do oil crop after Aman season. On the other hand, farmers' preferred BRRI dhan72 and BRRI dhan76 and wanted to cultivate these varieties for the next year along with surrounding farmers	distribution among farmers
8	**Breeder seed and TLS production** In Aus, total 13457 kg seed was produced in charbadna farm where 11617 kg was breeder seed. In T. Aman 2021, a total of 18178 kg and in Boro 2021-22, a total of 31,440 kg breeder seed were produced. In T. Aman 2021, a total of 20571 kg TLS and in Boro 2020-21, a total of 15095 kg	Increase quality seed production and distribution among farmers and BADC
9	**Farmers' training and field day under different projects/GoB** A total 1080 farmers trained about modern rice production technology during 2021-2022. Twelve field day and one wokshop conducted during research area.	For disseminate high yielding varieties
	BRRI, Regional Station, Satkhira	
	Research Progress 2021-22	
Sl. No.	**Research Progress**	**Major Output**
1.	Development of four-cropped cropping pattern under irrigated ecosystem	Four-crop model Mustard (Relay)-Boro-Jute (Transplanted)-T.Aman
2.	Seed production and dissemination program (SPDP)	
3.	Screening of hybrid parental lines at full growth stages in the saline field	BRRI hybrid dhan3 and BRRI hybrid dhan5 were found better among the tested entries
4.	Regional Yield Trial (RYT)	Blast resistant advanced lines were suggested for ALART
5.	Advanced Line Adaptive Research Trial (ALART)	All the programs were done successfully
6.	Head-to-head adaptive trial (HHAT) of Modern Rice Varieties	BR10 and BR23 were found effective among the tested varieties including recently released varieties
	Regional Station, Sonagazi, Feni	

	Research Progress 2021-2022	
Sl. No.	**Research Progress**	**Major Output**
	Season: Aus 2021	
1.	Stability Analysis of BRRI developed rice varieties in Aus 2021 To investigate the stability of BRRI developed Aus rice varieties To find out location specific suitable variety(s)	Among the twelves rice varieties, BRRI Hybrid dhan7 ranked the top in terms of yield (6.86 t ha^{-1}) followed by BRRI dhan48 (5.51 t ha^{-1}). Growth duration of these varieties ranged from 102-117 days
2.	Regional Yield Trial (RYT-1) in Aus 2021 To evaluate specific and general adaptability of the advance breeding lines as compared with standard checks in on-station.	None of the tested lines Were selected
3.	Regional Yield Trial -2 in Aus 2021	None of the tested lines were selected
4.	Seed production and Dissemination Program (SPDP) Aus 2021 (54 SPDPs were executed in 54 bigha land under twelve Upazila of five districts (Feni, Noakhali, Cox'sbazar, Rangamati and Bandarban) during Aus 2021 in collaboration of Department of Agricultural Extension (DAE). BRRI dhan82, BRRI dhan83, BRRI dhan85 and BRRI dhan98 were used in the SPDPs) ➢ Rapid dissemination of newly released rice varieties to the farmers ➢ Motivate farmers to produce and preserve good quality seeds ➢ Increase availability of quality seed of modern rice varieties at farm level ➢ Exchange seeds from farmers to farmers ➢ Collect feedback about the varieties from farmers and Extension personnel.	Total production of all the varieties was 33876 kg from which 3215 kg was retained as seeds (13% of total production) by the farmers for next season cultivation. About 2183 farmers gained awareness and knowledge about the varieties and 332 farmers (15% of total farmers) were motivated to cultivate the varieties.
5.	Demonstration of BRRI hybrid dhan7 ➢ Rapid dissemination of BRRI hybrid dhan7 to the farmers ➢ To increase food security producing more rice.	Done
6.	Stability Analysis of BRRI Developed Rice Varieties in T. Aman 2021	Among the 47 varieties, BRRI hybrid dhan6 (7.06 t/ha) gave highest yield followed by BRRI dhan71 (6.81 t/ha),

	➢ To investigate the stability of BRRI developed Aman rice varieties. ➢ To find out location specific suitable variety(s)	BRRI dhan95 (6.26 t/ha) and BRRI dhan66 (6.05 t/ha) Growth duration of these varieties ranged from 105-167 days
7.	Regional Yield Trial (RYT-1) STR in T. Aman 2021 To evaluate specific and general adaptability of the advance salinity tolerant breeding lines as compared with standard checks in on-station.	One tested line was selected
8.	Regional Yield Trial (RYT-2) STR in T. Aman 2021	None of the tested lines were selected
9.	Regional Yield Trial (RYT) RLR in T. Aman 2021	None of the tested lines were selected
10.	Regional Yield Trial (RYT) ZER in T. Aman 2021	None of the tested lines were selected
11.	Advanced Lines Adaptive Research Trial (SubTR-SD) in T. Aman 2021 ➢ To evaluate the yield potential and adaptability of the rice genotypes at farmers' field as submergence tolerance short duration during T. Aman season. ➢ To get feedback information about the advantages and disadvantages of the selected materials from farmers and Extension personnel. ➢ To select suitable material(s) for proposed variety trial (PVT).	All tested entries gave highest yield compared to checks.
12.	Advanced Lines Adaptive Research Trial (SubTR-LD) in T. Aman 2021	All tested entries gave highest yield compared to checks.
13.	Advanced Lines Adaptive Research Trial (PQR) in T. Aman 2021	All tested entries gave highest yield compared to checks.
14.	Survey and monitoring of rice diseases in Aman 2021. To monitor the disease prevalence at Chattogram and Rangamati region.	Bacterial Leaf Blight (BLB), Bacterial Leaf Streak (BLS), Sheath rot, False smut and Sheath blight infestation were observed in different scores BRRI dhan49 and BRRI dhan79 were affected by false smut disease in different locations due to fluctuation of environmental conditions. BRRI dhan87 was affected by tungro in different locations during Aman 2021.
15.	Head to Head Adaptive Trial (LD, SD, CE & FFS) under TRB, Aman 2021 ➢ Validate the adaptability of modern rice varieties in different environments at farmers' field	All tested entries gave highest yield compared to checks.

	➢ Investigate the performance of promising varieties compared to popular mega variety. ➢ Select suitable variety(s) for target environments	
16.	Head to Head Adaptive Trial (LD, SD & CE) under TRB, Aman 2021	All tested entries gave highest yield compared to checks.
17.	Seed Production and Dissemination Program (SPDP) during T. Aman2021, under GOB	A total of 600 SPDPs were conducted in 600 bigha land under fortyUpazila of eight districts (Feni, Noakhali, Laxmipur, Khagrachari, Chattogram, Cox'sbazar, Bandarban and Rangamati) during Aman 2021 in collaboration with DAE. BRRI dhan34, BRRI dhan71, BRRI dhan78, BRRI dhan79, BRRI dhan80, BRRI dhan87, BRRI dhan90 and BRRI Hybrid dhan6 were used in the SPDPs. Total production of all the varieties was 201410 kg from which 16795 kg was retained as seeds (13% of total production) by the farmers for next season cultivation. About 9657 farmers gained awareness and knowledge about the varieties and 1284 farmers (15% of total farmers) were motivated to cultivate the varieties.
18.	**Breeder seed production** (BRRI dhan34, 49, 82 & 87) in T. Aman 2021 To guarantee that the subsequent generation seed class (foundation seed) shall conform to the prescribed standards of genetic purity.	A total of 13.5 tons breeder seeds were produced during Aman season.
19.	Truthfully Labeled Seed (TLS) Production (Variety: BRRI dhan34, 48, 49, 52, 70, 71, 73, 75, 76, 78, 79, 80, 82, 83, 85, 87, 90, 93, 94, 95, 97, 98, 99, 100) in T. Aman 2021 ➢ Utilize quality seed for conducting Research (HHAT) and Demonstration (SPDP) ➢ Provide seeds to different stakeholders to enhance dissemination of modern rice varieties.	Total production of TLS during Aman were 10.5 tons.
20.	RYT Zinc Enriched Rice (ZER) in Boro 2021-22 To evaluate specific and general adaptability of the advance salinity tolerant breeding lines as compared with standard checks in on-station.	None of the tested lines were selected
21.	RYT Favorable Boro Rice Medium Duration (FBR-MD) in Boro 2021-22	Six tested lines were selected

22.	RYT Favorable Boro Rice Medium Duration (FBR-LD) in Boro 2021-22	One tested line was selected
23.	RYT Favorable Boro Rice Medium Duration (FBR-SD) in Boro 2021-22	two tested lines were selected
24.	RYT Favorable Boro Rice Biotechnology	None of the tested lines were selected
25.	Effect of micronutrient Zinc in Boro 2021-22 To investigate the effect of Zinc on Boro rice varieties.	Continued
26.	Screening of Insect pest and Diseases ➢ To investigate pest and disease incidence and tolerance of the modern rice varieties. ➢ To select resistant rice varieties against major rice insect pest and disease	
27.	Yield maximization in Boro 2021-22 To maximize the yield of rice through integrated use of manures and fertilizers	Continued
28.	Evaluation of NPK Combo in Boro 2021-22 To see the effect of NPK combo fertilizer on yield of rice production	”
29.	Evaluation of Flora Boro 2021 To see the effect of Flora on better growth of rice plant	”
30.	MLT Plant Pathology Boro 2021-22 To Evaluate specific and general adaptability of disease resistant advance lines	”
31.	Screening of modern rice against Stem Borer & Leaf Folder To evaluate pest incidence and tolerance on modern rice varieties	”
32.	OYT Plant Pathology Boro 2021-22 To evaluate disease tolerance and yield potential of advance breeding lines	”
33.	Effect of Nitrogen on Modern varieties of Boro rice 2021-22 • To evaluate the responses of Bangabandhu dhan100 under a range of nitrogen supplies. • To find out optimum nitrogen requirement for maximum yield of Bangabandhu dhan100.	”
34.	Advanced Lines Adaptive Research Trial (STR-1)	All tested entries gave highest yield

	in Boro 2021-22 ➢ To evaluate the yield potential and adaptability of the advanced rice genotypes at farmer's field as salinity tolerance Boro rice in the real salinity prone area. To get feedback information about the advantages and disadvantages of the selected materials from farmers and Extension personnel. ➢ To select suitable material(s) for proposed variety trial (PVT).	compared to checks.
35.	Advanced Lines Adaptive Research Trial (STR-2) in Boro 2021-22	All tested entries gave highest yield compared to checks.
36.	Advanced Lines Adaptive Research Trial (STR-1) in Boro 2021-22	”
37.	Advanced Lines Adaptive Research Trial (STR-2) in Boro 2021-22	”
38.	Advanced Lines Adaptive Research Trial (Superior High Yielding Rice- SHR) in Boro 2021-22	”
39.	Advanced Lines Adaptive Research Trial (FBR Barishal) in Boro 2021-22	”
40.	Advanced Lines Adaptive Research Trial (PQR) in Boro 2021-22	”
41.	Optimizing Planting Geometry of BD100 in Boro2021-22 ➢ To investigate the responses of Bangabandhu dhan100 to varying plant spacings. ➢ To determine the optimum spacing for better performance of Bangabandhu dhan100	For producing highest grain yield from Bangabandhu dhan100, it is recommended to use closer spacing in coastal region, but if we want highest tiller number and panicle number we can use wider spacing.
42.	Effect of micronutrient Zinc on the performance of modern rice varieties in Boro 2021-22 To investigate the effect of Zinc on the performance of the rice varieties.	continued
43.	Stability Analysis of BRRI Developed Rice Varieties in Boro 2021-22 ➢ To investigate the stability of BRRI developed Boro rice varieties. ➢ To find out location specific suitable variety(s)	Among the 49 varieties, BRRI hybrid dhan3 (9.73 t/ha) gave highest yield followed by BRRI hybrid dhan5 (8.59 t/ha), BRRI dhan89 (8.57 t/ha), BRRI hybrid dhan2 (8.52 t/ha) and BRRI dhan92 (8.17 t/ha). Growth duration of these varieties ranged from 141-162 days.
44.	Survey and monitoring of rice diseases in Boro2021-22	BRRI dhan28, BRRI dhan29 and BRRI dhan84 were affected moderately by blast

	To monitor the disease prevalence at Chattogram and Rangamati region.	during Boro season. The farmers were suggested by BRRI Sonagazi for preventive measures using fungicide.
45.	F_1 Seed Production of BRRI hybrid dhan5 in Boro 2021-22 To produce F1 hybrid seed of BRRI hybrid dhan5	A total of 450 kg (0.34 t/ha) F_1 seed from BRRI hybrid dhan5 was produced.
46.	Breeder Seed Production (Variety: BRRI dhan28, BRRI dhan29 and BRRI dhan48) To guarantee that the subsequent generation seed class (foundation seed) shall conform to the prescribed standards of genetic purity	A total of 19 tons breeder seeds were produced during Boro season.
47.	Truthfully Labeled Seed (TLS) Production (Variety: BRRI dhan89, 92, 97, 99, 100, 102) in Boro 2021-22	Total production of TLS during Boro was 16.1 tons.
48.	Seed Production and Dissemination Program (SPDP) during Boro2021-22, under GOB (A total of 420 SPDPs were conducted in 31 upazila of 8 districts (Feni, Laxmipur, Noakhali, Chattogram, Khagrachari, Rangamati, Bandarban and Cox'sbazar) under GOB during Boro 2022. Twelve modern rice varieties BRRI dhan67, BRRI dhan74, BRRI dhan84, BRRI dhan88, BRRI dhan89, BRRI dhan92, and BRRI dhan96, BRRI dhan97, BRRI dhan99, Bangabondhu dhan100, BRRI Hybrid dhan3 and BRRI Hybrid dhan5 were demonstrated in the SPDPs.) ➢ Rapid dissemination of newly released rice varieties to the farmers ➢ Motivate farmers to produce and preserve good quality seeds ➢ Increase availability of quality seed of modern rice varieties at farm level ➢ Exchange seeds from farmers to farmers. ➢ Collect feedback about the varieties from farmers and Extension personnel.	Total production of all the varieties was 393250 kg from which 58331 kg was retained as seeds (15% of total production) by the farmers for next season cultivation. About 17316 farmers gained awareness and knowledge about the varieties and 3143 farmers (18% of total farmers) were motivated to cultivate the varieties.
49.	Seed Production and Dissemination Program (SPDP) during Boro2021-22, under TRB (A total of 60 SPDPs were conducted in 20 upazila of 8 districts (Feni, Laxmipur, Noakhali, Chattogram, Khagrachari, Rangamati, Bandarban and Cox'sbazar) under Kormosuchi during Boro 2022. Five modern rice varieties BRRI dhan84, BRRI dhan92, and BRRI	Total production of all the varieties was 53876 kg from which 11105 kg was retained as seeds (21% of total production) by the farmers for next season cultivation. About 6020 farmers gained awareness and knowledge about the varieties and 1074 farmers (18% of total farmers) were

	dhan97, BRRI dhan99 and Bangabondhu dhan100 were demonstrated in the SPDPs.)	motivated to cultivate the varieties.
50.	Seed Production and Dissemination Program (SPDP) during Boro2021-22, under HHAT (A total of 101 SPDPs were conducted in 11 upazila of 8 districts (Feni, Laxmipur, Noakhali, Chattogram, Khagrachari, Rangamati, Bandarban and Cox'sbazar) during Boro 2022. Eight modern rice varieties BRRI dhan67, BRRI dhan74, BRRI dhan84, BRRI dhan89, BRRI dhan92, and BRRI dhan97, BRRI dhan99 and Bangabondhu dhan100 were demonstrated in the SPDPs.)	Total production of all the varieties was 88250 kg from which 8356 kg was retained as seeds (9% of total production) by the farmers for next season cultivation. About 6988 farmers gained awareness and knowledge about the varieties and 2089 farmers (29% of total farmers) were motivated to cultivate the varieties.
51.	Farmers Training on Rice Technologies 2021-22 ➢ To update knowledge and skills of farmers and extension personnel on modern rice production technologies. ➢ To enhance dissemination of new technologies among the farmers.	A total number of 80 farmer trainings on "Modern Rice production technology" were conducted in Eight different districts during the reporting period. A total of 2400 farmers (1770 male and 390 female) and DAE personnel (208 male and 32 female) were trained up with rice production technology in different ecosystem especially on tidal submergence, salinity and favorable environment.
52.	Field Day 2021-22 Awareness building and create interest among the farmers and concerned extension agents about the modern rice production technologies.	A total of 38 field days were arranged during Aus, T. Aman & Boro season 2021-22. Out of 38 field days 29 were funded by GOB, 8 by Karmasuchi and 1 by Hybrid rice project. Almost 3520 progressive farmers, local leaders, DAE field personnel, public representatives & NGO workers participated in those occasions.
	Regional Station, Rajshahi	
	Research Progress 2021-22	
SL	**Program area/Project (Aus-Aman 2021-22)**	**Major Output**
	Program area: Varietal Development	
1	Hybridization	**Made 7 crosses with 364 F1 seeds**
2	Confirmation of F1	Out of 32 crosses, 25 crosses were confirmed
3	FRGA	21834 progenies were harvested
4	Yield Trial (RYT)	14 genotypes were selected from 9 RYT for further used
5	Collection and maintenance of local landraces	18 genotypes were collected & evaluated
SL	**Program area/Project (Boro 2021-22)**	**Major Output**
1	Hybridization	19 crosses and 261 F1 seeds

2	FRGA	17141 progenies were harvested from 20 crosses
3	Yield Trial (RYT)	142 genotypes were evaluated through 20 RYT & 36 genotypes were selected for further used
4	Collection and maintenance of local landraces	15 genotypes were collected & evaluated
5	Purification of Zira landraces	8 Zira landraces were purified for further used
	Pest management	
1	Survey and monitoring of different rice diseases in T. Aman 21, Rajshahi	Survey was done in 3 upazilla
2	Evaluation of effective chemical against Sheath Blight disease of rice, T. Aman 2021	none of fungicides was found
3	Efficacy of New Chemicals in Controlling Grain Spot, Brown Spot and Narrow Brown Spot of BRRI dhan52	none of fungicides was found
4	Integrated Approaches in reducing Sheath blight diseases in T Aman 2021	Disease pressure was low but it contributed in maximizing yield.
5	Effect of selected insecticide for stem borer management	Fipronil 50SC (3.44% white head) found superior among all insecticides but at per with Cartap 50SC (4.45% white head).
	Rice Farming System	
1	Evaluation of crop productivity and soil health under four crops cropping patterns in Rajshahi region	Considering system yield, the higher REY was found in Potato/pumpkin (relay)-T Aus-T. Aman (BRRI dhan75) cropping pattern followed by Mustard-Onion-T. Aus-T. Aman (BRRI dhan75. The lower system yield was found in Potato-Maize-T. Aman (BRRI dhan95) cropping pattern.
2	Evaluation of crop productivity and soil health under strip tillage system in maize-mungbean-rice cropping pattern	The gross return (Tk. 519500) as well as gross margin (Tk.258980) remained higher in Strip tillage dry seeded rice followed by strip tillage maize and mungbean, while those were remained lower in conventional transplanted rice followed by conventional maize and mungben. treatment (Gross return Tk.499480 and Gross margin Tk. 230940)
3	Evaluation of crop productivity under four crops cropping patterns in Rajshahi region	Considering system yield of four crop-based patterns, the higher REY (31.57 t/ha) was found in CP_1. Pair row potato/pair row Maize-T Aus (BRRI dhan82)-T. Aman (BRRI dhan75). Among the five cropping patterns, the lower system yield was found in three

		crop-based cropping patterns of CP_5: Maize-Mungbean-T. Aman (BRRI dhan75). (20.1 t/ha).
4	Effect of time of planting of rice varieties in Barind Region in Boro Season	The yield performance of BRRI dhan89 was remained higher in early seeding (upto 15 December) while the yield performance remained higher in late planting situation (upto 30 January).
5	Performance evaluation of Aman rice in Rajshahi Region	In on-station and in farmer's field, the highest grain yields were found in BRRI dhan51 (5.86 and 5.56 t/ha) and the lowest yields were recorded in BRRI dhan87 (5.12 and 4.76 t/ha).