

### Research Progress 2022-2023

Sl. No.	Program Area/Project/ Experiment Title & Research Progress of 2022-23	Major Output
	<b>Program Area: Varietal Development program (VDP)</b>	
	<b>Name of Division: Plant Breeding Division</b>	
	<b>1. Rice Breeding</b>	
<b>1.1</b>	<p><b>Development of Upland Rice (B. Aus and Jhum rice)</b></p> <p>In 2022-23, eleven crosses were made using 17 parents. Out of seven crosses, six crosses were confirmed as true F<sub>1</sub> through hybridity test. Out of 2,262 lines, a total of 64 genotypes derived from 14 crosses were selected from LST trial based on uniform flowering, grain type traits and phenotypic acceptability under field condition. In OYT trial, twenty-seven entries were selected out of 207 advanced breeding lines considering growth duration, yield, uniformity of morpho-agronomic traits and superiority in one or more traits over the standard checks. Eight genotypes such as BR12236-5R-6, BR12244-5R-24, BR12248-5R-18, BR12248-5R-22, BR12248-5R-37, BR12248-5R-65, BR12248-5R-122 and BR12263-5R-75 were selected from 15 tested entries on the basis of yield and short growth duration in PYT-1. In PYT-2, four genotypes were selected namely, BR12239-5R-136, BR12244-5R-190, BR12246-5R-97 and BR12248-5R-31 from fourteen advanced lines and in PYT-3 trial, seven genotypes were evaluated but none of the entry was selected. Four genotypes viz. BR11262-B-109-3-47, BR10756-2B-8-72, BR10409-15-2-8 and BR10417-15-2-11 were selected out of seven tested entries in SYT.</p> <p>Improvement of jhum rice under upland rice program was implemented to develop high yielding rice variety with low (10-19%) to high (&gt;25%) grain amylose content and drought tolerance along with good eating quality for jhum cultivation acceptable to tribal of Chattogram hill districts. Seventeen crosses were made using promising parental genotypes from local Jhum cultivars namely Chikon</p>	<p>For B. Aus, promising high yielding (4.0-4.5 t/ha) lines/ varieties will be developed with multiple traits such as quick seedling emergence, vigorous growth, shorter growth duration (90-100 days); tolerance to lodging and drought and pre-harvest sprouting tolerance; medium bold to medium slender grains and good eating and cooking quality.</p> <p>For Jhum rice, high yielding rice variety with low (10-19%) to high (&gt;25%) grain amylose content and drought tolerance along with less fertilizer use efficiency, good eating quality acceptable to tribal people of Chattogram hill districts following their traditional cultivation practices (Dibbling method of planting associated with other crop species) will</p>

	<p>Chakma, Patri dhan, Gunda-1, Mojenshi, Kalo Binni, Sumodhan, Ranqui; exotic varieties (Japanese Black rice, DR-6, Abhaya, Basmati); BRRRI varieties (BR24, BRRRI dhan55); promising advanced breeding lines (BR12239-5R-197, BR10418-54-4-96, BR10411-54-6-33, BR12239-5R-93, BR10756-28-8-12, BR12234-4R-209 and BR10756-28-8-72) having good performance in terms of yield in rainfed situation, drought tolerance capacity and other remarkable traits following respective product profile. Seven crosses were confirmed as true F<sub>1</sub>. Six F<sub>2</sub> population were grown for generation advance through field RGA (Rapid generation advance). A total of 9,180 progenies obtained from 17 crosses of F<sub>4</sub> generation were advanced through field RGA. Twenty-three entries were selected from 48 tested genotypes in OYT were selected. In the reporting year, four preliminary yield trials (PYT) were executed. Among these, four genotypes were tracked better to promote from fourteen evaluated genotypes in PYT-1. No entries were selected in PYT-2 due to poor performance better than the check varieties. In PYT-3, only six genotypes out of 18 were better yielder performance over the checks. In PYT-4 trial, none of the entry was promoted for succeeding trial considering growth duration, yield and phenotypic acceptability. Seven genotypes out of 16 entries were selected in SYT. An advanced yield trial was conducted in six locations of three hilly districts (Khagrachari, Rangamati and Bandarban) of Bangladesh. Eight genotypes including BRRRI dhan83 as standard check and one local check i.e., most popular cultivar specific to each location were evaluated. The other six common genotypes for each of the six trials were Chinese Rice, Japanese black rice, Mongthongno, IR1-DQ157-R6-D1, GSR IR1DQ121-Y6-D2 and BR(Bio)10376-AC4-1-3. Among all the entries, despite heterogeneity in climatic condition and topographic architecture, BRRRI dhan83 was the top yielder in every trial.</p>	<p>be developed.</p>
<p><b>1.2</b></p>	<p><b>Development of T. Aus</b></p> <p>In total, 30 crosses were made using 40 parents and 4,127 F<sub>1</sub> seeds were obtained; 23 crosses were confirmed as true F<sub>1</sub>; 24,300 progenies of 53 crosses in T. Aus season were advanced through modified field rapid generation advance (FRGA) technique. Out of 7,700 lines of 22 crosses, 792 uniform lines were identified from LST based on uniformity in heading, plant height, and acceptable grain type in the field condition. Finally, 697 fixed lines were selected from 792 lines on the basis of trait genotyping with 12-SNP indica panel. Forty genotypes were selected out of 318 entries in observational yield trial (OYT), twenty-four advanced lines were selected out of 195 from AYT#1 and AYT#2 for T. Aus growing areas of Bangladesh on the basis of homogeneity with respect to plant height, phenotypic acceptability at vegetative and maturity</p>	<p>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 alone with tolerance to lodging and heat (high temperature) at the reproductive phase, pre-harvest sprouting and good grain quality.</p>

	<p>stages and physicochemical properties. Three genotypes were selected from RYT#1 and two genotypes were selected from RYT#2 for non-saline tidal ecosystem, along with the check BRRIdhan27, BRRIdhan48 and BRRIdhan98. The proposed line BR8781-16-1-3-P2 was evaluated along with the check variety BRRIdhan27 under PVT in six locations of non-saline tidal T. Aus growing areas of Bangladesh. Finally, proposed line was recommended to release as variety BRRIdhan106. Lodging tolerance is the special feature of this variety. Amylose content is 27.2% and protein content of this variety is 8.5%.</p>	
<b>1.3</b>	<p><b>Development of rice for shallow flooded and deep-water environment</b></p> <p>In total, 23 crosses were made by using 20 parents and produced 2,500 F<sub>1</sub> Seeds. In total seven F<sub>1</sub>s crosses were confirmed through QC SNP panel analysis. A total of 11,754 progenies from 73 crosses (3,064 progenies of 15 F<sub>2</sub> crosses, 3,295 progenies of 19 F<sub>3</sub> crosses, 3,541 progenies of 20 F<sub>4</sub> crosses, 1,881 progenies of 19 F<sub>5</sub> crosses) were advanced through RGA. In yield trials, 34 genotypes were selected out of 83 genotypes. In OYT trial, the genotype BR11186-5R-119 gave highest yield (3.5 t/ha) which is significantly higher than the check variety BRRIdhan91 (1.8 t/ha) whereas in AYT the genotype BR11186-5R-549 (3.5 t/h) gave highest yield which was significantly higher than the check variety BRRIdhan91 (1.7 t/ha). The heritability obtained for growth duration was ranging from 82% to 88% and grain yield was ranging from 61 % to 74% indicating acceptable level of precision in these experiments. Through maintenance breeding 15 shallow flood tolerant genotypes and landraces were grown and maintained for future breeding purpose.</p> <p>Two lines namely BR10230-7-19-2B (3.1 t/ha) and BR9392-6-2-1B (3.0 t/ha) were selected out of six genotypes in the ALART under deep water (100-150 cm) condition. The ALART materials were suggested for evaluating as re-trial due to damage of crops by heavy flood in four locations. On the other hand, BR10260-5-15-21-6B was evaluated in PVT trial and this line produced 1.45 t/ha more yield than the check variety BRRIdhan91. However, the PVT material was suggested to evaluate as re-trial due to damage of crops in three locations. In T. Aman (stagnant water) 2022-23, RYT#Tall materials were evaluated with four breeding lines and check BRRIdhan91. The highest yield was observed in the advanced line BR10247-14-18-7-3B (4.94 t/ha) followed by the line BR10238-5-1-9-3B (4.82 t/ha) and BR9892-8-2-2B (4.70 t/ha).</p>	<p>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.</p>
<b>1.4</b>	<p><b>Development of Rainfed Lowland Rice (RLR)</b></p> <p>In T. Aman 2022-23 reporting year, totally 5,329 F<sub>1</sub> seeds were obtained from 32 single crosses and 35 crosses were confirmed as true hybrids using 10-SNP <i>indica</i> QC panel. A total of 8,362</p>	<p>Short duration varieties (105-115 days) with 4.5-5.0 t/ha yield potential and</p>

	<p>individual progenies of 27 crosses from F<sub>3</sub> and F<sub>5</sub> generations were harvested from T. Aman season through RGA method. The materials were advanced in Boro 2022-23 season and 20,000 progenies of 59 crosses from F<sub>2</sub> and F<sub>4</sub> generations were harvested in Boro season at Gazipur through RGA method. A total of 384 genotypes were selected out of 6,651 progenies of Line Stage Testing (LST) trial with 5.66% selection intensity. A total of 507 genotypes were evaluated in two Observational Yield Trials (OYT) in Gazipur, Cumilla and Rangpur. Among the tested genotypes 104 genotypes were selected and forwarded in Advanced Yield Trial (AYT). In Advanced Yield Trial (AYT) 26 genotypes were evaluated in two trials in Gazipur, Cumilla and Rangpur and 16 genotypes were found as promising for advanced. None of the genotypes were found promising from IRLON (International Rainfed Lowland Observational Nursery) out of 28 fixed lines. Secondary Yield Trial (SYT) containing three tested genotypes, only one was advanced based on grain yield. Among the four tested genotypes of Regional Yield Trial (RYT) none was advanced for ALART due to not significant higher yield performance.</p>	<p>medium duration (116-130 days) varieties with 6.0-7.0 t/ha yield potential will be developed.</p>
<p><b>1.5</b></p>	<p><b>Development of Salt Tolerant Rice (STR)</b></p> <p>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 T. Aman season, 29 crosses were made using 40 well characterized elite parents with higher genetic merit/breeding values and various alleles of interest. A total of 39 F<sub>1</sub>s were confirmed as true hybrids through hybridity test via F<sub>1</sub> verification by quality check (QC) genotyping with purity SNP panel during T. Aman season. In T. Aman season, 41192 segregating progenies derived from 110 crosses were advanced in F<sub>2</sub>-F<sub>5</sub> generations using FRGA technique. Yield trials were carried out in Gazipur, Debhata, Kaliganj and BRRI Farm, Satkhira in T. Aman season. In LST, out of 5085 breeding lines of 30 crosses, 452 lines were selected on the basis of strong culm with good plant ideotype, acceptable grain type and uniformity at heading in field condition. Out of 772 genotypes, 237 genotypes were selected from OYT. Four PYTs (PYT-1 to PYT-4) were conducted using 179 breeding lines by following alpha lattice design. One hundred seven genotypes were selected from these trials depending on grain yield, salinity tolerance and phenotypic acceptability. Forty-five genotypes, out of 105 genotypes were selected from AYT-1 and AYT-2. In ALART, three genotypes were evaluated and one genotype (BR11716-4R-102) was recommended for PVT. The mean grain yield of selected line (BR11716-4R-102) ranged from 3.30 t/ha to 6.52 t/ha in ten locations which were significantly higher than the check varieties.</p>	<p>Promising Salt tolerant lines/salt tolerant varieties will be developed with seedling stage (EC 14 dS/m) &amp; 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</p>

	<p>In Boro Season, 35 crosses were made using 64 detailed characterized elite parents with higher breeding values. A total of 32 F<sub>1</sub>s were confirmed as true hybrids through F<sub>1</sub> verification by quality check (QC) genotyping with purity SNP panel. In total 49,590 segregating progenies from 114 crosses (F<sub>2</sub>-F<sub>5</sub> generation) were harvested from FRGA nursery and grown in the subsequent generation. In LST trial, 956 lines out of 6277 lines were selected on the basis of desirable plant type, grain quality and uniformity in flowering under field condition. A total of 146 genotypes were selected out of 312 from OYT based on growth duration, grain yield, and homogeneity in different morpho-agronomic traits. Out of 159 genotypes, 45 genotypes were selected from four PYTs. Thirty-one genotypes were selected from three AYT's. Thirty-one genotypes were evaluated under four RYTs and two genotypes BR11712-4R-93 and BR11717-4R-12 were selected from RYT-1 to conduct ALART. These two genotypes produced higher yield than the check variety BRR1 dhan89 and BRR1 dhan99 at six locations and showed higher tolerance to salt stress during boro season 2022-23.</p>	
<p><b>1.6</b></p>	<p><b>Development of Premium Quality Rice (PQR) for T. Aman and Boro Seasons</b>  <b>PQR T. Aman.</b> Efforts were made to develop aromatic and non-aromatic fine quality rice with national (Kalizira/ Chinigura /Kataribhog /Radhunipagol) and international (Jasmine type) standards and photosensitive rice for domestic use and export. In T. Aman 2022-23, a total of 62 crosses (42 single crosses and 12 backcrosses for PQR and 9 single crosses for photosensitive rice) were made. Total 63 crosses (40 for PQR and 23 for photosensitive rice) were confirmed as true hybrids using quality control SNP panel analysis. A total of 14, 962 progenies from 76 crosses (7083 progenies of 14 F<sub>2</sub> crosses, 6131 progenies of 36 F<sub>3</sub> crosses, 876 progenies of 12 F<sub>4</sub> crosses and 872 progenies of 14 F<sub>5</sub> crosses) were advanced through RGA under PQR program. A total of 2,460 progenies from 23 crosses (1001 progenies of eight F<sub>2</sub> crosses, 594 progenies from five F<sub>3</sub> crosses, 638 progenies from five F<sub>4</sub> crosses and 227 progenies from five F<sub>5</sub> crosses) were advanced through RGA under photosensitive program. Under PQR, a total of 84 fixed lines were selected from 1,000 fixed lines of eight crosses and from photosensitive rice breeding program, 20 fixed lines out of 197 fixed lines were selected from LST. In Observational Yield Trial (OYT) 11 genotypes were selected out of 35 genotypes from PQR. In Preliminary Yield Trial (PYT), 11 genotypes were selected out of 24 genotypes under PQR program and 11 genotypes were selected out of 25 genotypes under Photosensitive rice breeding program. A total of 11 genotypes were selected out of 24 genotypes under PQR program and nine genotypes were selected out of 22 genotypes under Photosensitive rice</p>	<p>National and international grade (Kalizira, Chinigura, Kataribhog, Basmati, Jasmine, Banglamoti and BRR1 dhan34 type) high yielding aromatic varieties with earliness, good plant type, anti-oxidant potential will be developed.</p>

breeding program from Advanced Yield Trial (AYT). Two promising genotypes were evaluated under PQR-ALART but none of the genotypes were selected. In OYT, the genotype BR9053-16-3-4-1 produced highest yield (5.4 t/ha) which is non-aromatic having BRRi dhan90 type grain quality genotype that could be used as recipient parent. In PYT, the Katari type aromatic genotype BR9178-7-2-4-4-P1 produced highest yield of 5.5 t/ha with a growth duration of 120 days. In AYT, the genotype BR10824-5-6-4-1 having BRRi dhan34 type aromatic grain having stronger plant type produced 4.2 t/ha yield with similar growth duration of BRRi dhan34. Under photosensitive rice program in PYT, the genotype BR10212-4-3-1 produced significantly higher yield (6.6 t/ha) than the check varieties BR22 (4.6 t/ha) and BR23 (5.2 t/ha) followed by the genotype BR10212-17-3-2 (6.5 t/ha) having strong photosensitivity. The heritability obtained for growth duration was ranging from 86% to 92% and grain yield was ranging from 54 % to 82% indicating acceptable level of precision in these experiments. Through maintenance breeding, a total of 235 genotypes including 146 aromatic rice landraces were grown as panicle to row method to maintain as nucleus stock for future use.

**PQR Boro:** The project aims to develop of aromatic and non-aromatic fine quality rice with international (Basmati/Banglamati/SoruBalam type) standards in Boro season for domestic use and export quality purpose. Totally 1,802 F<sub>1</sub> seeds were obtained from 29 crosses. Twenty-six F<sub>1</sub> crosses were confirmed out of 26 crosses as true hybrid. In total 13,210 progenies of 29 crosses from F<sub>2</sub>, F<sub>4</sub> and F<sub>5</sub> generations were advanced through RGA method. A total of 623 genotypes were selected from 6,546 progenies of LST trial. A total of 198 genotypes were evaluated in three Observation Yield Trials (OYT) in Gazipur, Rajshahi and Rangpur. Among the tested genotypes 56 genotypes were selected and forwarded in Advanced Yield Trial (AYT). In PYT, none of the genotypes were selected out of seven tested genotypes. From two SYT's, a total of 27 genotypes were evaluated and 12 genotypes were advanced in RYT. In RYT and ALART none of the genotypes were selected to advance but the materials will be used for hybridization purpose. The proposed Variety Trial (PVT) of premium quality rice Lata Balam was conducted. The yield of Lata Balam was 8.188 t/ha whereas, the average yield of check variety BRRi dhan50 was 6.997. Considering yield from all 10 locations, the proposed variety (Lata Balam) gave 17.67% higher yield in ten locations than BRRi dhan50. Therefore, BRRi dhan107 was recommended to release as extra-long slender premium quality rice for commercial cultivation throughout Bangladesh in the 111<sup>th</sup> meeting of NSB held on 09 January 2024.

**Under the development of Antioxidant Enriched Rice Variety, T. Aman and Boro season; In**

T Aman 2022-23, a total of 15 crosses were made using 13 parents and 2,273 F<sub>1</sub> seeds were obtained, and 25 single crosses were selected and confirmed through QC SNP panel analysis. Panicles of 10,698 progenies from 21 crosses (6,962 progenies of eight F<sub>2</sub> crosses, 2144 progenies of four F<sub>3</sub> crosses, 1025 progenies of four F<sub>4</sub> crosses and 567 progenies of five F<sub>5</sub> crosses) were advanced through RGA. A total of 163 fixed lines from 1,682 fixed lines were selected from 11 crosses of LST. In OYT1 and OYT2, 51 genotypes were selected out of 245 (two trials) aromatic and non-aromatic genotypes. A total of 54 genotypes were selected out of 176 (PYT1, PYT2, PYT3 and PYT4) aromatic and non-aromatic genotypes. From advanced yield trial (AYT), 11 genotypes were selected out of 30 genotypes. In OYT, the genotype BR12839-4R-8 produced highest yield (6.8 t/ha). In PYT, the short duration genotype BR12839-4R-137 produced highest yield which is 6.1 t/ha with growth duration 123 days while the medium duration genotype BR12839-4R-106 produced highest yield which is 6.2 t/ha having growth duration 129 days. Also, an aromatic genotype BR12836-4R-312 with strong plant type produced 5.5 t/ha yield in PYT. In AYT, the highest yielder genotype was BR12839-4R-157-2 producing 6.3 t/ha yield followed by the genotype BR12839-4R-5-2 which produced 6.0 t/ha with the growth duration of 132 and 130 days respectively.

In Boro 2022-23, a total of 26 crosses were made using 25 parents and 5,997 F<sub>1</sub> seeds were obtained, and six single crosses were confirmed and selected through QC SNP panel analysis. Panicles of 17,400 progenies from 41 crosses (4,000 progenies of six F<sub>2</sub> crosses, 10100 progenies of 23 F<sub>3</sub> crosses, 2500 progenies of eight F<sub>4</sub> crosses and 800 progenies of four F<sub>5</sub> crosses) were advanced through RGA. A total of 15 fixed lines were visually selected from 162 fixed lines of four crosses of LST. In OYT, 32 genotypes out of 110 genotypes were selected. In PYT, seven genotypes out of 24 genotypes were selected. From advanced yield trial (AYT), eight aromatic and 11 non-aromatic genotypes out of 42 genotypes were selected from two trials. From two RYT trials (short and medium duration), one short duration (out of three genotypes) and two medium duration genotypes (out of three genotypes) having higher C3G content were selected. In AYT, the genotype BR12839-4R-106 produced highest yield which is 7.5 t/ha with growth duration 152 days followed by the genotype BR12839-4R-34-1 producing yield of 6.9 t/ha having growth duration 149 days. These two genotypes also possess very high antioxidant (C3G) which is 479 and 459 mg/kg, respectively. In AYT (aromatic), the aromatic genotypes BR12839-4R-124-2 produced highest yield (6.84 t/ha) followed by the genotype BR12836-4R-312 (6.8 t/ha). C3G

	<p>content of these genotypes is 242 and 305 mg/kg, respectively. In RYT (medium duration), the highest yielder genotype was BR12839-4R-157-2 producing 7.12 t/ha yield followed by the genotype BR12839-4R-5-2 which produced 6.8 t/ha yield in Gazipur. Both of the selected genotypes have higher C3G content i.e., 268 and 209 mg/kg, respectively. The growth durations of these genotypes are 142 and 140 days, respectively.</p>	
<p><b>1.7</b></p>	<p><b>Development of Favorable Boro Rice (FBR)</b></p> <p>Thirty-four crosses were made using 29 promising lines/varieties 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.). Thirty-six crosses were confirmed as true F<sub>1</sub> through a hybridity test using QC SNP genotyping. In total 29,069 individual progenies from 118 cross combinations of F<sub>2</sub>-F<sub>5</sub> generations were advanced in the RGA nurseries following single seed decent method of breeding. Out of 2,548 lines tested in LST, 259 fixed lines were harvested based on visual observation on homogeneity in flowering, plant height and grain size and shape. Finally, 219 lines were selected based on the presence of favorable alleles of high amylose specific Wx, blast resistance, BB resistance, BPH resistance and cold tolerant genes. The genotypic profiles showed that all the selected lines had favorable alleles for high amylose specific markers Wx(a), Wx-10, 9 lines had blast resistant gene Pi9. In contrast, 23 lines had favorable allele for BB resistance gene xa5 and 29 lines had Xa21 gene. However, 67 lines had seedling stage cold tolerant allele SCT1. Total 6 lines had reproductive stage cold tolerant gene <i>qPSST3</i>, 57 lines had <i>qPSST7</i> and 5 lines had heat tolerance gene <i>qPSST9</i>.</p> <p>In OYT trial, thirty-nine genotypes were selected out of 694 fixed lines which was tested in four locations following sparse testing model of genomic selection. The selection was done based on genomic BLUP for yield. Genomic BLUP values were estimated using genome-wide genotyping data and phenotypic values for yield of training population tested at MLT sites. Thirty-six breeding lines were tested in advanced yield trial (AYT) at two locations under three categories, AYT-Early, AYT-ML. In AYT-Early, three genotypes out of 15 entries showing around 6.8 -7.5 t/ha grain yield potentiality with 149- 153 days growth duration. From AYT_ML, six genotypes showing 5.44 -6.76 t/ha grain yield potentiality with 153- 154 days growth duration.</p> <p>31 advanced breeding lines were tested at nine research stations including HQ of regional yield trial (RYT) under short, medium, long maturity classes and extra-long slender. In RYT (SD) three breeding lines showed 150 days, 152 days and 144 days growth duration with 0.32 t/ha, 0.35 t/ha</p>	<p>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.</p>

	<p>and 0.75 t/ha higher yield, respectively over BRRI dhan96 (yield 6.24 t/ha growth duration 144 days); three breeding lines showing 6.4-7.1 t/ha yield with 152 days growth duration while both the check varieties BRRI dhan81 and BRRI dhan89 yielded 5.0 t/ha and 7.1 t/ha in RYT (MD). In RYT (LD) the advanced lines BR11318-5R-148, BR11318-5R-84 and BR11894-5R-260 produced similar yield to the check variety BRRI dhan89 (7.4 t/ha). Among three varieties BR11318-5R-84 showed similar growth duration and yield was 0.58 t/ha higher yield than the check variety BRRI dhan89. Besides, four breeding lines BR7528-2R-19-16-RIL-52, BR7528-2R-19-16-RIL-55, BR7528-2R-19-16-RIL-59 and BR9945-5R-21 yielded more than 0.6-0.8 t/ha yield advantage over BRRI dhan50 with similar growth duration were selected for further advancement in extra-long slender category.</p>	
<p><b>1.8</b></p>	<p><b>Development of Cold Tolerance Rice (CTR)</b></p> <p>Thirty-five crosses were made using 32 lines and varieties as parents targeting to develop high yielding breeding lines enriched with favourable alleles of key target traits, viz. disease resistance (blast and BLB), insect resistance (BPH) and acceptable grain quality (amylose, chalkiness, palatability, zinc content, etc.). Thirty crosses were confirmed as true F1 through a hybridity test using QC SNP genotyping. In segregating RGA nurseries, in total 5,712 individual plants were advanced from 27 cross combinations of F<sub>2</sub>-F<sub>5</sub> generations following SSD method. Out of 2,513 lines tested in LST, 219 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.</p> <p>Thirty-seven genotypes out of 414 breeding lines and 9 genotypes out of 235 breeding lines tested under natural cold stress (at booting stage) and non-stress conditions at two locations in OYT-1 and OYT-QTL, 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. A total of 22 breeding lines were selected from 130 lines tested at four locations in three AYT class trials under two simulated cold-stress (October seeding) and non-stress control environments. From RYT-CTR, three genotypes out of six breeding lines/varieties tested at 13 locations including 10 haor sites under Kishoreganj, Sunamganj, and Habiganj districts showed better performance in terms of yield and cold tolerance at reproductive stage. In this trial BR11894-R-R-R-R-169 yielded up to 5.97 t/ha under severe cold stress (&lt;20<sup>0</sup>C) condition for consecutive three weeks during PI to heading stage, while others including moderately tolerant BRRI dhan67 produced no grain yield.</p>	<p>Cold tolerance rice varieties will be developed with high yielding and short duration (6.0-7.0 t/ha yield with 135-145 days growth duration for haor areas) and high yielding medium duration (6.5-7.5 t/ha yield with 145-150 days growth duration for Northern regions) rice varieties tolerant to cold stress at seedling and reproductive stage.</p>
<p><b>1.9</b></p>	<p><b>Development of Zinc Enriched Rice (ZER)</b></p>	

	<p>The project aims to develop high yielding rice varieties with improved nutritional quality with high zinc (<math>Zn \geq 24</math> mg/kg) in polished grain. The project also prioritizes development of stress tolerant zinc enriched rice varieties in a combination of submergence + zinc, drought + zinc, salinity + zinc and cold + zinc enriched rice with improved grain yield. The experiments were conducted in both T. Aman and Boro seasons. In T. Aman season, 20 single crosses were made that produced 2955 seeds. A total of 45 crosses were selected and confirmed as true F1s. In RGA method, 23,376 segregating progenies were harvested from F2 to F5 generations of 114 crosses. Initially 239 uniform lines out of 2856 LST lines were harvested based on visual observation on homogeneity in flowering, plant height and grain size and shape. From the Observational Trial (OT), 15 genotypes were selected from 70 genotypes. A total of 08 genotypes were selected out of 56 genotypes from two PYT's based on yield performances. Only four promising genotypes were selected out of 11 genotypes from the SYT. None of the entries were recommended for promoting from RYT.</p> <p>In Boro season, 15 single crosses were made that produced 1639 seeds. A total of 11 crosses were confirmed as true F1s. A total of 56,080 progenies were advanced from F2 to F5 generation at the time of maturity and preserved and processed with proper labels through RGA method. Initially 484 uniform lines were selected from 7065 LST lines based on visual observation on homogeneity in flowering, plant height and grain size and shape. A total of 17 genotypes were selected out of 61 genotypes from PYT based on yield performances. Five promising genotypes were selected out of fifteen genotypes from SYT. One genotype out of three genotypes were selected for re-RYT from the RYT.</p>	<p>Rice varieties with high iron and zinc content with resistance to major insect pests and diseases and acceptable grain quality will be developed.</p>
<p><b>1.10</b></p>	<p><b>Development of Insect Resistant Rice (IRR)</b></p> <p>The main thrust of the project was to develop varieties resistant to gall midge (GM), brown plant hopper (BPH) and white backed plant hopper (WBPH). The experiments were conducted in both T. Aman and Boro seasons. In the T. Aman season, 19 crosses for forward breeding, three BC<sub>1</sub>F<sub>1</sub> and four BC<sub>2</sub>F<sub>1</sub> crosses for line augmentation, and three BC<sub>1</sub>F<sub>2</sub> crosses for QTL deployment were made, and 15 crosses were confirmed as true hybrids using quality check (QC) genotyping with purity SNP panel. In total 57,132 segregating progenies from 82 crosses of F<sub>2</sub>-F<sub>5</sub> generations were advanced through Field Rapid Generation Advanced (FRGA) technique. Out of 2803 F<sub>5:6</sub> LST lines derived from 16 different crosses, 229 genotypes were selected based on strong plant architecture, grain type and uniformity in heading under field condition as well as the presence of the favorable alleles of key target genes for BPH (<i>bph9</i>, <i>bph17_1</i>, <i>bph17_2</i>, <i>bph17_3</i> and <i>bph32</i>),</p>	<p>BPH and Gall midge resistant variety will be developed with better yield potential (5.5-6.5 t/ha for T. Aman and 7.0-8.0 t/ha for irrigated Boro season).</p>

	<p>Gm (<i>Gm4_3</i> and <i>Gm4_4</i>) and grain quality (<i>Wx-A</i> and <i>Wx-10</i>). The yield trials (OYT, PYT and AYT) were conducted at three locations of BIRRI Gazipur, Cumilla and Rangpur. Forty-nine genotypes were selected from 228 breeding lines in OYT. Two selected OYT genotypes had both <i>bph17</i> and <i>bph32</i>, one genotype had both <i>bph17</i> with <i>Gm4</i>, and one had <i>bph17</i>, <i>bph32</i> with <i>Gm4</i> SNP favorable alleles. Twenty-four genotypes were selected from 100 genotypes in PYT. Ten genotypes were selected from 28 lines in AYT. In Boro season, 20 crosses for forward breeding, three crosses for pre-breeding, three F<sub>1</sub> and three BC<sub>2</sub>F<sub>1</sub> crosses for line augmentation were made, and 16 crosses were confirmed as true hybrids through F<sub>1</sub> verification using quality check (QC) genotyping with purity SNP panel. A total of 46,901 individual plants were advanced from 79 crosses in F<sub>2</sub>-F<sub>5</sub> generations by FRGA technique. In LST, 794 lines having strong plant architecture, grain quality, uniformity in heading under field condition and the presence of the favorable alleles of key target genes for BPH (<i>bph9</i>, <i>bph17_1</i>, <i>bph17_2</i>, <i>bph17_3</i> and <i>bph32</i>), Gm (<i>Gm4_3</i> and <i>Gm4_4</i>) and grain quality (<i>Wx-A</i> and <i>Wx-10</i>) were selected from 5889 F<sub>5:6</sub> breeding lines that are the descendants of 23 crosses. Eighty-four genotypes out of 360 were selected from OYT that tested in three locations. Thirty lines were selected from 82 lines in PYT. Out of 30 genotypes, 14 were selected from AYT for further evaluation. Total 65 parental lines were maintained in insect resistant maintenance breeding program.</p>	
<p><b>1.11</b></p>	<p><b>Development of Disease Resistant Rice (DRR)</b></p> <p>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. Twelve crosses for BB and 15 for blast in T. Aman and nine crosses for BB and 12 for blast were made in Boro season. Ten crosses for BB and twelve for blast in T. Aman and seven crosses for BB and nine for blast in Boro season were confirmed as true F<sub>1</sub>. A total of 18,000 progenies for BB and 17,500 progenies for blast were advanced from F<sub>2-6</sub> generation through Green-house RGA and FRGA. Three hundred thirty-three uniform lines were isolated from 4,100 LST lines in T. Aman and out of 4,071 lines, 382 lines were identified from LST in Boro season based on uniformity in heading, plant height, and grain type. Nine genotypes for BB were selected from observational yield trial (OYT) in T. Aman season whereas 60 entries out of 460 for BB during Boro season showed better yield potential and agronomic performance over the check varieties and tolerance to BB. From AYT, four advanced lines were promoted based on growth duration, grain yield and BB score compared to the check varieties in T. Aman season and 18 genotypes out of 67 for BB were selected in Boro season. In the regional yield trial (RYT), two genotypes for T. Aman</p>	<p>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).</p>

	<p>season and five for Boro performed better compared to yield, growth duration, BB resistance, and better grain quality characters but yield was not &gt;10% higher than the check varieties. Therefore, the high-yielding background BB-resistant promising lines will be used as a genetic resource to develop high-yielding disease-resistant varieties. Blast resistant genotypes which were developed by the scientist of Plant Pathology Division were evaluated in ALART. Considering blast resistance, two genotypes were recommended as short duration genotypes comparing the check variety BRRIdhan28 and two were recommended as long duration genotypes comparing the check variety BRRIdhan89 for evaluating in PVT during Boro2023-24.</p>	
<p><b>1.12</b></p>	<p><b>Development of Submergence and Water Stagnation Tolerant Rice varieties</b></p> <p>The project aims for the development of high yielding rice varieties tolerant to submergence (flash flooding) and medium stagnant water (MSW) stresses. Totally 43 single crosses were made and 4500 F<sub>1</sub> seeds were produced. Thirty-four single crosses were confirmed and selected through QC SNP panel analysis. A total of 25395 progenies from 80 crosses (4,930 from 12 F<sub>2</sub> crosses, 12,220 from 22 F<sub>3</sub>, 4,680 from 27 F<sub>4</sub> progenies, 810 from nine F<sub>5</sub> progenies, and 2,755 from ten F<sub>6</sub> 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 7%. From LST population, 3,006 lines from 12 crosses were genotyped with trait markers using custom SNP panel among which 162 lines were selected based on uniformity and traits markers like <i>Sub1</i>, <i>Wx-A group</i>, <i>Wx-A_NB</i>, <i>xa13</i>, <i>Xa21</i> etc. In yield trial, a total of 368 genotypes were tested out of which 150 genotypes were selected based on phenotypic acceptance, growth duration, survivability and higher yield performance. From OYT, 76 genotypes out of 271 genotypes, from AYT_Early, 44 genotypes out of 118 genotypes, from AYT_Late, 17 genotypes out of 58 genotypes, from PVS one genotype out of ten genotypes were selected. Two lines were evaluated in ALART from which one line was recommended to evaluate in PVT, one line was evaluated in PVT and the line performed better over the check. In OYT, the genotype BR12154-5R-65-2 with 88% survivability produced highest yield of 6.7 t/ha under stress condition and in average yielded 6.5 t/ha followed by the genotype BR12487-5R-75 produced 6.7 t/ha under controlled stress and in average 6.2 t/ha with 92% survivability. In INGER, the early genotype SV1582 produced highest yield (5.6 t/ha) under rainfed condition where two checks BRRIdhan87 and BRRIdhan52 yielded only 4.8 t/ha and 4.6 t/ha respectively. In AYT_Early genotype BR12162-5R-350-3 and IR15F1886 produced highest</p>	<p>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.</p>

	<p>yield of 7.0 t/ha followed by BR11692-5R-345 (6.7 t/ha) and SV1179 (6.6 t/ha) under controlled stress condition. In AYT_Late, the genotype IR13F582 gave highest yield of 7.2 t/ha with 89% survivability in control stress condition followed by the genotype IR93339129-B-7-7-B-B-B-16 (7.1 t/ha) with 84% survivability. In ALART (ALART_Tidal submergence), the genotype BR9158-19-9-6-50-2-HR1 produced significantly higher yield (4.89 t/ha) over both check BRRi dhan52 (4.49 t/ha) and BRRi dhan44 (4.31 t/ha) with similar growth duration. This line was recommended to evaluate in PVT in T. Aman 2023-24. In PVT, the genotype IR16F1148 yielded 5.28 t/ha which was 18% higher than the check variety BINA dhan11 (4.48 t/ha) but national technical committee (NTC) recommended for re-PVT in next T-Aman season as there was less flood in the farmer field condition. The heritability obtained for grain yield under stress of all trials conducted was ranging from 44 % to 95%, whereas that for non-stress trials was ranging from 38 % to 83%, indicating acceptable level of precision in these experiments. Through maintenance breeding, a total of 280 genotypes including submergence tolerance land races landraces were grown as panicle to row method to be maintained as nucleus stock for future use.</p>	
<p><b>1.13</b></p>	<p><b>Development of Water Saving and Aerobic Rice varieties</b></p> <p>The objective of the project was to develop short duration water-use-efficient rice genotypes with 10% more yield than the check varieties under transplanted alternate wetting and drying (AWD) and aerobic conditions. A total of 35 crosses were made using 35 parents and 2,350 F<sub>1</sub> seeds were obtained, and 14 single crosses were selected and confirmed through QC SNP panel analysis. A total of 8,037 individual panicles were selected from 30 crosses (4,430 of 13 crosses from F<sub>2</sub>, 3315 of 13 crosses from F<sub>3</sub> and 292 of four crosses from F<sub>5</sub>) were harvested from RGA.</p> <p>From yield trial, a total of 37 genotypes were selected out of 143 genotypes. In OYT, 12 genotypes were selected from 63 genotypes. From PYT, 25 genotypes were selected from 80 genotypes. In OYT, among all selected genotypes, the line IR 126999-B-32-2-1-3 gave highest yield (7.0 t/ha) followed by two similar yielder genotypes IR16F1147 (7.0 t/ha) and IR 126999-B-32-2-1-3 (7.0 t/ha). In PYT#1, two genotypes IR18R1119 and IR18R1121 produced highest yield (6.3 t/ha) having aroma whereas, the check variety BRRi dhan88 produced 5.6 t/ha yield. In PYT#2, the genotype IR93339129-B-7-7-B-B-B-16 produced the highest yield (7.5 t/ha) followed by the genotype BR12493-5R-151 (7.3 t/ha). In RYT, both the tested entry BR11206-5B-351 and BR11204-5B-224 produced similar average yield (6.6 t/ha) with the check variety BRRi dhan58 (6.8 t/ha). However, the growth duration of the genotype BR11204-5B-224 was one week earlier</p>	<p>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) &amp; aerobic condition.</p>

	<p>than the check variety BRRI dhan58. The heritability obtained for growth duration and grain yield of all trials conducted was ranging from 85 % to 95%, and 44 % to 85%, respectively indicating acceptable level of precision in these experiments.</p>	
<b>1.14</b>	<p><b>Development of Drought Tolerant Rice (DTR)</b>  The project aims to develop of high yielding drought tolerant rice varieties for northern and western region of Bangladesh in the T. Aman season. In T. Aman 2022-23, a total of 4,147 F<sub>1</sub> seeds were obtained from 25 crosses using 15 parents and 14 crosses were confirmed as true hybrids using 10-SNP <i>indica</i> QC panel. A total of 4,523 individual progenies from of 19 crosses from F<sub>3</sub> generation were harvested through RGA. The materials were advanced in the Boro 2022-23 season and 9,570 progenies of 33 crosses from F<sub>2</sub> and F<sub>4</sub> generations through RGA method. From Line Stage Testing (LST), 293 lines were selected from 2,058 progenies of 17 crosses with 14.5% selection intensity. A total of 619 genotypes were evaluated in two OYTs in Gazipur, Rajshahi and Rangpur. Among the tested genotypes 67 genotypes were selected and forwarded in Advanced Yield Trial (AYT). In AYT, 26 genotypes were evaluated in two trials in Gazipur, Rajshahi and Rangpur and seven genotypes were found promising and advanced. During flowering stage drought stress was observed in almost all three locations of OYT and AYT. Especially in Rajshahi and Rangpur, severe drought stress and in Gazipur moderate stress were recorded. Although having multiple genes/QTLs, none of the genotypes was selected based on grain yield in comparison to check varieties from Preliminary Yield Trial (PYT). No genotype was recommended by ARD due to similar grain yield performance compared to check varieties in Advanced Line Adaptive Research Trial (ALART).</p>	<p>Drought Tolerant Varieties for T. Aman season will be developed with potential yield target (5.0 – 6.0 t/ha).</p>
<b>1.15</b>	<p><b>Deployment and Validation of High Beta-carotene Rice and High-Iron &amp; Zinc Rice Varieties (Healthier Rice Project)</b>  The main objective of the project was to develop high yielding transgenic rice varieties with enhanced provitamin-A, iron and zinc content in polished rice grain. A total of 1,420 BC2F<sub>1</sub> seeds were obtained from three backcrosses. However, in three backcrosses (BR11723-4R-27, BRRI dhan81 and BRRI dhan87) none of the hemizygous plant (H type) was found in T. Aman 2022-23 season with a view to developing high iron and zinc enriched rice (HIZR). With a view to developing provitamin-A enriched rice, 567 homozygous plants (B type) were selected from 1047 plant of BC3F<sub>3</sub> generation through Marker Assisted Selection (MAS) method. A total of</p>	<p>Development of high yielding rice varieties with enhanced Provitamin A, high Iron and Zinc content in polished rice grain.</p>

	<p>Twelve promising lines i.e., BR13263-GR2E:24-1-1, BR13263-GR2E:36-1-1, BR13263-GR2E:12-1-1-3, BR13263-GR2E:17-1-1-3, BR13263-GR2E:64-1-1-3, BR13263-GR2E:66-1-1-3, BR13263-GR2E:85-1-1-3, BR13265-GR2E:10-1-1, BR13265-GR2E:32-1-1-3, BR13265-GR2E:68-1-1-3, BR13265-GR2E:87-1-1-3 and BR13265-GR2E:107-1-1-3 were selected from Contained Trial (CT) based on their grain yield, carotenoid content and other yield contributing for further evaluation.</p> <p>In Boro 2022-23 season, 980 F1 seeds were obtained from three crosses and a total of 260 BC3F1 seeds were obtained from three backcrosses to develop high iron and zinc enriched rice.</p>	
<b>1.16</b>	<p><b>International Network for Genetic Evaluation of Rice (INGER)</b></p> <p>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 49 genotypes were selected out of 195 genotypes of nine INGER nursery sets of which four genotypes were selected out of 32 genotypes of one INGER nursery sets of Aus, 31 genotypes out of 109 genotypes from six INGER nursery sets of T. Aman 2022-23 and 14 genotypes out of 54 genotypes from two INGER nursery sets of Boro 2022-23 seasons were selected to be used in different breeding programs for direct use in the breeding pipeline.</p>	<p>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.</p>
	<b>Biotechnology Division</b>	
	<b>PROJECT I: DEVELOPMENT OF DOUBLED HAPLOID RICE VARIETY THROUGH ANTHHER CULTURE</b>	
	<b>Expt.1.1:</b> Development of low glycemic index (GI) rice variety through anther culture.	
	Five (5) doubled haploid lined were grown as SYT in T Aman 2022	Three lines were selected for regional yield trial (RYT) and hilly areas.
	A total of 7609 hybrid anthers from ten (10) crosses were plated on N6 media for anther culture during T. Aman 2022.	In a total of 16 calli were obtained from different crosses and no plants were regenerated yet.
	Twelve (12) crosses were done during T. Aman 2022 for future anther culture program.	491 F1 seeds were harvested from them and will be used for future anther culture.

	<b>Expt.1.2</b> Development of salt tolerant rice variety through anther culture.	
	A total of 3382 hybrid anthers from six (06) crosses were plated on N6 media for anther culture during Boro 2022-23. N6 media were used for callus induction and MS media containing 4mg/L BAP + 1.2mg/L NAA + 1.0 mg/L Kinetin were used for plant regeneration.	In total of 33 calli were obtained from different crosses and no green plants were regenerated yet.
	<b>Expt.1.3</b> Development of premium quality rice variety through anther culture	
	A total of 7609 hybrid anthers from ten (10) crosses were plated on N6 media for anther culture during T. Aman 2022.	In a total of 16 calli were obtained from different crosses and no plants were regenerated yet.
	Twelve (12) crosses were done during T. Aman 2022 for future anther culture program.	491 F1 seeds were harvested from them and will be used for future anther culture.
	Seeds of regenerated green plants (DH <sub>1</sub> ) from BRRI dhan90/Kataribhog cross were evaluated during T. Aman 2022.	Among them 33 fixed lines (DH <sub>2</sub> ) were selected.
	Four (4) double haploid lines from BRRI dhan38/Bashful (Acc. No. 3954) along with Check BRRI dhan87 & BRRI dhan103 were evaluated as OT during T Aman 2022.	No line was selected due to lodging problem.
	Four (4) double haploid Plants from BRRI dhan38/Bashful (Acc. No. 3954) were evaluated in Boro 2022-23	Among them 08 plants were selected for generation advancement.
	One hundred three (103) double haploid plants from cross of BRRI dhan50/Bashful (Acc. No. 3954) were evaluated in T. Aman 2022.	Among them 81 double haploid plants were selected for generation advancement.
	Eighty one (81) double haploid plants from cross of BRRI dhan50/Bashful (Acc. No. 3954) were evaluated in Boro 2022-23.	Among them 160 plants were selected for generation advancement.
	<b>Expt.1.4</b> Development of Aus variety through anther culture	
	Ten (8) crosses were made	A total of 328 F <sub>1</sub> seeds were harvested for future anther culture program.
	<b>Expt.1.5</b> Developmnt of antioxidant enriched black rice variety through anther culture	
	Twelve antioxidant enriched black rice lines developed using anther culture was evaluated as PYT in T Aman 2022.	Seven lines were selected for further evaluation.
	Sixteen antioxidant enriched black rice developed using both seed and anther culture were	Six lines were selected for PYT.

	evaluated as OT in T Aman 2022.	
	47 somaclonal (SC5) variants of antioxidant enriched black rice were evaluated as pedigree in T Aman 2022.	105 somaclonal variants of antioxidant enriched black rice were selected as pedigree.
	During Boro 2021-22, five antioxidant enriched black rice were developed using anther culture were evaluated as RYT.	Three lines were selected for further evaluation
	During Boro 2021-22, Thirteen antioxidant enriched black rice were developed using anther culture were evaluated as PYT.	Six lines were selected for SYT
	During Boro 2021-22, Twenty one antioxidant enriched black rice were developed using anther culture were evaluated as OT.	Eight lines were selected for PYT
	89 somaclonal (SC5) variants of antioxidant enriched black rice were evaluated as pedigree.	67 somaclonal variants of antioxidant enriched black rice were selected from SC5 generation.
	25 somaclonal variants (SC0) of antioxidant enriched black rice were regenerated from seeds of Selasih-SC14-12-2	SC1 seeds were harvested from 25 SC0 somaclonal variants
	<b>Expt.1.6</b> 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%.
	<b>Expt.1.7</b> Development of doubled haploid photoperiod sensitive rice variety through anther culture	
	A total 6884 anthers from nine crosses were plated in two media.	No callus was found from nine cross combinations.
	A total 3445 anthers were plated in two media.	Four calli was found from BRRRI dhan71/ Gainja cross combination but no green plants were found.
	<b>Expt.1.8</b> 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.
	<b>PROJECT II: DEVELOPMENT OF RICE VARIETY THROUGH SOMACLONAL VARIATION</b>	
	<b>Expt. 2.1</b> Progeny selection of somaclonal variants using EMS treated rice seed	
	Seed culture was done to create somaclonal variations in T. Aman 2022. Seeds of Kataribhog, Tulshimala, Radhunipagol & Shakkhorkhana (Local varieties) were used in this experiment. Culture Medium consisting of MS basal salts (Murashige and Skoog, 1962) with 2.0 mg <sup>l</sup> <sup>-1</sup> of 2,4-D were used for callus induction and MS media containing 4mg/L BAP + 1.2mg/L NAA + 1.0 mg/L Kinetin were used for plant regeneration.	In a total 57 plants from Kataribhog (13), Tulshimala (02), Radhunipagol (23) and Shakkhorkhana (19) were regenerated after seed culture. Seeds were harvested from these plants.
	<b>Expt. 2.2:</b> 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
	<b>Expt.2.3:</b> Development of premium quality (Kalijira type) variety through somaclonal variation	
	Fourteen (14) lines somaclonal variants (SCV <sub>1</sub> ) of Kalijira rice were grown in T Aman 2021	126 plants were harvested for further evaluation.
	<b>Expt.2.4:</b> Progeny selection of antioxidant enriched black rice somaclonal variants	
		A total 47 (SC <sub>5</sub> ) 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 <sub>5</sub> ) antioxidant enriched black rice plants of Padi Kool and Selasih were

		selected
	<b>PROJECT III: DEVELOPMENT OF RICE VARIETY THROUGH WIDE HYBRIDIZATION</b>	
	<b>Expt. 3.1</b> Development of rice variety through wide hybridization followed by embryo rescue	
	In a total, 84 plants from different generation of embryo rescued plants derived from BRRi dhan28/ <i>O. nivara</i> (IRGC103821), BRRi dhan28/ <i>O. glaberrima</i> (IRGC105190), BRRi dhan87/ <i>O. glaberrima</i> (IRGC105190), BRRi dhan48/ <i>O. glaberrima</i> (IRGC105190) were evaluated in T. Aman 2022.	Among them 38 selected (F4) plants were selected from BRRi dhan28/ <i>O. nivara</i> (IRGC103821), BRRi dhan28/ <i>O. glaberrima</i> (IRGC105190), BRRi dhan87/ <i>O. glaberrima</i> (IRGC105190), BRRi dhan48/ <i>O. glaberrima</i> (IRGC105190) for generation advancement.
	In a total 29 (F4) plants from BRRi dhan28/ <i>O. glaberrima</i> (IRGC105190), BRRi dhan87/ <i>O. glaberrima</i> (IRGC105190) and BRRi dhan48/ <i>O. glaberrima</i> (IRGC105190) were evaluated in Boro 2022-23.	Among them 44 plants (F5) were selected from BRRi dhan28/ <i>O. glaberrima</i> (IRGC105190), BRRi dhan87/ <i>O. glaberrima</i> (IRGC105190), BRRi dhan48/ <i>O. glaberrima</i> (IRGC105190) for generation advancement.
	Nine (9) lines derived from wide cross of BRRi dhan28/ <i>O. nivara</i> (IRGC103821) were evaluated as OT during T. Aman 2022 along with two checks BRRi dhan87 and BRRi dhan103. Selected Five (5) lines derived from wide cross of BRRi dhan28/ <i>O. nivara</i> (IRGC103821) were evaluated as PYT along with check BRRi dhan96 in Boro 2022-23.	Among them 5 lines were selected for further evaluation.  Among them 3 lines were selected for further evaluation.
	Nine (BC <sub>2</sub> F <sub>2</sub> ) plants from backcross progeny of previously embryo rescued plants were evaluated during T. Aman 2022. Thirty (BC <sub>2</sub> F <sub>3</sub> ) plants from backcross progeny of previously embryo rescued plants were evaluated in Boro 2022-23.	Among them thirty (30) plants (BC <sub>2</sub> F <sub>3</sub> ) were selected for generation advancement.  Among them 11 plants (BC <sub>2</sub> F <sub>4</sub> ) were

		selected for generation advancement.
<b>PROJECT IV: MOLECULAR MARKER ASSISTED SELECTION</b>		
<b>Expt. 4.1</b> Marker assisted selection for fragrance in F <sub>5</sub> Population of BRRI dhan87 and Kalijira.		
107 pedigree lines developed from a cross between BRRI dhan87 and Kalijira were evaluated		Among them 312 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 <i>BADH2</i> in early generation. 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).
<b>Expt.4.2</b> Marker assisted selection for aromatic and submergence tolerance rice genotype		
A three-way cross, two doubled cross and six crosses were done		F <sub>1</sub> seeds of different crosses were harvested
<b>Expt.4.3</b> Development of multiple disease resistant (blast and bacterial blight) rice varieties using marker assisted selection		
F <sub>1</sub> plants of 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 planted for development of both BB and blast resistant lines		F <sub>2</sub> seeds were harvested from four crosses
<b>Expt.4.4</b> 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.
<b>PROJECT V: GENE CLONING</b>		
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 using Qiagen kit and PCR was carried out using specific primer. Wheat calreticulin was targeted to isolate for cloning purpose		<i>TaCRT</i> gene was isolated from wheat and send for sequencing

	<b>PROJECT VI: RICE GENETIC ENGINEERING</b>	
	<b>Expt.6.1</b> Development of salt tolerant transgenic rice	
	BRRI dhan29 was transformed with salt tolerant genes ( <i>GlyI</i> and <i>GlyII</i> ).	A total of 18 T <sub>4</sub> plants were grown in transgenic greenhouse and among them 21 T <sub>5</sub> plants were confirmed by <i>GlyI</i> specific primer. T <sub>5</sub> progenies were grown in the transgenic green house.
	<b>Expt.6.2</b> Introgression of salt tolerant mangrove gene	
	BRRI dhan29 was transformed with salt tolerant genes ( <i>GlyI</i> and <i>GlyII</i> ).	A total of 18 T <sub>4</sub> plants were grown in transgenic greenhouse and among them 21 T <sub>5</sub> plants were confirmed by <i>GlyI</i> specific primer. T <sub>5</sub> progenies were grown in the transgenic green house.
	<b>Expt.6.3</b> Development of high yielding aromatic rice lines through genome editing	
	For deactivate of Function of <i>BADH2</i> gene, two primer were designed for construct preparation. Vector pRGEB31 was used in this experiment.	Guide sequence of <i>BADH2</i> was cloned into binary vector pRGEB31 and confirmed by PCR
	<b>PROJECT VII: C4 RICE DEVELOPMENT</b>	
	<b>Expt.7.1</b> 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 ( <i>Setaria italica</i> ) have been developed for further study. These lines are gradually raised, subjected to CO <sub>2</sub> stress in low concentration (20 ppm) CO <sub>2</sub> chamber for 72 hours and high-throughput screened for loss of C4 functions.
	<b>PROJECT VIII: DEVELOPMENT OF RICE VARIETY THROUGH MUTATION BREEDING</b>	
	<b>Expt.8.1</b> Development of variants using EMS of BRH-11-9-11-4-5B having reduced	
	Thirty one lines (M <sub>3</sub> ) along with check were transplanted in Boro 2022-23	Hundred (100) plants were selected for further evaluation

	<b>Expt.8.2</b> Development of Kilijira type rice variety through mutation by NMU	
	Seed from 91 M <sub>2</sub> Kilijira lines were transplanted in T Aman 2022 along with check	168 M <sub>3</sub> plants were selected during T Aman 2022 for further evaluation.
	<b>Expt.8.3</b> Development of high yielding sheath blight resistant rice variety	
	53 mutated plants from BRRRI dhan 87 of M <sub>4</sub> generation will be grown during T Aman2023.	High yielding sheath blight resistant rice varieties will be developed
	<b>Expt.8.4</b> Development of Premium Quality Rice through Mutation by EMS (Ethyle Methane sulfonate)	
	EMS treated seeds of two local varieties (Kataribhog & Tulshimala) were evaluated during T. Aman 2021. Thirty six (36) Kataribhog plants (M <sub>2</sub> ) and Twenty nine (29) Tulshimala plants (M <sub>2</sub> ) were evaluated during T. Aman 2022.	Among them six (06) Kataribhog (M <sub>3</sub> ) plants and thirty one (31) Tulshimala (M <sub>3</sub> ) plants were selected during T. Aman 2022 for generation advancement.
	<b>PROJECT IX: BASIC RESEARCH</b>	
	<b>Expt.9.1</b> Study on Kernel Elongation of Rice	
	Sixty four selected genotypes was grown in T Aman, 2022 and seed were harvested from single plant to make genetic purity. These pure seeds were grown in net house for further analysis.	Purified seed from single hill were harvested for further analysis.
	<b>Hybrid Rice Division</b>	
	<b>Program Area: Varietal Development</b> <b>Project: Material development, seed production and its distribution</b> <b>Research Progress of 2022-2023</b>	
01.	Six new CMS (A) lines (BRRRI13A/3115B, BRRRI48A/AsadB, BRRRI53A/3043B-1-10, BRRRI53A/3137B, BRRRI53A/208B-6-8 & BRRRI53A/217B-20-3) as BRRRI151A, BRRRI152A, BRRRI153A, BRRRI154A, BRRRI155A & BRRRI156A having diverse characters were developed.	Newly developed seven CMS lines will be used for new hybrid rice variety development for T Aman & Boro seasons.
02.	CMS multiplication and seed production package development of promising CMS lines and hybrid combinations has been initiated	After study of commercial seed production feasibility, the selected combination will submit to Seed Certification Agency (SCA) for variety release purposes.

03.	A total of 15570 kg of F <sub>1</sub> seeds of BRRI hybrid dhan2, BRRI hybrid dhan3, BRRI hybrid dhan5, BRRI hybrid dhan7 and BRRI hybrid dhan8 were distributed through different regional stations of BRRI and department of agricultural extension	Popularization of BRRI released hybrid varieties.
04.	Seed production program of BRRI hybrid dhan2, BRRI hybrid dhan3, BRRI hybrid dhan4, BRRI hybrid dhan5, BRRI hybrid dhan6, BRRI hybrid dhan7 and BRRI hybrid dhan8 was initiated at farmers level under Mymensingh, Gopalganj, Kurigram, Sherpur, Ishwardi, Lalmonirhat and Sonagazi district	Farmers could able to produce own F <sub>1</sub> seeds of BRRI released hybrid rice varieties and in such a way small entrepreneurship will be developed at farmers level
<b>Genetic Resources and Seed Division</b>		
<b>1.0</b>	<p><b>Project: Genetic Resources conservation and management</b></p> <ul style="list-style-type: none"> <li>• Collection of 193 germplasm.</li> <li>• Rejuvenation of 2323 germplasm and characterization of 132 germplasm with 53 morpho-agronomic characters.</li> <li>• In total, 173 new germplasm were registered as new accessions (from accession number 8,696 to 8,868) in BRRI Genebank after processing and duplicate sorting.</li> <li>• Molecular characterization of 80 Binni rice germplasm using 78 SSR markers of which three were used for evaluating aroma (RM273, RM223 and RM282) and four for evaluating amylose (RM170, RM190, RM253 and RM314) were performed for DNA Fingerprinting</li> <li>• Supply of 2778 accessions of germplasm of which 188 samples of BRRI varieties for research and demonstration.</li> </ul>	<p>Long term conservation of the rice germplasm and utilization for future research and breeding.</p> <p>Findings of the experiments according to objective could be utilized in further research.</p>
<b>2.0</b>	<p><b>Project: Seed production and variety maintenance</b></p> <ul style="list-style-type: none"> <li>• One hundred nineteen BRRI developed and recommended rice varieties were maintained through nucleus seed production. Besides, nucleus seeds of 71 varieties were produced to be used as the source of breeder seed (BS).</li> <li>• During Boro season, 173.28 tons Breeder seed from 21 varieties 32.48 tons of nine Aus varieties and 68.1 tons of 36 T. Aman varieties were produced.</li> <li>• Again, 107.0 tons Breeder seed from 21 varieties in Boro, 17.2 tons from seven varieties in Aus and 59.3 tons from 36 varieties in T. Aman seasons were distributed.</li> <li>• Breeder and foundation seed (FS) producing plots and farms were visited regularly by the GRS scientists to monitor the quality of the BS and FS, produced in different BRRI regional</li> </ul>	Maintenance of pure seed stock and supply of Breeder seed to GO, NGO and private seed producing organizations according to their demand under rice seed network of BRRI.

	stations as well as BADC and CCDB farms, respectively.	
<b>3.0</b>	<b>Project: Exploratory and genetic studies</b>	
	Two Genebank accessions Balam (acc. 516) and Sada Mota (acc. 7888) were evaluated in Regional yield trial (RYT) at BIRRI HQ, Gazipur and BIRRI R/S, Barishal in T. Aman 2022-23. The yield of Balam was 3138.8 g per plot equivalent to 5.23 ton/ha and that of Sada Mota was 2258.8 g per plot equivalent to 3.76 ton/ha in BIRRI HQ.	The genetic parameters/genetic studies of respective year will be helpful for varietal development and other plant breeding related issues.
	Three accessions Rosul Bhog (Acc. 5071), Malshira (Acc. 299) and Ganjia (Acc. 287) showed better performance out of 15 evaluated under late (transplanting 15 September) condition in T Aman 2022-23 season.	Estimated genetic variability, character associations, genetic relationships and selection criteria for yield and yield components of rice germplasm would be used for clear understanding of genetic makeup of the tested germplasm.
	Out of 75 evaluated Binni rice, 14 were found containing very low amylose % (5.71-9.04).	
	Molecular characterization of 19 Badshabhog rice germplasm along with BR5, BIRRI dhan34, BIRRI dhan90 and GI marked Bangladesh Kalijira and Dinajpur Kataribhog using 61 SSR markers were performed for DNA Fingerprinting.	
	<b>Name of Division: Grain Quality and Nutrition Division</b>	
	<b>Grain Quality Characteristics for Varietal Development</b>	
	1.1: Determination of physicochemical and cooking properties of advanced breeding lines	A total of 207 advanced lines of different division of BIRRI were analyzed.
	1.2: Determination of physicochemical and cooking properties of transforming rice breeding lines	A total of 3329 samples were analyzed
	1.3: Evaluation of physicochemical properties of newly released BIRRI varieties	BIRRI website were updated all physicochemical and cooking data upto BIRRI dhan89 and BIRRI hybrid dhan7.
	1.4: Nutraceutical Characterization of newly released BIRRI varieties	A total of six BIRRI varieties namely BIRRI dhan90, 91, 92, 93, 94, and 95 were analyzed for Antioxidant, Mineral, Fatty Acid and Amino Acid Profiling.
	1.5: Calibration of NIR to predict proximate composition of rice varieties	BR1 to BIRRI dhan85 proximate

		composition data analyzed using NIR. Waiting for the Chemical data for calibration.
	<b>Nutritional Quality Assessment of Rice</b>	
	2.1: Analysis of ferulic acid (FA) in RBO of Bangladeshi rice varieties in association of biochemical evaluation on burning effects of RBO in vivo rat experiment	Ferulic Acid (FA) and Gamma Oryzanol content from BR5, BRRRI dhan34, BRRRI dhan50, BRRRI dhan63, BRRRI dhan64 and BRRRI dhan84 rice bran and rice bran oil were analyzed.
	2.2: To Screening, Selection, and Training of Sensory Panelists	Methodology & Questioners developed; Study will commence soon.
	2.3: A study on the different components of rice in relation to the palatability	Physical, chemical, cooking and Antioxident properties were analyzed some of local cultivars and BRRRI HYVs for Tastiness
	<b>Commercial Rice Based Products</b>	
	3.1: Determination of physicochemical properties and nutritional quality of puffed, popped and flattened rice from newly released BRRRI varieties	Physical properties of puffed and popped rice of BRRRI varieties namely BR11, BR23, BRRRI dhan32, BRRRI dhan39, BRRRI dhan51, BRRRI dhan52 and BRRRI dhan58 were analyzed.
	3.2: Survey on rice-based value-added products available in the market (Recommendation from BARC workshop-2021)	A survey of rice-based value-added products available in the market was conducted in the districts of Dhaka and Khulna.
	3.3: Formulation of rice-based foods supplemented with anthocyanin-enriched fermented rice bran	A total of 20 rice cultivars including both pigmented and non-pigmented were characterized for physicochemical, cooking, nutraceutical properties.
	<b>Program Area: Rice Farming Systems</b>	
	<b>Rice Farming Systems Division</b>	

	<b>1. Survey</b>	
<b>1.1</b>	<b>Characterization of farming system of Charlands</b> The survey was conducted in Char Gadai, Kawnia, and Ranpur. However, surveys in other locations will be conducted during 2023-24.	Late Aman Gainja is very popular in Myizgari char at Sirajganj. Maize and Ground nut were the major crops in char land.
	<b>2. Development of Cropping System and Component Technology for Favorable Environment</b>	
<b>2.1</b>	<b>Performance evaluation of four-crop cropping pattern for irrigated medium high land ecosystem</b> Trial has been established in Kharif-1 and Kharif-1 and Rabi season.	Tomato (BARI Tomato-19)- Mungbean (BARI Mung-6) - T. Aus (BBRI dhan48) - T. Aman (BBRI dhan75) resulted in a remarkable REY of 44.06 t/ha, generating a gross margin of Tk. 6,49,680 per ha.
<b>2.2</b>	<b>Performance evaluation of three-crop cropping pattern for irrigated medium high land ecosystem</b> Trial has been established in Kharif-1 and Kharif-1 and Rabi season.	Onion (BARI Piaz-1)-Jute (BJRI Tosha Pat-8)-T. Aman (BRRI hybrid dhan6) cropping pattern resulted 23.74 t/ha REY with a gross margin Tk. 294010/ha which representing an increase of 114% and 169% compared to the REY and gross margin of the control pattern, respectively. However, Boro-T. Aus-T. Aman performed well among the tested cropping patterns having minimum two rices.
<b>2.3</b>	<b>Determination of optimum planting window of newly released rice varieties in Mustard-Boro-T. Aman cropping system</b> Trial has been established in Kharif-1 and Kharif-1 and Rabi season.	Both mustard varieties performed well when sown between 1-15 November. Binasarisha-9 yielded better with 10-15 days longer growth duration than BARI Sarisha-14.
<b>2.4</b>	<b>Effect of fertilizer management of Boro rice in late situation under Potato -Boro -T. Aman</b>	There was no significant difference

	<p><b>cropping system</b> Trial has been established in Kharif-1 and Kharif-1 and Rabi season. Boro rice in the field.</p>	among the treatments.
2.5	<p><b>Exploration of water logged wetland ecosystem through the development of Sorjan system for integrated fish, vegetable and fruit production</b> Sorjan system for integrated fish, vegetable and fruit production has been established</p>	<p>The highest gross margin (Tk 4500/dec) obtained from Indian Spinach-Ash gourd-Batishak-Bottle gourd under Atafol/Sharifa fruit tree.</p> <p>Due to heavy rainfall during Sitrang fish was flooded out on 24th October 2022.</p> <p>Different fruit saplings are in good condition.</p>
2.6	<p><b>Land-water interfacing with rice-fish-vegetables-fruit to intensify the system productivity</b> The experiment was conducted at West byed, BIRRI farm, Gazipur.</p>	<p>Water Chesnut was found more profitable giving a gross margin of Tk. 1780/decimal. Fishes not yet harvested. Lotus seed was not germinated. BIRRI dhan91 was damaged due to severe BLB infestation.</p> <p>In the pond dyke, the yield of summer and winter vegetables was 382 Kg and 232 Kg per decimal which gave a gross margin of Tk 7515 and Tk 2910/decimal, respectively. On the other hand, year-round papaya gave a gross margin of Tk 1540 from the yield of 195 Kg per decimal.</p>
2.7	<p><b>Evaluation of newly released BIRRI rice varieties under Boro -Fallow-T. Aman cropping pattern</b> BIRRI dhan89 and BIRRI dhan92 were evaluated in Boro and BIRRI dhan103 were evaluated in Aman season.</p>	<p>BIRRI dhan89/ 92-Fallow-BIRRI dhan75/87 sequences turned out 12.86-13.40 t/ha grain yield which were found more profitable (Gross margin Tk. 224570-140890/ha) for Boro-Fallow-T. Aman cropping system.</p>

2.7	The experiment was conducted at West byed, BRRI farm, Gazipur.	
	<b>3. Development of Cropping System and Component Technology for Stress Prone Area.</b>	
3.1	<b>Intensification of Watermelon-Fallow-T. Aman cropping pattern by inclusion of Aus rice</b> The experiment was established in Dacope, Khulna.	The yield of watermelon was 30.52-31.40 t/ha. In T. Aman season, BRRI dhan87 yielded 5.68 t/ha which was 62% higher than BR23. Aus rice was not established due to scarcity of rainfall.
3.2	<b>Improvement of single T. Aman cropping pattern through inclusion of salt tolerant Boro rice variety in saline coastal area</b> The experient was eatablised with newly released BRRI varieties at Batiaghata, Khulna.	BRRI dhan67-Fallow-BRRI dhan87 turned out the highest grain yield (10.82 t/ha) among the tested sequences.
	<b>4. Development of Cropping System Technologies for Hill Ecosystem</b>	
4.1	<b>Improvement of Jhum production system through the introduction of modern HYV Aus varieties in hilly areas</b>  BRRI dhan83 performed better 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 3.35-3.51, 3.31-3.62, 3.33-3.56, 3.47-3.73 and 3.29-3.52 t/ha respectively. Whereas different local varieties yielded 1.89-3.38 t/ha.
4.2	<b>Inclusion of mustard in Boro-Fallow-T. Aman cropping pattern in piedmont plain land</b> Explored the potential area for mustard cultivation under Boro-fallow-T. 4.2Aman cropping sytems. Conducted farmer's group discussion about the system productivity through the inclusion of mustard.	BARI Sarisha-14-BRRI dhan92-BRRI dhan87 cropping pattern resulted 17.59 t/ha REY which was 66-77% higher than the control pattern.
4.3	<b>Intensification of Fallow-Fallow-T. Aman cropping pattern through the inclusion of modern Aus rice in piedmont plain land in hilly areas</b> Explored the potential area for Aus cultivation under single T. Aman area. Conducted farmers group discussion about the system productivity through the inclusion of Aus.	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 grain yield of 10.64 t/ha.
4.4	<b>Fertilizer management in HYV Aus rice in Jhum cultivation system</b>	In all tested varieties, ring placement of

	Fertilizer management in ring placement could increase the yield level of HYV Aus rice in jhum cultivation	fertilizer around the dibbling hole gave higher grain yield than other treatments and it was found well manageable in the hilly areas.
	<b>5. Validation and Delivery of Cropping System Technology</b>	
5.1	<p><b>Intensification of Boro-Fallow-T. Aman cropping pattern through the inclusion of mustard in irrigated ecosystem</b></p> <p>Explored the potential area for mustard cultivation under Boro-Fallow-T. Aman cropping systems. Conducted farmer's group discussion about the system productivity through the inclusion of mustard.</p>	<p>Dhanbari, Tangail: The highest gross margin (2,81,800 Tk/ha) was obtained from BARI Sarisha-14-BRRI dhan102-BRRI dhan87 cropping pattern which was 94% higher than the two rice cropping system.</p> <p>Madhabpur, Habiganj: The highest gross margin (3,32,590 Tk/ha) was obtained from BARI Sarisha-14-BRRI dhan89-BRRI dhan90 cropping pattern which was 67% higher than the two rice cropping system.</p> <p>Trisal, Mymensingh: The highest gross margin (1,83,800 Tk/ha) was obtained from BARI Sarisha-14-BRRI dhan98-BRRI dhan87 cropping pattern which was 135% higher than the two rice cropping system.</p>
5.2	<p><b>Intensification of Boro-Fallow-T. Aman cropping pattern through the inclusion of Aus rice in Mymensingh region</b></p> <p>In Aman season, BRRI dhan75, BRRI dhan95 and BRRI dhan103 were evaluated in Mustard based cropping patterns with check Boro-Fallow-BRRI dhan49 cropping pattern.</p>	The highest grain yield (20.72 t/ha) was obtained from BRRI dhan92-BRRI dhan98-BRRI dhan71 with a
5.3	<p><b>Validation trial of Mustard-Patshak-T. Aus-T. Aman rice cropping pattern</b></p> <p>Two trial was conducted in 10 farmers' fields at Trisal, Mymensingh and Kaliganj, Gazipur.</p>	In both locations, the ICP had a higher Rice Equivalent Yield (REY) compared

		<p>to the ECP. In Mymensingh, the ICP had a REY of 20.79 t/ha, which was 63% higher than that of ECP (12.74 t/ha). In Gazipur, the ICP had a REY of 20.17 t/ha, which was 65% higher than the ECP's REY of 12.19 t/ha.</p> <p>In Mymensingh, the ICP had a GM of 2,60,128 Tk/ha, which was 39% higher than the ECP's GM of 1,86,660 Tk/ha. In Gazipur, the ICP had a GM of 2,53,577 Tk/ha, which was 38% higher than the ECP's GM of 1,83,993 Tk/ha.</p>
5.4	<p><b>On-farm trial on the effect of establishment methods and varieties on productivity, profitability and heat stress of late planted Boro rice in Potato-Rice-Rice cropping systems</b></p> <p>The trial was established in Nilphamari and Rangpur with transplanted and dry seeding method in Aman and Boro season. In both sites Dry seeded Aman rice plots were damaged.</p>	<p>In Boro season, transplanted rice gave higher yield than dry seeded rice.</p>
5.5	<p><b>Formulation of Energy Dense Rice Biscuit</b></p> <p>A case study was done with a potential entrepreneur (ARISTOCRAT Agro Ltd.). Energy content of EDRB was quantified by proximate analysis (RAL, BRRI; BCSIR; BSTI; UNICEF).</p> <p>Finally, the acceptability of EDRB was verified by an organoleptic test (500 participants in diverse groups).</p>	<p>According to the analytical report 100 gm of EDRB generated <math>495.93 \pm 15.10</math> Kcal of energy. Whereas wheat-based high energy-dense biscuits (prepared and distributed by UNICEF) generate an average of 450 Kcal energy. From the different sensory parameters, the overall acceptance of EDRB was calculated. About 90% of participants rated it as acceptable. 38% of all participants rated it as "Fairly acceptable" and 44.8% rated it as "Good and acceptable". Around 8% of participants rated it as "special or excellent". On the contrary, 5.2% rated it as unacceptable. Considering the above</p>

		reaction, EDRB showed immense potential to be utilized in Bakery Industries. Additionally, entrepreneurs express interest in investing in EDRB.
	<b>6. Integrated Farming Systems</b>	
6.1	<b>Crops and cropping pattern</b>	
6.1.1	<p><b>Intensification of Boro-Fallow-T. Aman cropping pattern through the inclusion of mustard in irrigated ecosystem</b></p> <p>Explored the potential area for mustard cultivation under Boro-Fallow-T. Aman cropping systems. Conducted farmer's group discussion to find out the opportunity of mustard inclusion in between T. Aman and Boro.</p>	BARI Sarisha-14-BRRI dhan89-BRRI dhan87 was found most profitable among the tested cropping pattern combinations. Farmers showed interest to cultivate mustard during the transition period to increase system productivity.
6.1.2	<p><b>Introducing newly released BRRI rice varieties for the improvement of major cropping patterns in FSRD site, Kaliganj, Gazipur</b></p> <p>Two trial were conducted in 24 farmers' fields at Kaliganj, Gazipur.</p>	Introducing Bangabandhu dhan100 in Boro and BRRI dhan87 in T. Aman season significantly increased the productivity of the Boro-Fallow-T. Aman cropping pattern. This improved cropping pattern resulted in 34% higher grain yield and a Tk 97,750/ha higher gross margin compared to the existing cropping pattern. BRRI dhan92 exhibited excellent performance in a single rice ecosystem; yielding 30% more grain than BRRI dhan29.
6.1.3	<p><b>Farmers' participatory evaluation of recently released BRRI varieties for Boro and T. Aman season</b></p> <p>BRRI dhan75, BRRI dhan87 and BRRI dhan103 were evaluated in Aman season. In Boro season,</p>	During the Aman season, farmers are extremely pleased with the yield of BRRI dhan71. Despite BRRI dhan90 yielding lower grain than its expected

	BRR1 dhan89, BRR1 dhan92, Bangabandhu dhan 100, BRR1 dhan102, BRR1 dhan104 and BRR1 dhan 105 were evaluated	<p>potential, farmers are still interested in cultivating this variety due to its excellent grain quality.</p> <p>In Boro season, farmers express great satisfaction with the performance of BRR1 dhan92 and Bangabandhu dhan100. Even though the yield of BRR1 dhan63 was comparatively lower, they appreciate it for its very fine grain quality. In the next Boro season, farmers have shown interest in cultivating BRR1 dhan63, BRR1 dhan92 and Bangabandhu dhan100.</p>
6.1.4	<p><b>Farmers' participatory quality seed production of recently released BRR1 varieties for Boro and T. Aman season</b></p> <p>A total of 1178 seeds were distributed for seed production in Aman season with BRR1 dhan71, BRR1 dhan75, BRR1 dhan87, BRR1 dhan90 and BRR1 dhan BRR1 dhan103.</p>	Each farmer kept 1-2% of their produced grain for seed purpose. They distributed 0.5-1% grain to the neighboring farmers. Most of the farmers sold major portion of their produced grain in market as non-seed.
6.1.5	<p><b>Evaluation of intercropping under mixed orchard in Madhupur tract</b></p> <p>Mixed cropping systems with Banana, Guava, Mango, Jujube was evaluated at Kaliganj, Gazipur.</p>	Total average vegetable production during 2022-23 was 191 kg from 8 decimal orchard where they consumed, sold and distribute 95, 61 and 26 Kg, respectively. The average gross return from selling vegetables was Tk 1840 per farmer during the reporting period.
6.2	<b>Homestead Production System</b>	
6.2.1	<p><b>Year-round vegetables production in homestead area</b></p> <p>Homestead area of 10 farmers at Kaliganj, Gazipur was utilized.</p>	On an average, total 183 kg summer and winter vegetables was produced from 14 decimal area; of which each farmer

		consumed 87 Kg and sold 76.8 Kg vegetables. The average gross return from homestead vegetables production was Tk 2304 per farmer during the reporting period.
6.2.2.	<p><b>Performance of turmeric and ginger in shady place of homestead area</b></p> <p>Turmeric (BARI Holud-4) and ginger (BARI Ada-1) were distributed to 08 farmers of Kaliganj, Gazipur to cultivate in shady places of the homestead area.</p>	Each farmer received 16 kg turmeric and 6 kg ginger per decimal of area.
6.2.3.	<p><b>Fruit tree plantation in homestead area</b></p> <p>Two Mango (BARI Aam-8), Malta (BARI Malta-2), Guava (BARI Peyara-2), Litchi (BARI Lichi-4) and Lemon (BARI Lebu-2) saplings were provided to 10 small and marginal farmers of Kaliganj, Gazipur under this activity.</p>	
6.3	<b>Livestock System</b>	
6.3.1.	<p><b>Production performance of Sonali chicken</b></p> <p>Twenty Sonali chicks were distributed to each of the ten selected farmers at Kaliganj, Gazipur. Chicks were about 30 days old. The male female ratio was about 1:4.</p>	On an average, each farmer earned a total Tk. 4078 by selling chicken and eggs.
6.3.2.	<p><b>Small scale pigeon rearing in farmer's household</b></p> <p>Two pairs of adult pigeon were distributed to each of ten farmers at Kaliganj, Gazipur. Egg, squab production and body weight was monitored regularly. Technical supports (feeding and watering management, vaccination etc.) as well as necessary treatments were provided as per requirement.</p>	Pigeon rearing was found profitable and it provides additional Tk 4350 per farmer per year by producing squab.
6.3.3.	<p><b>Goat rearing in homestead area</b></p> <p>One Black Bengal doe was distributed to each of ten farmers at Kaliganj, Gazipur. Technical supports (feeding, de-worming, vaccination etc.) and advice were also given regularly. Necessary treatments were also provided as per necessity.</p>	Seven goats gave birth of nine kids whereas two goats did not give kids yet.

6.3.4.	<b>Vaccination program for livestock</b>  Vaccination by Khuravax, PPR, FMD for cattle, goat and Ranikhet, DPV and Fowl pox for chicken, duck and pigeon were provided.	The disease incidence was significantly reduced and farmers were interested to continue vaccination of livestock.
6.4.	<b>Fisheries System</b>	
6.4.1.	<b>Semi-aquatic production system of vegetables and fish in derelict mini pond</b>  Aroid (BARI Panikachu-3) was cultivated in the derelict pond along with Fish (Mixed carp) at Kaliganj, Gazipur.	Farmer earned Tk 4865 by selling stolon and Tk 68,000 by selling of Aroid from a 20 decimal derelict pond. Fish are not yet harvested.
	<b>Program Area: Crop Soil Water Management</b>	
	<b>Agronomy Division</b>	
	<b>Planting Practices</b>	
1	Effect of time of planting on the yield of submergence tolerance PVT genotype	To achieve satisfactory yield, IR16F1148 should preferably be transplanted on 20 <sup>th</sup> July to 5 <sup>th</sup> August.
2	Yield Loss Assessment of Rice under Late Planting Condition	The optimum transplanting date of BRR dhan88 and BRR dhan89 to achieve maximum grain yield at Gazipur is 5 <sup>th</sup> January. The average daily yield reduction of BRR dhan88 and BRR dhan89 are 86 and 93 kg ha <sup>-1</sup> , respectively was occurred transplanted after 5 <sup>th</sup> of January.
3	Effect of time of planting of newly developed BRR varieties at BRR R/S Rangpur	To achieve higher yield in the Rangpur region, BRR dhan75 should preferably be transplanted on 20 <sup>th</sup> July- 20 <sup>th</sup> August, BRR dhan87 & BRR dhan90 on 20 <sup>th</sup> of August and BRR dhan93 on 20 <sup>th</sup> July – 05 <sup>th</sup> August. BRR dhan88, BRR dhan89 and BRR dhan92 produced

		higher grain yield on 16 January and 01 <sup>th</sup> February planting
4	Effect of planting time on growth and grain yield of newly released BRRi varieties at BRRi R/S Cumilla	BRRi dhan87 and BRRi dhan95 produced higher grain yield on 5 August to 20 August transplanting in Aman season at BRRi R/S Cumilla.
5	Effect of planting date on the growth and yield of newly developed BRRi varieties in Barishal region	BRRi dhan74 and BRRi dhan 89, transplanted on 9 January produced higher grain (5.45 t ha <sup>-1</sup> , 5.80 /ha <sup>-1</sup> , respectively) than the delayed transplanting in Barishal region.
	<b>Fertilizer Management</b>	
6	Effect of organic and inorganic source of nutrients on nitrogen mineralization, microbial population and yield of rice	Additional use of crop residue (30 cm) and vermicompost (2 t ha <sup>-1</sup> ) increases microbial population, nitrogen mineralization and also grain yield in rice.
7	Effect of N levels and growth stage-based N application on growth, yield and nitrogen use efficiency in Rice	BRRi dhan87 gave highest grain yield in STB + 20% treatment; whereas, BRRi dhan95 gave highest grain yield in STB treatment. BRRi dhan95 required less nitrogen than BRRi recom. dose. The highest nitrogen use efficiency (%) was found in STB treatment of BRRi dhan96 and STB + 10% treatment of BRRi dhan92, respectively. BRRi dhan92 required more nitrogen than BRRi recom. Dose
8	Effect of BRRi organic fertilizer on growth and yield of BRRi dhan90	The highest yield (3.6 t ha <sup>-1</sup> ) was observed in BRRi organic fertilizer combined with BRRi recom. dose (T <sub>3</sub> )

		than control.
9	Effect of foliar application of chitosan on growth, yield and physio-biochemical characteristics of rice under salinity stress	In 65 mM salinity level BRRRI dhan49 gave 16.3% higher yield with 250 ppm chitosan spray than without spray
10	Application of chitosan to improve salt tolerance of rice in the Boro season	In 65 mM salinity level BRRRI dhan67 gave 45% higher yield with 250 ppm chitosan spray than without spray
11	Mitigation of waterlogging stress in T. Aman through the application of plant protectants coupled with balanced fertilization	Recommended fertilizer (100%) with Phyto protectants (ABA) could partially improve the growth, and ameliorates the adverse effects of waterlogging stress on rice.
12	Growth stage-based Nitrogen management for yield maximization of Hybrid rice in T Aman and Boro season	Nitrogen applied in basal (25%)+Active tillering stage 25%)+Mid tillering stage 25% +Before panicle initiation (BPI) 25% with 120kg N ha <sup>-1</sup> produced the highest grain yield, straw yield, uptake more N in grain and straw. The optimum N rate appeared as 100 kg and 109 kg ha <sup>-1</sup> and 91 kg ha <sup>-1</sup> for BRRRI hybrid dhan6 with corresponding GSBNM practices respectively. Among them, 100 kg N ha <sup>-1</sup> is the best for BRRRI hybrid dhan6 according to growth stage-based application and scheduling. But in Boro season for BRRRI hybrid dhan5 N application, @150 kg ha <sup>-1</sup> with basal (20%) + Active tillering stage (30%) + maximum tillering stage (30%) + Booting (20%)+ during flowering (15%) produced the highest grain yield.

13	Physiological, biochemical and molecular mechanisms of salinity tolerance in rice	Salinity tolerance in BRRI dhan47, BRRI dhan67 and BRRI dhan78 associate with the function of <i>OsHKT1;1</i> in maintenance of $K^+/Na^+$ homeostasis in the tissue. Salinity tolerance in BRRI dhan73 and BRRI dhan99 might associate with both the function of high-affinity $K^+$ transporter 4 ( <i>OsHKT1;1</i> ) and $Na^+/H^+$ exchangers ( <i>OsNHX1</i> ).
<b>Good Agricultural practices</b>		
14	Yield maximization of Boro rice through good agricultural practice (GAP)	The net change in the profit obtained by the GAPs techniques was observed to be 808 Tk. ha <sup>-1</sup> for BRRI hybrid dhan5, 23383 Tk. ha <sup>-1</sup> for BRRI dhan100 and 11608 Tk. ha <sup>-1</sup> for BRRI dhan96. Hence, it can be concluded that the adoption of GAPs practices in rice cultivation is economically viable.
<b>Yield maximization</b>		
15	Effect of agronomic factors for maximizing yield of BRRI dhan70 through developing sustainable production management protocol	For maximizing yield of BRRI developed Long Slenderer Premium Quality Fine Rice variety like BRRI dhan70 ( <i>Katarivog type</i> ) through developing sustainable production management protocol in T Aman season, the highest grain yield was obtained from the agronomic based treatment combination of F <sub>2</sub> S <sub>1</sub> A <sub>1</sub> T <sub>2</sub> (5.89 t ha <sup>-1</sup> ) followed by F <sub>2</sub> S <sub>1</sub> A <sub>2</sub> T <sub>1</sub> (5.16 t ha <sup>-1</sup> ) than F <sub>2</sub> S <sub>1</sub> A <sub>2</sub> T <sub>2</sub> (4.16 t ha <sup>-1</sup> ). The lowest grain

		yield was observed from F <sub>2</sub> S <sub>2</sub> A <sub>1</sub> T <sub>1</sub> (1.52 t ha <sup>-1</sup> ) than F <sub>1</sub> S <sub>2</sub> A <sub>2</sub> T <sub>1</sub> (2.08 t ha <sup>-1</sup> ).
16	Maximizing yield of BRR I developed T Aman varieties through influencing some Agronomic Critical Factors	For maximizing yield of BRR I developed T Aman varieties through influencing some Agronomic Critical Factors BRR I dhan71 (Short duration, 114 days), BRR I dhan87 (Medium duration, 128 days) and BRR I dhan52 (Long duration, 145 days) varieties obtained the highest yield by M4 and M5 agronomic management combinations than other tested agronomic management treatment. But in T Aman season 2022, it was found that all tested varieties gave higher grain yield in the agronomic management combination M <sub>4</sub> . Higher yield was achieved due to higher contribution of yield component factors especially higher panicle and fill grain production and less sterility%.
17	Effect of agronomic factors for maximizing yield of BRR I dhan94 through developing sustainable production management protocol	For Maximizing yield of medium duration BRR I dhan94 variety through developing sustainable production management protocol in Aman season, the highest grain yield was achieved from the treatment F <sub>2</sub> A <sub>2</sub> S <sub>2</sub> T <sub>2</sub> (6.53 t/ha) followed by F <sub>1</sub> A <sub>2</sub> S <sub>1</sub> T <sub>2</sub> (5.81 t ha <sup>-1</sup> ) than F <sub>1</sub> A <sub>2</sub> S <sub>2</sub> T <sub>2</sub> (5.79 t ha <sup>-1</sup> ) . It also observed that significant higher yield was achieved due to higher contribution of yield components. For obtaining the highest grain yield, BRR I dhan94 will be

		seeding on 15 July and transplanting with 30 days old seedling, maintaining 20 × 20 cm spacing. Soil test-based fertilizer was applied
18	Maximizing yield of BRRRI developed Boro varieties through influencing some Agronomic Critical Factors	The highest grain yield was observed by long duration variety BRRRI dhan89 in all management treatment followed by BRRRI dhan29 than short duration BRRRI dhan88. In respect to all management treatment, Management 3 than Management 2 are the highest yield performer by long duration and short duration variety for obtaining higher yield. So, seeding would be done on 1 <sup>st</sup> to 2 <sup>nd</sup> week of December with younger seedling (15 to 25-day old) may transplant following wider spacing (30 x 25 or 25 × 25 cm) with in 3 <sup>rd</sup> week of December with 1 or 2 seedling per hill. Upper soil stirring would be done on 20 & 35 DAT. STB fertilizer management would be followed and additionally 1% MoP solution to be spray on 30 and 45 DAT.
19	Effect of some agronomic factors for maximizing yield of long duration variety BRRRI dhan92 through developing sustainable production management protocol in Boro season	For maximizing yield of long duration BRRRI dhan92 through developing sustainable production management protocol in Boro season, the highest grain yield was obtained from the treatment F <sub>2</sub> S <sub>1</sub> A <sub>1</sub> (8.53 t ha <sup>-1</sup> ) followed by F <sub>1</sub> S <sub>1</sub> A <sub>1</sub> (8.24 t ha <sup>-1</sup> ) than F <sub>1</sub> S <sub>2</sub> A <sub>1</sub> (7.60 t ha <sup>-1</sup> ). The lowest grain yield was

		observed from F <sub>2</sub> S <sub>3</sub> A <sub>3</sub> (6.15 t ha <sup>-1</sup> ) than F <sub>1</sub> S <sub>1</sub> A <sub>3</sub> (6.25 t ha <sup>-1</sup> ). The obtained higher yield was contributed by higher number of panicle and fill grain production and lower sterility %. The result means that for obtaining higher yield, STB fertilizer along with 1 t/ha vermi compost need to apply along with 1% MoP solution spray at 30 and 45 DAT. 15-day old seedling maintaining wider spacing should be transplanted.
	<b>Soil Health Improvement</b>	
20	Characterization of salt-tolerant PGPR isolated from coastal saline soil in Bangladesh	The salt-tolerance and plant growth-promoting traits revealed that Sat-2, Sat-4, Sat-5 and Sat-6 are potential salt-tolerant PGPR strains.
21	Study on salt-tolerant PGPR inoculation on the growth of rice seedlings under salt-stress condition	Among the four tested bacterial strains Sat-2 and Sat-4 are comparable with the check bacterial strain UPMRB9. Hence, this bacterial strain could be considered as a salt-tolerant strain which can significantly contribute to reducing the salinity stress of rice at the seedling stage.
22	Improvement of soil health in four crops pattern through agronomic management	Despite of cultivation of 4 crops in same land, are not harmful in terms of soil fertility the proper agronomic management is given. In T. Aus, T. Aman-Potato-Mungbean cropping pattern showed higher number of total

		bacterial population ( $3.05 \times 10^6$ cfu/g dry soil over the Boro-fallow-T. Aman cropping pattern
	<b>Weed Management</b>	
23	Effect of herbicide on Azolla infestation in rice field	Penoxulam and 2,4-D Amine perform better to control Azolla in the irrigated rice field
24	Reduce weed seed in weed Seed Bank of soil in long-term fallow management and herbicide uses in Rice- rice Cropping System	The floristic diversity of the soil weed seed bank was higher in the depth of 0-5 and 5-10 cm depth in the month of September and October. The cyperaceous family had the highest species richness under different weed management techniques followed by broadleaf and grassy weeds.
25	Evaluation of candidate herbicide for weed control efficiency in T Aman 2022 and Boro 2022-23 season	During reporting year (T. Aman 2022 and Boro 2022-23), fifty-one herbicides of twenty different groups were evaluated.
26	Residue analysis of herbicide, insecticide and fungicide in soil, water and rice under irrigated ecosystem	The retention time of bensulfuron-methyl, thiamethoxam, 41hlorantraniliprole and tricyclazole were 2.14-2.25, 1.85, 2.22 and 2.14 min, individually. Among the 30 samples from different matrix (clean rice, straw and soil), pesticide residues were found only in 10 grain and straw samples from double dose of pesticides treated plot. No residues were found in soil matrix.
	<b>Name of Division: Soil Science Division</b>	
	<b>Project 1. Fertility Assessment of Rice Soils and Nutrient use efficiency in rice</b>	

<p>Expt. 1.1 Management interventions to improve NUE and reduce N losses in double rice cropping of Bangladesh</p> <ul style="list-style-type: none"> <li>▪ <math>AE_N</math> ranged from 5-11 kg grain <math>kg^{-1}</math> N applied.</li> <li>▪ <math>RE_N</math> ranged from 27-57%.</li> <li>▪ Greater <math>RE_N</math> in N83UDP followed by N110PU, N110 (PU+CD) &amp; N83 (PU+BOF).</li> </ul>	<p>Improvement of mitigation options for reducing N loss &amp; GHG emissions at harvest</p>
<p><b>Expt. 1.2. Screening of N use efficient BAAP rice genotypes</b> 210 BAAP genotypes screened in Aus season.</p>	<p>N use efficient rice genotypes will be identified.</p>
<p><b>Expt. 1.3. Phosphorus response study of newly released rice varieties</b> -Response of added P is lower in wet season than in dry season -BRRI hybrid dhan4 performed better with 100% STB P application in T. Aman 2022.</p>	<p>The requirement of phosphorus for optimum yield of the latest varieties will be quantified.</p>
<p>Expt. 1.4 Updating of nitrogen doses for modern rice varieties The calculated economically optimum N dose for BRRI dhan95 in T. Aman 2022 season was 80 kg/ha.</p>	<p>The requirement of nitrogen for optimum yield of the latest varieties will be quantified.</p>
<p><b>Project II: Identification and Management of Nutritional Disorders in Rice</b></p>	
<p><b>Expt. 2.1 Long-term Effect of Organic and Inorganic Nutrients on Yield and Yield Trend of Lowland Rice</b></p> <ul style="list-style-type: none"> <li>• Long-term omission of N, P, K and S adversely affected rice yield</li> <li>• Zn omission had no negative effect on rice yield in Grey Terrace soil of BRRI farm, Gazipur</li> <li>• Application of IPNS based fertilizers had positive effect on rice yield and N uptake</li> <li>• The SOC increased in the organic treated plots</li> </ul>	<p>Increased yield and soil health maintenance through balanced fertilization</p>
<p><b>Expt. 2.2 Long-term missing element trial (BRRI R/S Rangpur)</b> At BRRI Rangpur, N is the most yield limiting nutrient followed by P, K and S in both Boro and T. Aman season.</p>	<p>Nutrient supplying capacity of Rangpur soil will be determined.</p>
<p><b>Expt. 2.3. Effect of intensive rice cropping on rice yield under continuous wetland condition</b> Intensive rice cropping with complete fertilizer (NPKSZnCu) resulted in highest yield of rice</p>	<p>The consequences of intensive cropping under continuous wet land conditions</p>

	compared to other fertilizer treatments.	will be evaluated.
	<b>Project III. Integrated nutrient management</b>	
	<b>Expt. 3.1 Integrated Nutrient Management for double and triple Rice Cropping for Maximizing Productivity</b> Annual yield for double and triple rice cropping were 11 t/ha and 14 t/ha, respectively.	Rice yield improvement through nutrient management in the coastal area.
	<b>Expt. 3.2 Nutrient management under conservation agriculture (CA) in double rice cropping system</b> 100% recommended fertilizer was sufficient for maximum rice yield both in puddled and unpuddled conditions in T. Aman and Boro seasons. Rice straw incorporation increased rice yield.	Develop tools for sustainable nutrient management under reduced tilling.
	<b>Expt. 3.3 Soil management to maximize the yield of newly released rice varieties</b> BRRI dhan96 showed positive response to added N in BRRI R/S, Sonagazi	Developing management practices to maximize rice yield.
	<b>Expt. 3.4 Estimation of C and N flows in a village and developing methods to improve soil C and N within the system</b> Application of 2 t/ha cow dung or BRRI organic fertilizer or Bio-coated urea reduced 30% N use in rice production	Total C and N flows of the soil will be determined using appropriate methods (volatilization, leaching of N and by GHG gas emission).
	<b>Project IV. Soil micronutrients, heavy metals and environmental problems</b>	
	<b>Expt. 4.1 Effect of Silicon and selenium on the growth and yield of rice</b> Foliar spray of Si and Se with complete fertilizer showed a positive effect on the number of filled grains per panicle of BRRI dhan87.	Rice yield improvement through the application of beneficial nutrients.
	<b>Expt. 4.2 Effect of biochar on rice yield and soil health on problem soils</b> Application of rice husk biochar in Boro season showed a residual effect in the following T. Aman season which reduced 30% use of chemical fertilizer without significant yield reduction in the charland soils of Sirajganj.	Improvement of soil health by biochar management in Charland areas.
	<b>Expt. 4.3 Varietal effects on rice yield and greenhouse gas emissions in the South-western coastal ecosystems of Bangladesh</b> <ul style="list-style-type: none"> <li>➤ Insignificant variation of rice yield was observed among the tested varieties (BRRI dhan75, BRRI dhan87, BRRI dhan90, and BRRI hybrid dhan6</li> <li>➤ Lower CH<sub>4</sub> emission was found in BRRI dhan75 compared to other varieties</li> </ul>	Technology for increased crop productivity with reduced negative environmental impacts will be developed.

<b>Project V. Soil Microbiological studies</b>																				
<b>Expt. 5.1 Soil Microbial Characteristics of different AEZ's</b>					Microbial population in different soils will be quantified.															
AEZ	PGPR	N <sub>2</sub> -fix (mg/l)	P-Solubilize (mg/l)	IAA (mg/l)																
10	<i>Bacillus cereus</i>	7	1730	28																
15	<i>Pseudomonas geniculata</i>	14	2961	145																
22	<i>Stenotrophomonas sp</i>	7	3681	11																
<b>Expt. 5.2 Bio-Coated Urea: a new approach to improve N fertilizer use efficiency (NUE) and crop yield</b>					Bio-coated urea fertilizer will be formulated.															
<table border="1"> <thead> <tr> <th>Treatment</th> <th>GrainYield (t/ha)</th> </tr> </thead> <tbody> <tr> <td>Control</td> <td>2.31</td> </tr> <tr> <td>RD(PU+PKS)</td> <td>4.7</td> </tr> <tr> <td>RD(BCU+PKS)</td> <td>4.8</td> </tr> <tr> <td>25% Red.N(PU+PKS)</td> <td>4.4</td> </tr> <tr> <td>25% Red.N(BCU+PKS)</td> <td>4.5</td> </tr> <tr> <td>50% Red.N(PU+PKS)</td> <td>3.46</td> </tr> <tr> <td>50% Red.N(BCU+PKS)</td> <td>4.9</td> </tr> </tbody> </table>						Treatment	GrainYield (t/ha)	Control	2.31	RD(PU+PKS)	4.7	RD(BCU+PKS)	4.8	25% Red.N(PU+PKS)	4.4	25% Red.N(BCU+PKS)	4.5	50% Red.N(PU+PKS)	3.46	50% Red.N(BCU+PKS)
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<b>Name of Division: Irrigation and Water Management Division</b>																				
<b>1</b>	<b>Determination of Physical and Hydraulic Properties of Different Soil Types</b>				Documentation of important soil physical properties can help for implementing efficient water management and can contribute to data bank generation for crop modeling.															
	<p><b>Progress:</b></p> <ul style="list-style-type: none"> <li>Twelve soil samples were collected from BRRRI research field at 4 different depths from 3 locations</li> <li>GPS of all soil sampling points recorded for Geo-referencing</li> </ul>																			
<b>2</b>	<b>Development of Automated Alternate Wetting and Drying Irrigation System for Rice Production</b>				Development of precision irrigation system in ric cultivation that will save irrigation water and reduce fuel and labor cost															
	<p><b>Progress</b></p> <ul style="list-style-type: none"> <li>Four ultrasonic sensors based Automated AWD unit prototype has been developed and installed in the field</li> <li>The system is running by rechargeable battery powered by solar energy and able to relay</li> </ul>																			

	water level data to a sever to be stored	
3	<p><b>Optimization of Water Use Efficiency Through Subirrigation in Bangladesh</b></p> <p><i>Progress:</i></p> <ul style="list-style-type: none"> <li>• Subirrigation irrigation system installed at BRRRI farm Gazipur</li> <li>• Subirrigation lateral spacing: 1.2 m, depth: 50 cm, area: 132 sq. m.</li> <li>• Water supply: 1000 L Overhead Tank with Gate valve</li> <li>• BRRRI dhan89 transplanted as test variety</li> </ul> <p>Irrigation water volume and field water level is monitored daily</p>	Increased water use efficiency and productivity
4	<p><b>Increasing Land Productivity in Valley Area of Hilly Region Through Integrated Minor Irrigation System</b></p> <p><i>Progress:</i></p> <ul style="list-style-type: none"> <li>• LULC analysis has been done using satellite images and and physical varification</li> <li>• Significant amount of water resources available during dry season and could be conserved by building earthen cross dam</li> <li>• Irrigation equipment like LLP will be needed to utilize the water resources for irrigation</li> </ul>	Suitable water management options has been identified for agriculture and livelihood improvement in the hilly area.
5	<p><b>Performance evaluation of the proposed rice varieties under different water regimes</b></p> <ul style="list-style-type: none"> <li>• Six long duration advanced lines were tested along with BRRRI dhan92</li> <li>• The crop is now at the Maturity stage</li> </ul>	Suitable water management practice for the cultivars will be suggested.
6	<p><b>Irrigation water requirement and rainfall utilization for delayed transplanting of Boro rice in BRRRI farm, Gazipur</b></p> <p>Experiment was conducted at BRRRI farm Gazipur in Boro season 2022-23 using BRRRI dhan81 with 4 transplanting dates.</p> <p>More irrigation was applied in plots transplanting on 15 and 31 January compared to the plots transplanted on 14 February and 1 March.</p>	Irrigation water will be saved and groundwater level declination will be reduced
7.	<p><b>Improving soil-water availability for crop production in Charland by amendment practices</b></p> <p>Five soil amendment practices were tested for water availability improvement in char-land. Soil compaction is appearing better than the other practices in respect of water conservation.</p>	Irrigation requirement will be decreased
8	<p><b>Land Productivity Improvement in the Coastal Environment</b></p>	
	<p><b>Saline water irrigation strategies for Boro rice cultivation in the coastal saline area</b></p> <p>Experiment conducted in the saline coastal area on the effect of different level of saline water</p>	Level of salinity will be determined for satisfactory yield of rice in saline areas

	irrigation for rice growth and yield revealed that the latest salt-tolerant rice variety like BRRIdhan97 and BRRIdhan67.	
<b>9</b>	<b>Sustainable Management of Water Resources</b>	
	<b>Assessment of Groundwater Resources and Safe Utilization in Different Geo-Hydrological Regions</b> Study on groundwater assessment showed that groundwater level depletion was about 44.17 m in last 25 years at BRRIfarm, Gazipur showing an alarming average declining rate of 1.77 m per year. For the sustainable management of water resources, conjunctive use of municipal wastewater with fresh water would be a good irrigation option in Boro season.	Sustainability of groundwater utilization will be assessed
	<b>Conjunctive use of wastewater and freshwater for irrigation in Boro rice cultivation</b> Industrial and municipal wastewater with was mixed with freshwater in different ratios for irrigation application in Rice cultivation. BRRIdhan89 was the tested variety. Conjunctive use of wastewater with fresh water may save the groundwater use for irrigation.	Potential of wastewater utilization
	<b>Assessment of Surface and Groundwater Quality for Irrigation in Selected Locations of Bangladesh</b> <i>Progress:</i> <ul style="list-style-type: none"> <li>• The water samples were collected from different sources of ground water and surface water.</li> <li>• Collected samples were preserved refrigerator in laboratory for chemical analysis</li> <li>• The chemical analysis of the collected sample is ongoing</li> </ul>	Safe irrigation water sources has been documented
	<b>Assessing on-farm water-use efficiency of BRRIfarm, Gazipur</b> The water use efficiency at west byde of BRRIfarm, Gazipur was 70.60%. It revealed that 29.40% of the applied water is being wasted due to several reasons like internal earthen canals, leakage in pipes, excessive application and field losses.	Improvement of irrigation system
	<b>Groundwater Use Potential for Supplemental Irrigation for Boro Rice Production in the Haor Areas</b> The yield reduction due to water stress at reproductive phase of Boro in haor areas was upto 43%. Yield of Boro crop in Shanir Haor (Tahirpur, Sunamganj) is almost doubled after application of supplementary irrigation at reproductive phase by groundwater development. Only 2-4 irrigations were required to obtain satisfactory yield.	Higher yield of rice will be achieved with supplemental irrigation
<b>10</b>	<b>Renewable Energy</b>	
	<b>Feasibility assessment of solar pump utilization for irrigation purpose in Chattogram region</b>	

	Solar pump utilization for irrigation purpose at Subornochar upazila of Noakhali district in the Chattogram region is not feasible when the source of water is groundwater.	Feasibility of solar powered irrigation will be assessed
	<b>Development of A Low-Cost DC Solar Water Pump for Irrigation in Bangladesh</b> During development of a low-cost brushless DC solar pumpsystem, it is required some modifications to achieve the design rpm and discharge.	Low cost solar pump will be developed
<b>11</b>	<b>Technology Validation in the Farmers Field</b>	
	<b>Increasing Cropping Intensity in the Coastal Barishal and Khulna Region Through Water Resources and Soil Salinity Management Karmasuchi (Funded by MOA)</b> 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. 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.	
	<b>Mitigating risk and scaling-out profitable cropping system intensification practices in the salt affected coastal zones of the Ganges Delta (Funded by Australian Centre for International Agriculture Research)</b>	
	<b>Modeling climate change impact on agriculture and developing mitigation and adaptation strategies for sustaining agricultural production in Bangladesh (KGF Funded)</b> The “Modeling climate change impact on agriculture and developing mitigation and 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. Elevated temperature shortened the crop growth duration as well as reduced the crop water requirement. There were similar seasonal ETo for Boro and T. Aus seasons, although duration of T. Aus season is	

	comparatively less (153 days) than Boro (182 days) and T. Aman (184 days) seasons. Higher temperature, higher bright sunshine hours and wind speed in T. Aus season increased the ETo rate.	
	<p><b>Upscaling of improved water management practices for sustainable productivity in the haor areas (KGF Funded)</b></p> <p>Yield loss due to water stress in the reproductive phase was assessed in Shanir haor and Matian haor of Tahirpur upazila. The 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 (Fig. 13). The study results indicated that huge yield loss occurred in the haor area due to water stress in the reproductive phase of Boro rice. The average yield obtained in the AWD plots was similar to the farmers practice plots. Generally, 2-3 irrigations were saved in AWD irrigation practice then the farmers practice (maintaining saturation to standing water). Irrigation time was reduced by 20 percent due to use of polythene pipe compared to earthen canal. Due to use of polythene pipe the irrigation time per unit area was reduced significantly.</p>	
	<p><b>Intervention in surface water utilization through integrated minor irrigation schemes for escalating water and land productivity in coastal region (ISIMISC)</b></p> <p>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.</p>	
	<b>Plant Physiology Division</b>	
	<b>Project 1: Salinity tolerance</b>	
1	Screening of rice germplasm for salinity tolerance at seedling stage.	Among the 300 germplasm Acc. No. 3870 and 3881 were found tolerant with SES score 3 and Acc. No. 3750, 38667,

		3893, 4176 and 4186 were found moderately tolerant with SES score 5.
2	Screening of hybrid parent lines for salinity tolerance at seedling stage.	Out of 375 hybrid parent lines 4 lines were found tolerant (Namely BHR37, BHR80, BHR259 and BHR260) including T. check: IR58443, Pokkali and Horkuch and 78 parent lines were found moderately tolerant to salinity.
3	Screening of BRRI hybrid rice varieties for salinity tolerance at seedling stage.	BRRI hybrid dhan5 was found moderately tolerant to salinity
4	Screening of rice advance breeding lines for salinity tolerance at seedling stage at Boro season	One line (BR12274-4R-113) were found tolerant and could be proceed for further breeding program.
5	Screening of rice advance breeding lines for salinity tolerance at seedling stage at Aman season.	Ten (10) advanced breeding lines, (BR11712-4R-333, BR11722-4R-73, BR11722-4R-398, BR11714-4R-69, BR11714-4R-74, IR108604-2-1-AJY3-B-1, TP24493, IR16T1661, IR18T1073, IR15T1319) was found tolerant and could be proceed for further breeding program.
<b>Project 2: Submergence tolerance</b>		
6	Screening of local germplasms for Anaerobic tillering ability under water stagnant condition at T. Aman season	Out of 90 germplasm 21 germplasm was survived after de-submergence, and the percent survivability was ranged from 16.67 to 33.33% (SES score 9). Survivability of the tolerant check varieties FR13A and BRRI dhan79 had 100% and 83.33%, respectively whereas susceptible check varieties not survived.
7	Screening of local germplasms for Anaerobic tillering ability under water stagnant condition at T.	Among tested genotypes 14 germplasms

	Aman season	(namely, genebank Acc. No.2098, 2102, 2105, 2116, 2118, 2121, 2124, 2133, 2135, 2139, 2149, 2155, 2156 and 2157) were produced $\geq 10$ tillers/hill under water stagnant condition. Further validation could be done to confirm the above-mentioned germplasms for anaerobic tillering ability.
	<b>3. Project: Drought Toleracne</b>	
8	Screening germplasm for drought tolerance at reproductive phase T. Aman 2022	Out of 300 germplasm 41 germplasm showed better performance under rainfed condition at reproductive phase which were selected for further confirmation under control condition in rain out shelter.
9	Evaluation of previously selected germplasm under drought stress at reproductive phase in the rain-out shelter	Under control drought condition in the rainout shelter, out of 44 germplasm BRRRI Gene Bank Acc. no. 2451 yielded highest followed by Acc. no. 2554, 2312, and 2320. The sterility percentage of these genotypes was less than 50.
	<b>Project 4: Heat Tolerance</b>	
10	Screening of rice germplasm for high temperature tolerance	Out of 50 germplasm one germplasm (Acc. No. 2135) scored 3 with 88% spikelet fertility and 5 germplasm had SES score 5 with spikelet fertility 51-70%). The tolerant and susceptible check had 51 and 1% spikelet fertility with SES score 5 and 7 respectively.
11	Screening for high temperature induced spikelet fertility QTL introgression lines under controlled	Two lines with spikelet fertility 57-59%

	conditions.	at 38 °C and 75% RH during flowering were selected.
12	Observational yield trial of high temperature induced spikelet fertility introgression lines in the BRR1 dhan28 and BRR1 dhan29 backgrounds.	105 and 89 progenies of BRR1 dhan28 and BRR1 dhan29 were selected for further trial
13	Marker assisted introgression of high temperature induced spikelet fertility QTL ( <i>qHTSF4.1</i> ) in the background of BRR1 dhan48, BRR1 dhan62 and BRR1 dhan71.	<ul style="list-style-type: none"> <li>▪ The combination of R4M30 and CAPS able to identify all combination of crosses except BRR1 dhan62/N22.</li> <li>▪ However, KASP is capable to identify the QTL in all cross combination.</li> </ul> <p>It was discovered that BRR1 dhan71 possessed the heat-tolerant QTL <i>qHTSF4.1</i> in its background.</p>
<b>Project 5: Cold Tolerance</b>		
14	Exploring new sources of cold tolerance from BRR1 Gene Bank collections at seedling stage	<p>Out of 300 germplasm, BRR1 GeneBank Acc. Number 2836 showed cold tolerant having the SES score 3 and 27 BRR1 GeneBank germplasm showed moderately cold tolerant at seedling stage having the SES score 5.</p> <p>The selected BRR1 GeneBank Acc. number are 2776, 2777, 2778, 2783, 2826, 2828, 2829, 2832, 2834, 2835, 2836 2837, 2843, 2844, 2847, 2855, 2860, 2867, 2868, 2869, 2875, 2884, 2919, 2922, 2971, 2973, 2987, 2998.</p>
15	Screening of advanced breeding lines for cold tolerance at seedling stage	Among the tested genotypes 3 advanced breeding lines BR12552-3R-179, BR12552-3R-199 and BR11337-5R-29 from favorable Boro and cold tolerant rice showed more than 80% survivability

		having the SES score 1. However, some total of 695 genotypes have a survivability rate ranging from 50 to 70%. From these lines 191 advanced breeding lines and 9 germplasm with SES score 3 and survivability >50% were selected as cold tolerant at seedling stage. Moreover, 472 advanced breeding lines and 23 germplasm with SES score 5 and survivability $\geq$ 50% were selected as moderately cold tolerant.
16	Evaluation of breeding lines for reproductive stage cold tolerance	Among the tested breeding lines BR11894-R-R-R-R-169 had the highest yield (7.13 t/ha) followed by BR11894-R-R-R-R-110 (7.02 t/ha) when sowing was done on 7 Nov. The yield of check varieties BRRIdhan67 and BRRIdhan89 were 6.26 and 6.63 t/ha respectively.
<b>Project 6: Growth and yield</b>		
17	Evaluation of lodging tolerance in BRRIdveloped T. Aman varieties	On the basis of plant morphological characterization BRRIdhan75, BRRIdhan79, BRRIdhan80 was found lodging tolerant.
18	Characterization for lodging tolerance of BRRIdreleased Boro varieties and advanced breeding lines	BRRIdhan96, BRRIdhan81, BRRIdhan88, BRRIdhan61, BRRIdhan58, BRRIdhan47, IR12A173, BR11318-5R-63, IR17A1694 has lodging resistance capacity in various aspect of morphological and anatomical lodging

		parameters.
19	Photosensitivity test of some local germplasm with 4 BRRI released varieties	All of the local germplasm and 3 BRRI released were found strongly photoperiod sensitive, only BR11 showed weakly photosensitive.
20	Photosensitivity test of some advanced breeding lines	Out of 201 advanced lines and 3 varieties (Gainza, BR22, BR23), 17 lines were insensitive, 12 advanced breeding lines were strongly photosensitive and among three varieties Gainza, BR22 and BR23 variety was found strongly photoperiod sensitive.
21	Effect of harvesting time on yield of rice at wet and dry season.	Highest yield was found between 29 to 33 DAF and 33 to 37 DAF for dry and wet season respectively. A significant yield (about 20-50%) was reduced due to early harvesting (about 21 to 25 DAF) in wet season. At Dry season, about 18-28% yield could be reduced if harvesting done after three weeks after flowering. About 12% reduction in field yield occurred when harvesting was done one week later than optimum time in both seasons.
<b>Project 7: Genome editing</b>		
22	CRISPR-Cas9 mutagenesis of the <i>OsRR22</i> gene for improving salinity tolerance of rice	The guide sequence was properly cloned into the binary vector pC1300-Cas9. The binary vector pC1300-Cas9 harboring Cas9/ <i>OsRR22</i> sgRNA was mobilized into <i>Agrobacterium tumefaciens</i> LBA4404 by freeze-thaw method and

		<p>confirmed through PCR-gel electrophoresis. Plants were regenerated through <i>Agrobacterium</i>-mediated transformation. Genomic DNA was extracted from the leaves of transformed plants using the sodium dodecyl sulfate (SDS) method. Hygromycin phosphotransferase positive plants were identified using HPT primer pair designed from Hygromycin phosphotransferase resistant zone of the Cas9 vector. PCRs amplifications was performed using primer pairs which generated an amplicon harboring the target site, and the resulting amplicons was sequenced using the Sanger method. Mutant plants have been identified and are being characterized.</p>
23	<p>Generation of male sterile rice line for two-line hybrid system by editing <i>TMS5</i> gene using CRISPR/Cas9 system</p>	<p>The guide sequences were properly cloned into the binary vector pC1300-Cas9. The binary vector pC1300-Cas9 harboring <i>Cas9/OsTMS5</i> sgRNA was mobilized into <i>Agrobacterium tumefaciens</i> LBA4404 by freeze-thaw method and confirmed through PCR-gel electrophoresis. Plants were regenerated through <i>Agrobacterium</i> -mediated transformation. Genomic DNA was extracted from the leaves of transformed plants using the sodium dodecyl sulfate (SDS) method. Hygromycin phosphotransferase positive plants were</p>

		identified using HPT primer pair designed from Hygromycin phosphotransferase resistant zone of the Cas9 vector. PCRs amplifications was performed using primer pairs which generated an amplicon harboring the target site, and the resulting amplicons are being sequenced to detect mutation in the target DNA using the Sanger method.
	<b>Project 8: C4 rice research and development</b>	
24	Investigation of anatomical and photosynthetic differences of C3 and C4 species	Rice lemma and palea contain 5 and 3 vascular bundles, respectively. However, vascular bundles were found in Uridhan 12-15 and 8-12.
25	Wide hybridization between Latisail (AAAA) and Uridhan (KKLL)	Ten F1 plants were grown, but only two survived and produced F1 plants that were anatomically and molecularly characterized for hybridity.
26	Optimizing chlorophyll fluorescence imaging system for photosynthetic efficiencies of C3 and C4 species in different stress condition	1) One putative mutant progeny was identified. 2) Two days of submergence and six days of recovery were found to be critical in differentiating submergence tolerance using Chlorophyll Fluorescence Imaging System.
	<b>Program Area: Pest Management</b>	2)
	<b>Entomology Division</b>	
1	Experiment Title: Pest and natural enemy incidence at BRRRI farm, Gazipur.  Progress: Populations of rice insect pests, their NE and crop damage intensities in seven habitats	At BRRRI research farm in Gazipur, weekly monitoring of rice insect pests and their natural enemies across seven

	<p>including seedbed, rice ratoon, grass fallow, grass bund, irrigated rice, rice bund and upland rice were monitored weekly at BRRRI research farm, Gazipur with sweep net (40-cm diameter) in all plots. One hundred complete sweeps were taken in each habitat at every standard week to record the insect pest and NE's population. The collected insects were kept in labeled bags and brought to the laboratory for sorting, identification and quantification. Overall insect pest incidence was low in the reporting year. GLH, WLH and SHG were the most abundant pests and found in all habitats. Highest number of SHG was found in grass fallow followed by grass bund, ratoon and transplanted rice. Higher numbers of natural enemies were found in the grass bund, grass fallow and seedbed. GMB, Dam. fly, spider and LBB were the dominant predators in all the habitats of the reporting year.</p>	<p>habitats showed overall low pest incidence. GLH, WLH, and SHG were the most prevalent pests across all habitats, with grass fallow harboring the highest SHG population, while grass bund, grass fallow, and seedbed supported higher numbers of natural enemies, including GMB, Dam. Fly., SPD, and LBB.</p>
2	<p>Experiment Title: Insect pests and natural enemies in light trap.</p> <p>Progress: Rice insect pests and their natural enemies were monitored throughout the year by Pennsylvanian light trap during the reporting year at BRRRI headquarter, Gazipur and BRRRI regional stations at Cumilla, Sonagazi, Barishal, Rangpur, Rajshahi and Habiganj. Total numbers of insect pests were highest at Habiganj and followed by Gazipur, Barishal, Cumilla, Rangpur and Rajshahi. The abundance of BPH, WBPH, GLH and YSB was observed at all the 7 locations. Among the major insect pests, highest number of BPH was observed at Habiganj and Gazipur; WBPH was observed at BRRRI Gazipur and BRRRI RS Barishal. The highest peak of YSB was observed at BRRRI RS Barishal and BRRRI RS Habiganj. Higher populations of GLH was found in the month of November at BRRRI RS Habiganj. Highest leafroller (LR) was found in Barishal and Cumilla. Total number of natural enemies was found highest in Barishal followed by Habiganj, Cumilla, Sonagazi, Rangpur and Gazipur. Green mirid bug population of Habiganj was higher than those of other stations. The highest number of LBB was found in Habiganj and Barishal. Carabid beetle showed the highest population at Barishal in April, October in Gazipur and November in Habiganj. Similarly, in contrast, several peaks of STPD were observed at Barishal but highest was found in the month of January. A small peak of STPD was observed in the month of August and May at BRRRI, Gazipur.</p>	<p>Higher peak of insect pests was found in October-November and May to June across the locations. Among natural enemies, highest peak was found in April to May and October to November for CDB, November to January for GMB, February and May for LBB and January for STPD.</p>
3	<p>Experiment Title: Survey and monitoring of rice arthropods in Rangpur region.</p> <p>Progress: The insect pest population, their damage intensities and abundance of the natural enemies were surveyed during the reporting year in Rangpur region. The incidence patterns of</p>	<p>In the Rangpur region during the T. Aman season, insect pest infestation remained below ETL, with LR, GLH, and SHG being the most prevalent pests.</p>

	<p>major insect pests and their natural enemies were assayed. Twenty complete sweeps were conducted randomly in 30 rice field at different locations of Rangpur region. The insect pest infestation was below the ETL during T. Aman season in Rangpur region. Among the insect pests leafroller (LR) population was found highest (6.35/20 sweep) followed by GLH and SHG, 4.25 and 3.35/20 sweep respectively (Fig. 5). Other insect pest's population were very low 0.10 to 1.8/20 sweep. Incase of natural enemies, spider (SPD), damsel fly (Dam. fly), lady bird beetle (LBB), carabid beetle (CBB) and green mirid bug (GMB) were found in all locations of Rangpur region. Among the natural enemies SPD population were found highest (10.05/20 sweep) followed by Dam. fly (6.25/20 sweep), LBB (2.5/20 sweep) CBB (1.35/20 sweep) and GMB, 0.15/ 20 sweep (Fig. 6). During interviewed it was found that most of the farmers (&gt;87%) were used granular insecticide with 1st urea top dressing at 15-20 days after transplanting (DAT) and consecutively they used additional 2-3 times spray insecticide to control the insect pests of rice though insect infestation not reach to the ETL.</p>	<p>Natural enemies like SPD, Dam. fly., LBB, CDB, and GMB were consistently present, although farmers frequently used granular insecticides despite pest levels not reaching ETLs.</p>
4	<p>Experiment Title: Survey and monitoring of rice arthropods in coastal region.</p> <p>Progress: The survey was conducted at 12 locations in Botiaghata, Khulna during Boro season. BRRI released high yielding rice variety BRRI dhan67 were cultivated in Boro season. Insect pest population, their damage intensities and abundance of the natural enemies at tillering stage of rice plants were surveyed in transplanted rice field of respective location. Sweeping in the rice filed was done with a sweep net of a diameter of 12 inches with a handle, one-meter long. Insect pests and their natural enemies were collected from each location by 20 complete sweeps and were sorted, identified and counted accordingly. Among the recorded insects, short horned grasshopper (62/20 sweeps) and whorl maggot (52/20 sweeps) population were found highest in all the locations. Number of adult yellow stem borer moths (30/20 sweeps) was found in most of the location and the damage symptoms of YSB was also very evident in almost all the locations. However, the number of adults were limited despite having severe damage symptoms of dead heart in the field. It might be due to the early infestation of YSB during the vegetative stage of rice in the field which allowed the insects to develop their population. Another reason of the outbreak of YSB could be the indiscriminate and frequent insecticide application by the farmers. It was observed that farmers were using two or more times insecticides in the rice field without knowing the consequences and some were using wrong insecticides which are not registered for using in rice. These might induce pest resurgence and resistance in the rice field. Some other</p>	<p>During the Boro season in Botiaghata, Khulna, a survey across 12 locations revealed high populations of SHG and whorl maggots, with YSB infestations evident despite limited adult presence, possibly due to early infestation and indiscriminate insecticide use by farmers. While other pests like white leafhoppers and GLH were present below economic threshold levels, natural enemies were notably abundant, suggesting their potential role in pest control, though their numbers were lower in areas with higher insecticide application, while saline locations experienced crop damage and lacked insect presence.</p>

	<p>insects were also found such as white leafhopper (WLH), green leafhopper (GLH), long horned cricket (LHC), rice leafroller (RLR) and rice bug (RB) and the population range was in between 1-35/20 sweeps. But the population was below the economic threshold level (ETL). Natural enemy (NE) incidence was also observed during the survey. Among them, spider population was the highest (129/20 sweeps) followed by damsel fly (73/20 sweeps), green mirid bug (19/20 sweeps), staphylinid beetle (14/20 sweeps), lady bird beetle (4/20 sweeps), carabid beetle (6/20 sweeps) and tiger beetle (3/20 sweeps) population were recorded in the rice field. Natural enemy incidence was lower where the insect pest population were high in number. That might be happened due to the frequent application of insecticide in the rice field. Whereas, in some locations higher number of natural enemies were found with low insect pests. This might indicate that natural enemy can reduce the number of harmful insect pests in the rice field. In addition, insects were not present in the location where salinity level was the highest (17.68 dS/m) because of the crop damage.</p>	
4	<p>Experiment Title: Fall Armyworm (FAW) monitoring in rice field.</p> <p>Progress: Pheromone traps were installed in BIRRI HQ, Gazipur, BIRRI Regional Station Cumilla, farmers field at Jogitola, Gazipur and Vagjoare, Pirganj, Rangpur. Three pheromone traps were set 100 m between traps (in separate fields). There were no maize fields (at least apart 200m). In each of the four places in each field, BIRRI scientists/scientific assistant were carefully examine weekly in 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 panicle, fresh frass etc.). Trapped catch data were taken 10 to 14 weeks in different locations. The ranged of FAW catches was 0.02 to 0.08/trap/day. Highest FAW moth catches was observed 0.08 moths/trap /day at the farmers field of Vagjoare, Pirganj, Rangpur. That might be happened as maize field was remained 200m adjacent to the trial field. No fresh window panes (WP) and infested plants (IW) were found during scouting.</p>	<p>Pheromone traps placed across various locations including BIRRI HQ, Gazipur, BIRRI Regional Station Cumilla, and farmers' fields detected low FAW moth catches, with the highest observed in Vagjoare, Pirganj, Rangpur. Despite adjacent maize fields, no signs of new FAW damage were found during weekly examinations, indicating effective monitoring and potential preventive measures against infestation.</p>
5	<p>Experiment Title: Effect of temperature on the biology and life cycle of rice leafroller, <i>Cnaphalocrosis medinalis</i>.</p> <p>Progress: Rice leafroller colony was maintained on BR3 plants under greenhouse conditions at BIRRI Gazipur. 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).</p>	<p>RLR can rapidly complete the growth and development when the temperature is in between 25°C to 30°C.</p>

	<p>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 RLR eggs to 3 constant temperatures (20, 25 &amp; 30°C) at 65 ± 5% RH in separate experiments, one temperature at a time, and allowing the eggs to develop into adults. Egg incubation period was significantly higher in 20°C from the temperature of 25°C and 30°C. However, for the 25°C and 30°C temperature the duration was almost similar. Larval period was also significantly different in 3 different temperatures. In lowest temperature which is 20°C, the duration was higher compared to 25°C and 30°C. Pupal growth duration was not significantly different but in 30°C, pupal period completed quickly. Total duration of egg to adult was longer at 20°C. However, in 25°C adult longevity was higher. In 25°C, adult RLR stayed alive for more days than 30°C and 20°C. Overall in lowest temperature (20°C), RLR growth was the slowest and they completed their life cycle for 34 days. Whereas, in 25°C and 30°C, they have showed fast growing nature to complete all the stages from egg to adult within 26 and 20 days respectively.</p>	
6	<p>Experiment Title: Species composition of stem borer at BRRRI research field, Gazipur.</p> <p>Progress: A total of 50 to 100 typical white heads (WH) were collected randomly once in a week from BRRRI farm, Gazipur. In total of 374 white head tillers were collected from BRRRI farm Gazipur during T. Aman season. Stem borer larvae were dissected out and their numbers were recorded species-wise. Striped stem borer (SSB) was the dominant species followed by YSB and DHB at BRRRI farm Gazipur. Total 263 stem borer larvae were found from 374 tillers on seven different dates and highest 92 SSB larvae was found from a single stem. It was a small size data and need more study with large data in different location to draw a conclusion.</p>	<p>During the T. Aman season at BRRRI farm Gazipur, a total of 374 white head tillers were collected weekly, revealing SSB as the dominant species, followed by YSB and DHB. With 263 stem borer larvae found across seven dates, further extensive studies across different locations are needed for conclusive insights due to the limited dataset.</p>
7	<p>Experiment Title: Conservation of natural enemies through eco-engineering.</p> <p>Progress: Experiment with BRRRI dhan87 at BRRRI farm Gazipur during T. Aman season of this reporting year. One-acre field divided into two treatments. T1: Rice field with flowering plants (sesame and cosmos) on bunds for parasitoid habitat. T2: Farmers' practice with prophylactic insecticide (carbofuran 5G once, chlorpyrifos 20EC twice). Twenty sweeps taken from both blocks 3 days after T2 insecticide use. Insect pest status remained below the ETL in both the treatments. Highest number of GH was found in T2 (4.50/20 sweep) followed by brown planthopper (1.75/ 20 sweep), WLH and GLH (1.5/20 sweep). The ranged of other insect pests like, YSB, RB and RLR was found (0.5 to 1.50/20 sweep) in T2 and (0.5 to 0.75/20 sweep in T1</p>	<p>Rice fields with nectar-rich plants (Eco-engineering) had highest natural enemies and parasitism, while fields with frequent insecticide use showed least. Eco-engineering didn't reduce yield, suggesting using nectar-rich plants instead of toxic insecticides for pest control.</p>

	<p>respectively) at BIRRI Gazipur. Among the natural enemies' highest numbers of natural enemies were found in T1 where insecticide was not used. Number of SPD, Dam. fly and LBB were found highest 5.25, 4.5 and 1.25 per 20 complete sweeps respectively in T1 compared to T2 (4.50, 3.75 and 1.0 respectively/20 sweep) at BIRRI farm, Gazipur. Rice leafroller larval parasitism and YSB egg parasitism observed highest in T1 (37.8 and 36.84 % respectively) compared to T2 (2.75 and 1.25 % respectively). Though grain yield was observed similar both in T1 and T2 (6.10 and 6.07 t/ha respectively) but additional sesame was produced in T1 which increase the rice equivalent yield (REY). As a result, 4.26 % additional yield obtained in T1 compared to T2.</p>	
8	<p>Experiment Title: Test of different insecticides against major insect pests.</p> <p>Progress: Evaluation of the effectiveness of commercial formulations of different insecticides against major insect pests of rice was performed in field and storage condition. A total of 155 commercial formulations of insecticides were evaluated against BPH. Among them 145 insecticides were found effective against BPH. For YSB, out of 9 commercial formulations, all were found effective. A total 4 insecticides were tested against RH and all 4 were found effective. Furthermore, 12 insecticides were tested against rice weevil (RW) and all were found effective.</p>	<p>The evaluation of 155 commercial insecticide formulations against major rice pests showed high effectiveness, with 145 formulations effective against BPH, all 9 against YSB, all 4 against RH, and all 12 against RW. These findings underscore the efficacy of commercial insecticides in controlling various rice pests in both field and storage conditions.</p>
9	<p>Experiment Title: Use of nanoparticle to control rice insect pests.</p> <p>Progress: The efficacy of Ag, Cu and ZnO nanoparticles against GLH were tested at five different concentrations (1000, 750, 500, 250 and 0 ppm). Nanoparticle solution of different concentration were sprayed on 15 days old rice seedlings. Twenty 3rd - 4th instar nymphs of GLH were released into each treatment and kept them at <math>28 \pm 1^{\circ}\text{C}</math>, in green house condition and mortality of insect was recorded on the 24, 48 and 72 hours after nanoparticle spray. Three nanoparticles including Ag, Cu and ZnO were tested against GLH. Ag nano-particles showed 59 % mortality of GLH nymph. Furthermore, Cu and ZnO nano-particles showed 39 and 42 % mortality of GLH nymph respectively. However, Ag nanoparticle showed comparatively higher mortality than Cu and ZnO against GLH. More experiments with new synthesis nanoparticles are planned to be tested again using more major insect pests of rice.</p>	<p>The efficacy of silver (Ag), copper (Cu), and zinc oxide (ZnO) nanoparticles against Green Leafhopper (GLH) was tested at five different concentrations (1000, 750, 500, 250 and 0 ppm), with Ag nanoparticles demonstrating the highest mortality rate of 59% compared to Cu (39%) and ZnO (42%). Further research is planned to explore the effectiveness of newly synthesized nanoparticles against additional major insect pests of rice.</p>
10	<p>Experiment Title: Effect of insecticides on natural enemies of rice insect pests.</p>	<p>Six commercially registered insecticides, including acetamiprid, spinosad,</p>

	<p>Progress: Six commercially registered insecticides for rice of different chemical group were evaluated at BRRI, Gazipur in Boro season. The generic name of six insecticides are 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 of spraying by sweeping the field with twenty complete sweeps and populations were counted. 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. Sweeping data of insect pests and non-pest insects (natural enemies and neutral insects) was counted after 48 hours of spraying. SPD, GMB, Dam.fly, LBB, CBD, chironomids, parasitoid and dipteran fly were the major rice insect's natural enemies (NE) in the counted sweep sample. Total non-pest insects including natural enemy were found higher in control (85), then chlorantraniliprole (69), chlorpyrifos (61) and spinosad (58) respectively. So, chlorantraniliprole showed comparatively safe for natural enemies of rice field. On an average 20 to 60% NE were less in treated plots than control.</p>	<p>abamectin, chlorantraniliprole (Virtako), fipronil, and chlorpyrifos, were evaluated in rice fields at BRRI, Gazipur during the Boro season. Results showed that while chemical pesticides were effective against target pests, they also negatively impacted natural enemies and non-target insects, with chlorantraniliprole demonstrating comparatively lower harm to natural enemies compared to other insecticides.</p>
11	<p>Experiment Title: Residues analysis of different insecticide in rice by using Liquid Chromatography and Mass Spectrometry (LCMS).</p> <p>Progress: The field study was carried out at BRRI Gazipur during T. Aman 2022 and Boro 2022-2023 in adjacent field plots with complete randomized block design, each with an area of <math>5 \times 4 = 20</math> m<sup>2</sup> with three replications. Most popular insecticide Virtako 40WG (chlorantraniliprole 20% + thiamethoxam 20%) was used both in T. Aman and Boro season. Two treatments were used i.e., T1=Prophylactic use (3 times) with standard dose, T2= Three time use with double of standard dose. During Boro season insecticide applications were performed at 5, 10 and 15 days after flowering (DAF) and three plots were remained untreated (not sprayed) as a control. After harvest, a homogenous sample 1.0 kg was separated for each treatment. 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. The concentrations of chlorantraniliprole were less than limit of detection (&lt;LOD) but the concentration of thiamethoxam were 0.140 to 0.034 mg/kg in the polished rice grain of different treatments. The</p>	<p>No residues or residues below MRL were observed in the application of insecticide Virtako 40WG (chlorantraniliprole 20% + thiamethoxam 20%) at and thiamethoxam.</p>

	<p>correlation coefficients (<math>r^2</math>) were 0.999 (standard solutions). In another experiment the concentrations of chlorantraniliprole were less than limit of detection (&lt;LOD) in treatment T1 (insecticide application at 5 days after flowering) and T2 (insecticide application at 10 days after flowering) but the concentration of chlorantraniliprole was determined 0.039 mg/kg in the polished rice grain of T3 treatments (insecticide application at 15 days after flowering). This concentration is about ten times lower than the Maximum Residue Limit (MRL). The European Union (EU) Maximum Residue Limit (MRL) of thiamethoxam 0.6 mg /kg. The correlation coefficients (<math>r^2</math>) were 0.999259 (standard solutions).</p>	
13	<p>Experiment Title: Development and validation of analytical methods for multiple pesticide residue determination in rice grain using Liquid Chromatography with Tandem Mass Spectrometry (LCMS/MS).</p> <p>Progress: Method development for multiple residue analysis of five insecticide namely carbofuran, chlorantraniliprole, chlorpyrifos, isoprocarb and thiamethoxam were standardize by Shimadzu LCMS/MS 8050. Detection was carried out in multiple reaction monitoring (MRM). The pesticide residue database of the LCMS/MS system was used for the data analysis. QuEChERS (Quick, Easy, Cheap, Effective, Rugged and Safe) Method for Pesticide Residue Analysis (Method AOAC 2007.01) was applied for sample preparation.</p>	<p>Multiple pesticide residue determination in rice grain will be determined by the developed methods using LC-MS/MS.</p>
14	<p>Experiment Title: Screening of advanced breeding lines against major insect pests of rice.</p> <p>Progress: In total three breeding lines, namely SV0724 (ING229) of IRBPHN Set 17 and another two line BR9674-1-4-1-3-P1 and BR9674-7-3-2-1-P2 of zinc enriched (ZER) in Regional Yield Trial (RYT), were found moderately susceptible (score 5) against BPH during the evaluation at green house. A total of 26 advance breeding lines out of 780 were showed moderately susceptible reaction (score 5) and only single breeding line (BR 12193-5 R-96) was showed resistant reaction (score 3) against BPH. In Line Stage Testing (LST) of Insect Resistant Rice (IRR), 7 breeding lines out of 204 showed moderately susceptible (score 5) reaction against BPH.</p>	<p>Moderately resistance and resistance lines will be used for resistance variety development purpose.</p>
15	<p>Experiment Title: Suppression of serotonin synthesis in rice using CRISPR Cas9 for insect pest control.</p> <p>Progress: Serotonin plays diverse roles in mammals, insects, and plants, including insect</p>	<p>CRISPR-Cas9 editing of the CYP71A1 gene in BRRI dhan 92 rice varieties showed successful mutation, with surviving plants progressing to T2</p>

	<p>resistance in rice. The CYP71A1 gene in rice encodes an enzyme converting tryptamine to serotonin. Using CRISPR-Cas9, a 20 bp fragment of CYP71A1 was successfully edited in BRRI dhan 92 rice varieties. Transformed calli were cultivated, shoots developed, and edited plants screened against BPH. Surviving plants progressed to T2 generation, with leaf samples sequenced to confirm mutations. Electrophoresis results confirmed that five plants harbored Cas9/gRNA vector in BRRI dhan92. 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. The plants confirmed with Cas9 vector were progressed to T1 generation. DNA was extracted from 25 T1 plants and used for sequencing using gene specific primers. The sequencing results did not confirm the homozygous plants. In addition, we screened some population against using seedling bulk method. The plants were seeded in plastic tray. Tray seedlings were infested by 3rd instar BPH nymph and infestation was checked daily. Some plants showed healthy, and some plants died due to BPH infestation. Some plants are tolerant against BPH. We uprooted the healthy survived plants from each infested tray and transplanted in field for further progress. Seeds were harvested from those plants. In the T2 generation plants collected from survived T1 plants screened against BPH, DNA was extracted from six T2 plants and used for sequencing using gene specific primers. The sequencing results did not confirm the homozygous plants. This result suggests that mutated part of the gene of T0 was not successively transferred to the next generation.</p>	<p>generation, but sequencing revealed no homozygous mutants. Despite screening for BPH resistance and transplantation of surviving plants, T2 generation sequencing indicated unsuccessful transfer of the mutation to subsequent generations.</p>
16	<p>Experiment Title: Use of sex pheromone in corporation with other IPM tools to control stem borer.</p> <p>Progress: Three pheromone traps were set 100 m between traps in each of four locations BRRI HQ Gazipur, farmers field at Jogitola, Gazipur, BRRI regional station, Cumilla and farmers field of Vagjoare, Pirganj, Rangpur during Boro 2022-23. Every Monday the trap catch and field scouting data were collected and recorded. The ranged of YSB catches was 0.01 to 0.05/trap/day. Highest YSB moth catches was observed 0.05 moths/trap /day at the farmers field of Vagjoare, Pirganj, Rangpur. YSB populations and damages were noticeably lower not only the experimental plots but population of YSB and its damage remain very low all over the country during Boro 2022-23. This might be happened due to high temperature and low humidity. YSB is a terrestrial species but highly adopted to an aquatic environment and requires high levels of moisture in all</p>	<p>During Boro season, pheromone traps set at four locations showed low Yellow Stem Borer (YSB) populations, with the highest catch observed in Vagjoare, Pirganj, Rangpur. The reduced YSB populations and damages across the country were attributed to high temperatures and low humidity, indicating the species' vulnerability to environmental conditions.</p>

	developmental stages. Conversely, dryness or moisture stress is a major limiting factor for growth and development. High temperatures combined with low humidity (>34°C with RH <70% causing so-called lethal day) kills many eggs and first instars larvae of YSB during the summer months. As a result, no dead hearts and white heads were observed during field scouting for YSB.	
17	<p>Experiment Title: Reduction of insecticide use in rice cultivation to ensure safe food production.</p> <p>Progress: Sixteen demonstrations were conducted in 16 different farmers field of Rangpur region under ‘Reduction of insecticide and herbicide and determination of it’s residual effect to ensure safe food production’ programme which covered 5.87 ha of land. Insecticide was not used in researchers’ practice (T1) and two times insecticide was used in farmers practice (T2) plot. But yield was more or less similar in T1 and T2. Most of the farmers in Bangladesh habituated to use granular insecticide during 1st urea top dressing without thinking its need. The demo farmers of these programs are motivated that no need to use insecticide application at early crop stage (30-40 DAT). One field day at Tunirhat, Panchagarah was conducted during T. Aman season of the reporting year. More than 100 neighboring farmers were attended in the field days. The farmers were motivated to cultivate newly released BRRI varieties as well as BRRI recommended practice in insect management to reduce insecticide application in rice production. So, it needs such type of more demonstration in farmers’ field all over the Bangladesh.</p>	Sixteen demonstrations across farmers' fields in Rangpur aimed to reduce insecticide and herbicide use, covering 5.87 ha, showed similar yields between plots with and without insecticide use. Motivating farmers to adopt insect management practices without early insecticide application can contribute to reducing chemical use in rice production, emphasizing the need for further demonstrations nationwide.
18	Experiment Title: Validation trials on the develop IPM package for rice.	
19	<p>Experiment Title: Study on the efficacy of different rodenticides against rice field rats.</p> <p>Progress: Efficacy of four different rodenticides available in market namely bromadiolone, zinc phosphide (BARI), zinc phosphide and aluminium phosphide were evaluated to control rat in rice field of BRRI, Gazipur in T. Aman and Boro season. 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 in rice field. A total of 41 rat burrows were observed at five times during the experimental period.</p> <p>Aluminium phosphide (Phostoxin) treated rat pit had the maximum numbers of dead pits than another rodenticide treated rat pit. Zinc phosphide (BARI) showed less effective than other three rodenticides. So, to control rice field rat phostoxin was very effective followed by zinc phosphide,</p>	The study evaluated four rodenticides in rice fields, finding aluminium phosphide (Phostoxin) most effective in controlling rats, followed by zinc phosphide, bromadiolone, and zinc phosphide (BARI), respectively. Phostoxin demonstrated superior efficacy compared to other rodenticides, suggesting its potential as a primary choice for rice field rat control.

	bromadiolone and zinc phosphide (BARI).	
	<b>Plant Pathology Division</b>	
1.	<b>Survey and monitoring of rice diseases:</b> Disease incidence and Severity was higher in Aman season, 2022 compared to Boro 2022-23. Irrespective of season number of diseases was found higher in Cumilla and Rangpur compared to other regions. Across the regions, the prevalence of BB, BS, NB and ShB diseases was noticeable whereas the severity of NB, ShB and BB were higher compared to other diseases.	Web-based rice disease information platform will be developed
2.	<b>Digitization of disease surveillance system and visualization at BIRRI website:</b> The implementation of the digitized disease surveillance system using the Open Data Kit (ODK) platform, along with its subsequent visualization on the Bangladesh Rice Research Institute (BIRRI) website, yielded promising outcomes. The collected data provided comprehensive insights into disease dynamics, allowing for real-time tracking of disease occurrences, their spatial distribution, and severity levels. Throughout the survey period and area, sheath blight (ShB) disease exhibited the highest frequency (79.3%), followed by bacterial blight (51.5%), brown spot (36.4%), rice false smut (30.8%), neck blast (20.0%), and other diseases.	Web-based rice disease information platform will be developed
3.	<b>Development of Early Warning System (EWS) of rice blast disease:</b> The Rice Blast EWS is being developed based on the already developed Wheat Blast EWS. The BIRRI Team is now generating data on the relationships between weather factors and blast disease to validate disease coupling model. Among the five trials, severe leaf and neck blast disease infestations were found from the trials of Cumilla, Rangpur and Hankata, Gazipur.	Rice growers will be awared at least 7 days earlier of blast disease infection and to generate data on the thermal and humidity effect on rice disease development.
4	<b>Development of new markers for the detection of Rice Tungro Bacilliform Virus (RTBV):</b> Out of five primers, one primer effectively detected the RTBV strain of Bangladesh.	Novel primer/s will be to detect RTBV strain of Bangladesh.
5	<b>ITS primer-based sequencing of sheath disease complex pathogens:</b> Sequencing data were analyzed and compared with the available sequences of the sheath disease complex pathogens in NCBI database. Sequenced data were matched with the respective pathogens sequence which proved their individual identity. A phylogenetic tree was prepared using MEGA software.	Pathogens of rice sheath disease complex based on ITS primer-based sequencing will be differentiated.
6.	<b>Identification of the Source of Infection of Major Rice Diseases- Blast and False Smut:</b> From two years results revealed that blast disease was significantly higher in 2022 ( $P \leq 0.05$ ). In the previous year (2021), there was a tendency of higher blast incidence in diseased seed source; however, the difference was not significant with healthy seed source. On the other hand, rice	The source of infection of blast and false smut diseases of rice will be found out.

	false smut is a very tricky disease. In 2021, the difference of disease incidence was not significant between diseased and healthy seed sources. In the following year (2022), rice false smut disease did not appear in the experimental field.	
7.	<b>Studies on host range of the blast pathogen:</b> Four different variety of rice plants showed positive reaction against rice blast isolates but did not show any reaction to other blast isolates. All wheat, kaun and torpedo grass blast isolates were pathogenic to only corresponding plants. Three different weed grass plants did not show any reaction against all blast isolates. It was also observed that there was no cross infection among the tested blast isolates. reduced disease over 80%.	The host specificity of blast isolates among the rice, grasses, foxtail millet and wheat will be determined.
8.	<b>Improvement of differential system for rice blast disease in Bangladesh:</b> Alternate protocols for artificial disease inoculation under controlled conditions were standardized following detached leaf technique. Pathogenicity tests of all of these isolates will be done using differential varieties harboring 23 blast resistant genes following the standard protocols. The study's findings offer valuable insights for refining disease management strategies and enhancing rice productivity in the region. This is the regular study to monitor the virulence and evolutionary status of rice blast pathogen in Bangladesh. This information will help also for selecting the appropriate gene(s) to develop durable blast resistant variety.	The existing differential system for rice blast will be improve.
	<b>Etiology of Bacterial Panicle Blight (BPB): An emerging and climate sensitive rice disease in Bangladesh:</b> There were no visual differentiations among BLB, BLS and BPB in DNA profiling, although showed different colour on King's B media. Unfortunately, none of the isolates confirmed <i>Burkholderia glumae</i> among the tested isolates based on the sequence data.	A details study on bacterial panicle blight (BPB) disease in Bangladesh will be conducted.
9.	<b>Present health status of rice seed in Bangladesh:</b> Irrespective of variety and seed source sixteen pathogens have been detected and among them <i>Alternaria padwickii</i> incidence was higher followed by <i>Bipolaris oryzae</i> , <i>Curvularia lunata</i> and <i>Fusarium moniliforme</i> . The higher %incidence of seed born pathogens was recorded in farmers' own seed (3.7%) followed by DAE (2.8%) and BADC (2.2%) seed sources while the lower pathogens were observed in BRRI varieties (2.7%). Among the tested varieties, the higher %incidence of seed borne pathogens (3.4%) was recorded in BRRI dhan87 followed by BRRI dhan95 (3.2%) and BRRI dhan75 (3.1) while the lower incidence was found in BRRI dhan67 (2.8%).	Health conditions of rice seeds available from public and private sectors, and farmers' seed will be known

10	<p><b>Advanced Yield Trial of blast resistant lines in T. Aman 2022 at Satkhira and Gazipur:</b> Satkhira: Four blast resistant lines, BR(Path) 15640-3-4-4-6, BR (Path)15640-10-4-4-1, BR (Path)15640-39-8-3-2 and BR (Path) 15641-10-7-1-1 were selected for RYT, T Aman 2023</p> <p>Gazipur: selected 1 line, 87-5 Pi9 with 129 days GD and 5.5 t/ha GY which was similar to check variety BRRI dhan87</p>	Blast resistant variety will be developed
11	<p><b>Advanced Yield Trial of blast resistant lines, Boro 2022-23:</b> Three Boro advanced lines, BR (Path) 15641-10-7-1-1, BR (Path)... 10-2-3-3 and BR (Path)... HN3375 could be selected for further research</p>	Blast resistant variety <b>will be developed</b>
12.	In ALART, all of the tested lines produced more than 8t/ha grain yield which was more than 1t/ha higher than the standard checks. Hopefully two lines will be recommended for Proposed Variety Trial	Blast resistant variety <b>will be developed</b>
13.	<p><b>Development of pre-breeding materials of tungro resistance:</b> Five crosses were done in both Aman, 2022 and Boro, 2022-23 for the development of tungro resistant pre-breeding materials. Heterozygosity of the populations was confirmed by using the respective marker. After confirmation crossing was done to make the next generation.</p>	Tungro resistant genewill be introgressed in high yielding variety.
14.	<p><b>Evaluation of tungro resistance advanced lines in Gazipur, Feni and Cumilla:</b> No disease occurrence was found in Gazipur and Feni. In Cumilla, tungro disease was found in both locations i.e. in Debidwar and Chandina.</p>	Disease reaction of tungro resistant advanced lines in hot spot area will be evaluated
15	<p><b>Development of bacterial blight resistant pre-breeding materials for T. Aus:</b> Among the materials, the highest yield (7 ton/ha) was recorded from the genotype BR(PATH)13784-BC3-61-1-6-HR3, followed by BR(PATH)13784-BC3-34-9-10-HR9 (6.79 t/ha), and check variety BRRI dhan48 and BRRI dhan98 produced 6.57 and 6.61 t/ha, respectively. On the other hand, growth duration ranged from 102 days to 118 days.</p>	Medium duration bacteria blight resistance advanced lines for T. Aus season will be developed
16.	<p><b>Development of pre-breeding materials of BB and False smut resistance in the background of BRRI dhan49:</b> Four advanced breeding lines BR(Path)13817-BC3-14; BR(PATH)13817-BC3-9; BR(PATH)13817-BC3-4; BR(PATH)13817-BC3-13 produced significantly higher yield in both the location compared to check variety (BRRI dhan49). However, these materials also showed good degree of disease resistance as well.</p>	Resistant rice lines of bacterial blight and false smut disease will be developed
17.	<p><b>Regional Yield Trial (RYT) for Bacterial blight resistant advanced lines in Boro 2022-23:</b> Three advanced breeding lines, BR(Path)13800-BC3-8-1; BR(Path)13800-BC3-8-9; BR(Path)13800-BC3-109-10 produced better yield compared to check variety. Moreover, all the</p>	Specific and general adaptability of Blast and Bacterial blight resistant advance breeding lines along with disease

	materials showed a good degree of disease resistance as well.	parameters as compared with standard checks will be evaluated
18.	<b>Regional Yield Trial (RYT) for Blast and Bacterial blight resistant advanced lines in Boro 2022-23:</b> A total of seven advanced breeding lines, BR(Path)13800-BC3-8-5; BR(Path)13800-BC3-134-8; BR(Path)13800-BC3-8-11; BR(Path)13800-BC3-12-13; BR(Path)13800-BC3-224-17; BR(Path)13800-BC3-134-25; BR(Path)13800-BC3-224-44 produced significantly higher yield compared to check variety. Moreover, all the materials showed a good degree of disease resistance as well.	Specific and general adaptability of Blast and Bacterial blight resistant advance breeding lines along with disease parameters as compared with standard checks will be evaluated
19.	<b>Introgression of blast resistance gene(s) into BRRI dhan58 using marker assisted backcross breeding:</b> In BC <sub>3</sub> F <sub>6</sub> generation, we selected 27 plants which would be further advance based on morphological homogeneity, and yield potentiality	Blast resistance gene(s) Pi9 and Pb1 will be introgressed in high yielding BRRI dhan58
20.	<b>Screening of advanced breeding lines against bacterial blight (BB) disease during Aman 2022 and Boro 2022-23:</b> In Aman 2022, at first 14 days after inoculation among 295 breeding lines 133 advanced breeding lines were found as resistant, 26 advanced breeding lines were found as moderately resistant and 15 as moderately susceptible against bacterial blight disease. Other genotypes were found as susceptible to highly susceptible to bacterial blight disease. In Boro 2022-23, at first 14 days after inoculation among 295 breeding lines 41 advanced breeding lines were found as highly resistant, 74 advanced breeding lines were found as resistant, 16 advanced breeding lines were found as moderately resistant and 19 as moderately susceptible against bacterial blight disease. Other genotypes were found as susceptible to highly susceptible to bacterial blight disease.	Suitable BB resistant lines against <i>Xanthomonas oryzae</i> pv. <i>oryzae</i> will be identified
21.	<b>Response of Upland Aus Rice Germplasm to Blast Disease:</b> Among the tested materials, 19 entries showed resistance. We can see Malaysian genotypes (Padi Beleong (Jenis Padi Beleong), Padi Kalopak, BR16 * Karingam and Lansam) are taller than other genotypes. It also flowers early, which is a useful trait because early flowering enhances early heading, mature earlier. In term of antioxidant properties all Malaysian genotypes have higher antioxidant properties.	Blast resistance Aus germplasm will be find out
22.	<b>Screening of germplasm against sheath blight of rice during T Aman 2022:</b> Among them, 3 germplasms showed moderately resistant (score 3), 5 moderately susceptible (score 5), 13 susceptible (score7) and rest of them were found highly susceptible.	To find out Resistant to moderate genotypes against sheath blight disease found out
23.	<b>Development of blast resistant varieties using differential system and molecular markers:</b> Among the 10 selected lines, 3 lines were performed best in both blast resistance and good	Blast resistant materials for Bangladesh will be developed

	phenotypic characteristics. Those lines could be recommended as regional yield trial (RYT) in next boro season. In addition, 4586 blast resistance Recombinant Inbred Lines (RILs) were also developed.	
24.	<b>Detection of novel QTLs for blast and bacterial blight resistance revealed by genome-wide association studies in 112 rice landraces from Bangladesh.:</b> Genotype data for the specific 119 Bangladeshi germplasm were extracted, resulting in a final genotype file comprising 119 germplasm and 808,776 SNP data points spanning the entire genome. Screening for blast disease was conducted using two differential isolates, and the association study revealed three major quantitative trait loci (QTL) for isolate-1 and 11 QTL for isolate-2. The analysis identified three distinct clusters, consisting of 110, 8, and 1 genotype(s). Notably, KOIYA DIGHA (IRIS_313-9445) was found alone in a separate cluster	Novel loci underlying rice blast and BB resistance in local germplasm of Bangladesh found out.
25.	<b>Screening for Bacterial Blight and Blast Resistance (TRB):</b> Resistant gene <i>Pi9</i> derived lines showed resistant reactions against blast isolates and <i>Xa21</i> derived lines was released as BB resistant variety (BRRI dhan101) in Bangladesh	BB resistant variety (BRRI dhan101) released
26.	<b>Screening of INGER materials against leaf blast disease of rice:</b> Among the tested materials, 9 entries showed moderate resistant (MR) reaction against leaf blast disease. But these materials need further test to confirm the resistance.	Resistance against blast disease will be evaluated
27.	<b>Blast yield loss model development:</b> Both the dataset (2019 and 2021) fitted in the same POWER function in MS Excel and more importantly showed a similar trend and very close magnitude of yield loss against the 10 categories of filled grains percentage. Having closeness of the characteristics of the data, a power function-based model was developed using the both datasets (from 2019 and 2021).	A power function-based model was developed
28.	<b>Genotype and environmental interaction on neck blast incidence in blast prone area, Boro, 2022-23:</b> In set A, the flowering time of V3 (BRRI dhan28) and V1 (BRRI dhan29), V2 (BRRI dhan89), V4 (BRRI dhan28) were second week and last week of March respectively. During this period average minimum temperature ranged from 20 <sup>0</sup> to 23°C with 80 to 78% RH. With this environmental condition, neck blast disease incidence was about 16 to 14% in V3 and V4 varieties where as V1 and V2 showed 5 to 6% disease incidence. In Set B, the flowering time of V3 and V1, V2, V4 were last week of March and first week of April respectively. During this time, average minimum temperature ranged from 22 <sup>0</sup> to 24°C with 82 to 69% RH. In this situation, more or less similar pattern of neck blast disease incidence was observed in the varieties compared to first planting time (Set A). In this study, It was observed that BRRI dhan28 is more	The pattern of neck blast incidence in relation to variety BRRI dhan28 was understood

	susceptible to neck blast disease compared to other varieties.	
29.	<b>Evaluation of biopesticides for management of Leaf folder and stem borer in field condition:</b> It was observed that Highest dead heart was observed in control (T3) treatment compared to other treatments. Highest yield was recorded in plots where insecticide (T4) was sprayed followed by T1 where <i>Bacillus thurigiensis</i> was sprayed. This experiment will be further evaluated to get more conclusive result.	Efficacy of formulated biopesticides to control leaf folder and stem borer will be found out.
30.	<b>Bioaccumulation and detoxification of As (III) and disease management by <i>Achromobacter xylosoxidans</i> and increase rice yield in As-contaminated soil:</b> Plant height, total tiller, panicle length/hill and effective tiller/hill were increased in treated plot compared to control plot. Yield was increased (0.5t/ha) in treated plots compared to control plots in BRRI dhan58. Yield was increased (0.75 t/ha) in treated plots compared to control plots on BRRI dhan92.	Decrease As uptake to find out the major disease escaping capacity by applying <i>A. xylosoxidans</i> in rice field will be evaluated.
31.	<b><i>In vivo</i> efficacy of nano mediated fungicides to control sheath blight (ShB) disease of rice:</b> Compared to standard fungicide (Folicur) AgNPs mediated fungicide (1:1) performed better. However, it needs to be reconfirmed.	Efficacy of nano mediated fungicides for controlling sheath blight disease of rice was evaluated.
32.	<b>Study on efficacy level of AgNPs and ZnONPs biosynthesized from bacterial isolates comparing with fungicide for controlling rice blast disease:</b> 50% AgNPs showed lowest (25%) disease severity index among all biosynthesized nano agents, it represents 52% disease control over untreated plot.	The capability of biosynthesized nano agents for controlling rice blast disease was observed.
33.	<b>Effect of plant extract mediated silver nano particle on bakanae disease management:</b> In this trial no bakanae symptom (0%) was observed when AgNPs (neem leaf) used & the result was similar to the healthy control. On the other hand, highest plant height was increased in diseased control (8.2%) followed by AgNO <sub>3</sub> (1mM) (5.2%) treated seeds. Plant height was somewhat shorter (-2.4%) in silver nano (neem leaf extract mediated) treated plants compared with healthy control plants. In case of root length, it was observed that root length somewhat increased (6.4%) in silver nano (neem leaf extract mediated) treated plants compared to healthy control plants.  From the results it was observed that Silver Nano (neem leaf) is effective to manage bakanae disease as GA <sub>3</sub> (12.01ppm), IAA (3.93ppm) and ABA (0.57ppm) decreased compared to control. On the other side bakanae symptom expressed (Internode elongated highly and turned to death where GA <sub>3</sub> (21.07 ppm) and ABA (1.16 ppm) increased highly and IAA (1.42 ppm) decreased when the seeds were Inoculated with <i>F. fujikuroi</i> . At the same time Plant looks pale and turned to senescence and this was observed because GA <sub>3</sub> (1.71 ppm) decreased but IAA (16.96 ppm) and	Effect of nano particle on bakanae disease management was observed.

	ABA (0.82 ppm) increased when Inoculated with AgNO <sub>3</sub> .	
34.	<b>Efficacy of Cu Chitosan and Zn Chitosan nano particles against rice bacterial blight <i>in-vitro</i>:</b> Cu Chitosan showed good performance upto (2:8) dilution i.e. 1250 ppm and Zn Chitosan showed good performance upto (6:4) i.e. 6455 ppm.	Effective nano-particles in BB management was performed well.
35.	<b>Efficacy of nano particles against rice bacterial blight disease management in green house:</b> Among all the biosynthesized treatments CuO+ZnO (3000+3000ppm), CuO+ZnO (4000+4000ppm) and ZnO and CuO (4000ppm) showed better performance. At CuSO <sub>4</sub> salt (6000ppm) treatment lesion length was not found due to high concentration the leaf was burnt.	Proper dose of Cu and Zn Nano mediated fungicide was obtained against BB management.
36.	<b>Development of nano particle mediated fungicide for rice bacterial blight disease management in Bangladesh:</b> Among all the treatment 3g ZnO+1.5g Bismertiazol and 3g CuO+1.5g Bismertiazol showed best performance.	<b>Nano particle mediated fungicide for rice bacterial blight disease management was developed in Bangladesh</b>
37.	<b>Study on efficacy level of different nano agents comparing with fungicide for controlling rice blast disease:</b> Among different nano agents the lowest disease severity score 3 was observed in AgNPs and ZnONPs at 40% and 50% concentration. Well known Blast controlling fungicide Nativo 75 WG treated plot observed disease severity score 2. Where disease control (untreated) plot showed disease severity score 8.33. In case of percent disease severity index 50% Ag nano particles showed lowest (25%) disease severity index among all biosynthesized nano agents, it represents 52% disease control over untreated plot. Others nano agents showed medium disease severity index that ranging from 29% to 41%. Furthermore, chemical fungicide Nativo 75 WG treated plot resulted 13% disease severity index, which refers 75% disease control over untreated plot. From this study we can conclude that bio-synthesized nano particles AgNPs (40%) are effective, sound and eco-friendly disease combating agents. Further research and elaborate study are necessary to validate this result.	Capability of biosynthesized nano agents for controlling rice blast disease was found.
38	<b><i>In vitro</i> evaluation of biosynthesized AgNPs and ZnONPs against <i>Rhizoctonia solani</i> causing sheath blight of rice:</b> The UV-Visible spectroscopy revealed that tested AgNPs exhibited plasmon band at the wavelength of 435 nm with the absorbance of 2.42 and ZnONPs showed the band at 353 nm with the absorbance of 1.46. The mycelial growth of <i>R. solani</i> , was 100% inhibited on AgNPs amended plate and Amister top amended plate which was synthesized by bacterial isolate GB29(i). The average radial growth of <i>R. solani</i> was reduced by 55.93% when	Efficacy of biosynthesized AgNPs and ZnONPs against <i>R. solani in vitro</i> and field condition was found.

	medium amended with ZnONPs.	
39	<b>Evaluation of new chemicals against Blast, Sheath Blight and brown spot diseases of rice:</b> Among 20 new chemicals, only 5 fungicides-controlled blast disease by more than 80%. From the 1 <sup>st</sup> set of experiments only 6 and from the 2 <sup>nd</sup> set of experiments only 5 new chemicals controlled more than 80% Sheath Blight disease. None of the tested chemicals were effective against BS disease. Those chemicals were suggested to evaluate further for recommended to Plant Protection Wing, DAE for registration	Effective fungicide(s) against the diseases were evaluated.
40	<b>Residual Effect of Fungicide on Microbial Community in Phylloplane and Phyllosphere:</b> For the enumeration of bacterial population in the soil samples serial soil dilution was done. The slimy, colourless and coloured bacterial colonies appeared in the NA medium after 72 h incubation. Maximum number of colonies found 3 days before fungicide spray in all treatments. And the number of colonies significantly reduced after spraying Amister top. The toxic effects of the fungicides were more pronounced immediately after the application of fungicides. On the other hand, with an increasing incubation period, the bacterial population tended to increase.	The changes occur in soil microbial communities following use of Amister Top (Azoxystrobin + Difenconazole) was investigated.
41	<b>Determination of residual effect of fungicides in rice grain:</b> Methods validation has already done to determine tricyclazole group of fungicidal residues in rice grain using QuEChERS method. Collected samples are now preparing for analyses in Central Laboratory, BRRI.	Pesticide residue in pesticides sprayed rice will be evaluated.
	<b>Programme Area: Farm Mechanization and Postharvest Technology</b>	
	<b>Farm Machinery and Postharvest Technology Division &amp; Workshop Machinery and Maintenance Division</b>	
1.	<b>Programme area /Project title: Development of Agricultural Machineries</b>	
1	<b>Experiment: Design and Development of a Rice Transplanter cum Fertilizer Applicator (SFMRA)</b> <b>Progress:</b> <ul style="list-style-type: none"> <li>▪ Development of a power-operated RT having 30 cm Plant to Plant spacing was done</li> <li>▪ Laboratory and field tests were completed.</li> <li>▪ A power transmission system from RT to applicator was designed.</li> <li>▪ Fabrication of fertilizer applicator incorporation will be started in April 2023.</li> </ul>	▪ A power-operated rice transplanter will be introduced to the end-users

2	<p><b>Experiment: Design and Development of a Head Feed Combine Harvester (SFMRA)</b></p> <p><b>Progresses:</b></p> <ul style="list-style-type: none"> <li>▪ Basement Crawler Assemble</li> <li>▪ Hydraulic Section Assemble</li> <li>▪ Engine Setup</li> <li>▪ Header Unit &amp; Dashboard Assemble</li> <li>▪ Threshing Unit &amp; Cleaning Unit</li> </ul>	Head feed combine harvester will be available
3	<p><b>Experiment: Development and fabrication of whole feed combine harvester</b></p> <p><b>Progresses:</b></p> <ul style="list-style-type: none"> <li>▪ The prototype of the whole feed combine harvester fabricated using locally accessible materials.</li> <li>▪ Initial performance test was conducted during Boro 2022-23 and Aman 2022</li> <li>▪ Average travel speed of 2.11 km/h.</li> <li>▪ The machine's field capacity was measured at 2.24 (0.3 ha/h) bigha/h, while its operational fuel consumption was measured at 3.42 l/h.</li> </ul>	Whole feed combine harvester will be available
4	<p><b>Experiment: Identification and fabrication of fast-moving spare parts of combine harvester and rice transplanter enhancing sustainable mechanization in Bangladesh</b></p> <p><b>Progresses:</b></p> <ul style="list-style-type: none"> <li>▪ Data were collected from 17 machine owners on 8 different models of combine harvesters</li> <li>▪ Model name: Yanmar AG600A, Kubota PRO588i-G, Builders 4LBZ120YA, Bangla Mark BM-608, Yanmar YH-700, Metal Fmworld-DR150A, Mcdonald 4LZ-45 and Deadong DXM73GF</li> </ul> <p>2. Field performance data were collected from 45 field operation</p> <p>3. Data also collected on –</p> <ul style="list-style-type: none"> <li>▪ Detail information about the combine harvester</li> <li>▪ Machine owner and land holding capacity</li> </ul> <p><b>Machine operators' information</b></p> <ul style="list-style-type: none"> <li>▪ Actual field capacity and efficiency under different –</li> <li>▪ Rice Variety</li> <li>▪ Crop height and density</li> </ul>	The use of combine harvesters is rising steadily in the country. At the moment, farmers are given access to the different makes and models of the combine harvester, but because spare parts frequently fail, their operation is frequently interrupted during the peak period of the season. This study will enable the development of commercially viable parts for domestic production identifying the fast-moving parts. Additionally, it would increase the number of local small business owners, lessen reliance on imports, and make combine harvester viable and sustainable.

	<ul style="list-style-type: none"> <li>▪ Soil and field conditions</li> <li>▪ Plough pan depth and lodging condition etc</li> <li>▪ Grain losses during the operation</li> <li>▪ Total operation hours per season</li> <li>▪ Fuel consumption</li> <li>▪ Specific fuel consumption</li> <li>▪ Troubleshooting of the machine during operation</li> </ul> <ul style="list-style-type: none"> <li>• Fast moving parts and supply system</li> <li>• Frequency of damage to the fast-moving parts</li> <li>• Profit analysis</li> <li>• Problems of the machine owner</li> <li>• Problems of the machine users</li> </ul> <p>4. Some parts were taken initiatives to fabricate locally</p>	
5	<p><b><i>Experiment: Design and development of power operated automatic seed sower machine</i></b></p> <p><b><i>Progresses:</i></b></p> <ul style="list-style-type: none"> <li>▪ Fabrication of the machine was completed</li> <li>▪ The length of the tray conveyor: 520 cm</li> <li>▪ It holds the bed soil hopper, seeding hopper, topsoil hopper, and water container upon the tray conveyor.</li> <li>▪ The chain and sprocket used to transmit power</li> <li>▪ Different types of sprockets (12 teeth, 12/9 teeth, 16 teeth, 18 teeth, 20 teeth, and 24 teeth) are used to distribute the power.</li> <li>▪ A tray conveyor was designed to hold the whole structure of the machine</li> <li>▪ The capacity of the bed soil hopper, seeding hopper, and cover-up hopper is about 50kg of soil, 20kg of seed, and 30kg of soil, respectively.</li> <li>▪ The knob-type adjusting lever used in each hopper for controlling the soil rate, and seed rate and changing as per requirement.</li> <li>▪ The seed metering device having 12 teeth was used to maintain the seed rate properly in</li> </ul>	<p>A power-operated seed sower machine for raising mat type seedlings will be introduced to the end-users</p>

	the seeding hopper.	
6	<p><b>Experiment: Design and development of a self-propelled multi-rows power weeder for both wet and dry land conditions</b></p> <p><b>Progresses:</b></p> <ul style="list-style-type: none"> <li>▪ Based on the conception design and drawing a model was fabricated in the divisional workshop</li> <li>▪ Local materials were used to fabricate the machine</li> <li>▪ Fine-tuning works are running for the field performance test</li> <li>▪ Engine power (more than 7000 rpm) will be conveyed to the driving wheel with different arrangements with engage-disengage facility resulting in about 35 rpm of the driving wheel.</li> </ul>	<ul style="list-style-type: none"> <li>• A suitable power weeder for line transplanted dry and wet land crops will be available at the farmers' level.</li> <li>• Human drudgery in weeding will be reduced by introducing a high-capacity user-friendly power-operated feeder</li> </ul>
7	<p><b>Experiment: Development of mat-type seedling using a hydroponic technique</b></p> <p><b>Progresses:</b></p> <ul style="list-style-type: none"> <li>▪ Seedling height: 12 cm</li> <li>▪ Steam thickness increased with increasing the solution rate and decreasing with the seed rate.</li> <li>▪ The density of seedlings increased with the increase in seed rate.</li> <li>▪ Mat quality increased with an increase in the seed rate except for seed rate R4 in the case of media 1.</li> <li>▪ Mat Strength was increased with an increase in the seed rate and better results were found for M1 compared to M2</li> <li>▪ Based on mat quality and mat strength, the M1: S2: R3 combination was found better for raising mat-type seedlings.</li> </ul>	Using the Hydroponic technique to develop mat-type seedlings can save the topsoil of the field.
8	<p><b>Experiment: Development and fabrication of head feed power thresher</b></p> <p><b>Progresses:</b></p> <ul style="list-style-type: none"> <li>▪ Head feed thresher manufactured in the Nayem Engineering workshop at Modan, Netrokona.</li> <li>▪ The machine's performance was evaluated</li> <li>▪ A few faults were found and modifications were done to eliminate those faults.</li> </ul>	A prototype of a head feed thresher will be available for Bangladesh conditions.

9	<p><b>Experiment: Ground pressure and bearing capacity of combine harvester in different soil conditions</b></p> <p><b>Progresses:</b></p> <ul style="list-style-type: none"> <li>▪ Soil compaction factors are determined</li> <li>▪ Design parameters, model of the machine, and experiment site selection have been done</li> <li>▪ A total of 4 combine harvesters (2 Head feed, 2 Whole feed) are selected</li> <li>▪ Physical data of these machines are collected</li> <li>▪ Datasheet is prepared for field data evaluation</li> <li>▪ Field data will be collected in the upcoming Boro season</li> </ul>	The trafficability of a combine harvester can be determined
10	<p><b>Experiment: Test, evaluation, and modification of rubber roll de-husker and friction type polisher</b></p> <p><b>Progresses:</b></p> <ul style="list-style-type: none"> <li>▪ Modified rubber rolls de-husker</li> <li>▪ An electric motor of a 4 kW (3-phase 4 wire 1440 rpm) is used.</li> </ul> <p>A cyclone separator attached to the de-husker for collecting husk</p> <ul style="list-style-type: none"> <li>❖ BRR1 dhan104 (sample size: 20 kg) was used for testing</li> <li>❖ Moisture content of the un-parboiled paddy: 11.20% (wb)</li> <li>❖ Milling parameters were collected.</li> </ul>	The combination of de-husker and polisher will be an alternate milling system of auto rice milling.
11	<p><b>Experiment: Design and development of a solar seed dryer</b></p> <p><b>Progresses:</b></p> <ul style="list-style-type: none"> <li>❖ The dryer was developed with the facility of a central air distribution mechanism</li> <li>❖ The preliminary test was conducted and found good</li> <li>❖ A complete performance test will be conducted in the upcoming season</li> </ul>	A new solar dryer will be available for grain drying.
11	<p><b>Experiment: Performance evaluation of the Laser Land Leveler</b></p> <p><b>Progresses:</b></p> <ul style="list-style-type: none"> <li>▪ The average height of the points was used to make the level of the plot</li> <li>▪ The height elevation: 214 cm and the lowest: 198 cm.</li> <li>▪ The laser leveler was then operated using the 203.15 cm mean height</li> </ul>	The performance of the laser land leveler will be known

	During the upcoming Boro season, the influence of laser land leveling on rice harvest will be investigated	
12	<p><b>Experiment: Performance evaluation of a rice husk-straw pellet machine</b></p> <p><b>Progresses:</b></p> <ul style="list-style-type: none"> <li>▪ A rice husk-straw pellet machine (Victor- Model VTKLP-400) was procured and installed</li> <li>▪ Initial trial of the machine was completed</li> <li>▪ Pellets were produced using rice husk</li> <li>▪ The final performance test will be conducted and a report will be presented in the next internal review.</li> </ul>	The performance of the straw pellet machine will be known
	<b>Program Area: Socio Economics &amp; Policy</b>	
	<b>Agricultural Economics Division</b>	
1	<p><b>Farm level adoption and evaluation of modern rice cultivation in Bangladesh</b></p> <p><b>Objectives:</b></p> <ul style="list-style-type: none"> <li>• To determine the region-wise adoption rate of different MVs in Aus, T. Aman and Boro seasons;</li> <li>• To estimate the yield of different modern and local rice varieties in different seasons; and</li> </ul>	<b>Data collection is in progress</b>
2	<p><b>Estimation of Costs and Return of MV Rice Cultivation at the Farm Level</b></p> <p><b>Objectives:</b></p> <ul style="list-style-type: none"> <li>• Delineate input use pattern in modern Aus, T. Aman and Boro rice cultivation;</li> <li>• Estimate the profitability and risk of modern Aus, T. Aman and Boro rice cultivation at farm level.</li> </ul> <p><b>Status: Boro season data collection is ongoing</b></p>	<ul style="list-style-type: none"> <li>• Per hectare total variable cost of T. Aman rice (Tk. 84,892) cultivation were higher than in T. Aus season (Tk. 77,260).</li> <li>• Per hectare gross margin of rice cultivation in the Aman (Tk. 71335) season was higher than the Aus season (Tk. 48987).</li> <li>• BCR based on cash cost was the highest (1.29) in the Aman season, followed by Aus (1.13) season.</li> </ul> <p>Gross profit ratios are 39, and 46 for the Aus and Aman seasons. A high profit</p>

		ratio is an indication that the farmers are selling their produce at a high profit level.
3	<p><b>Adoption determinants and profitability of stress-tolerant (drought) rice in selected areas of Bangladesh</b></p> <p><b>Objectives:</b></p> <ul style="list-style-type: none"> <li>• determine the adoption status of drought-tolerant rice varieties in the Aman season;</li> <li>• compare profitability between drought-tolerant rice varieties and other rice cultivars; and</li> <li>• identify the factors affecting the adoption of drought-tolerant rice varieties.</li> </ul> <p><b>Status:</b> Out of two districts one district data collection has been done.</p>	Out of two districts one district data collection has been completed.
4	<p><b>Rapid assessment report: prospects and constraints of cultivating BRRI dhan87 in some selected areas of Bangladesh</b></p> <p><b>Objectives:</b></p> <ul style="list-style-type: none"> <li>• evaluates the adoption status and constraints to adoption of BRRI dhan87; and</li> <li>• suggest policy measures to increase the adoption of BRRI dhan87.</li> </ul> <p><b>Status: Data analysis completed</b></p>	<p>Partial Result:</p> <p>BRRI dhan87 characterized by a shorter field duration, higher yield potential, and improved grain and straw quality, remains significant. Farmers also appreciate its medium, slender grain quality with high amylose content, making it a favored choice for consumption.</p>
5	<p><b>Impact of poverty reduction on the nutrition security in Bangladesh</b></p> <p><b>Objective:</b></p> <ul style="list-style-type: none"> <li>• to examine the impact of poverty reduction of the farmers on the nutrition security in Bangladesh.</li> <li>• Suggest some policy guidelines from aforementioned findings.</li> </ul> <p><b>Status: Data analysis Completed</b></p>	<p>Partial Result:</p> <p>Over the two-panel period (2011-12 and 2015), due to the reduction of the poverty gap by 1%, household nutrition security increased by 22.5%.</p>
6	<p><b>Effect of subsidy on mechanization in rice cultivation: evidence from combine harvester in <i>haor</i> areas</b></p> <p><b>Objectives</b></p>	<p>Partial results:</p> <ul style="list-style-type: none"> <li>• Farmers in haor areas have reduced total cost of paddy cultivation by Tk</li> </ul>

	<ul style="list-style-type: none"> <li>• evaluate the profitability of MV Boro rice cultivation using combine harvester and human labor at the farm level.</li> <li>• assess economic viability of combine harvester from owners' perspective.</li> </ul> <p><b>Status:</b> Field-level data collection completed and data analysis is going on.</p>	<p>15807.04/ha through using combine harvesters over conventional manual harvesting.</p> <ul style="list-style-type: none"> <li>• Net return and BCR of paddy cultivation reached Tk 23610.53/ha and 1.20, respectively for using combine harvester whereas it was only Tk 11686.36/ha and 1.09, respectively in the case of the manual harvesting process.</li> </ul>
7	<p><b>Livelihood vulnerability to flood hazard in Bangladesh</b></p> <p><b>Objectives</b> estimate the households' socio-economic vulnerability in the flood-prone areas of Bangladesh</p> <p><b>Status: Data analysis completed</b></p>	<p>Partial results: Kurigram is more vulnerable than Jamalpur.</p>
8	<p><b>Assessment of food security of Garo tribe in selected areas of Mymensingh division</b></p> <p><b>Objectives:</b></p> <ul style="list-style-type: none"> <li>• Find out the calorie intake level of the sample households; and</li> <li>• estimate the nutritional status using food consumption score of the Garo tribe</li> </ul> <p><b>Status: Data analysis completed</b></p>	<p>Partial results: The assessment of calorie intake within households revealed that approximately 42% of the studied households were classified as non-poor, while the remaining 52% were categorized as ultra-poor, hardcore poor, or absolute poor.</p>
<b>Agricultural Statistics Division</b>		
	<p><b>Stability analysis of BRRI varieties</b></p> <p><b>Research Progress:</b></p> <ul style="list-style-type: none"> <li>• Database- on rice yield (from 2001-02 to 2022-23) of BRRI varieties</li> <li>• T. Aman/2022 -data collection and analysis completed</li> </ul> <p>Boro/2022-23- Experiment is in the field</p>	<p>1. Stability index of BRRI varieties according to seasons</p>
	<p><b>Improvement of BRRI Stability model by incorporate multiple factors</b></p> <p><b>Research Progress:</b></p>	<p>Best model selection for BRRI stability model improvement</p>

	<ul style="list-style-type: none"> <li>• In BRRI stability model multiple factor or trait did not incorporate yet.</li> <li>• A very recent robust stability model multi-trait stability index (MTSI) developed by Olivoto et al. (2019b) has been used for simultaneous selection regard to multi environment trials (METs) using both fixed and mixed effect models for several traits or factors.</li> </ul> <p>We have analyzed Aman 2017 stability data and completed a report on “multi-trait stability index (MTSI) for identifying the most stable genotypes of T. Aman rice (<i>Oryza sativa</i>) in Bangladesh”</p>	
	<p><b>CV for estimating yield and yield contributing characters of BRRI varieties</b>  <b>Research Progress:</b></p> <ul style="list-style-type: none"> <li>• The experiment was conducted at Gazipur in Aus, Aman and Boro seasons with BRRI varieties.</li> <li>• The yield and yield contribution characters were- Plant height, Plant height at max. tillering, 1000 grain weight, Panicle length, Spikelet per panicle, Panicle per hill, Filled grain, Unfilled grain, Tiller number per hill at max. tillering, Yield. Insect and disease incidence also recorded.</li> </ul> <p>Aus/2022, T. Aman/2022 and Boro/2021-22 -data collection and analysis partially completed</p>	<ol style="list-style-type: none"> <li>1. Determine the acceptable limit of CV for biometric characters of rice varieties</li> <li>1. Determine the relative contribution and significant level of phenotypic characters/yield contributing characters to rice yield</li> </ol>
	<p><b>Comparative study for rice yield estimation by adjusting moisture content. (In collaboration with Plant Physiology Div.)</b>  <b>Research Progress:</b></p> <ul style="list-style-type: none"> <li>• Variety wise overestimation collected from 106 BRRI for Aus, Aman and Boro seasons</li> </ul> <p>Decision tree for overestimation due to dust reduction in crop yield estimation have been developed</p>	<p>Adjustment factors for rice yield estimation</p>
	<p><b>Genotype x Environment Interaction of BRRI varieties</b>  <b>Research Progress:</b></p> <ul style="list-style-type: none"> <li>• Aman 2022 experiment data processing is continuing.</li> </ul> <p>Boro 2022-23 experiment is now on the field of different regional stations of BRRI and HQ.</p>	<p>Genotype x Environment Interaction effect of BRRI varieties</p>
	<p><b>Dynamics of Multi-trait stability index (MTSI) for identifying the most stable genotypes of three rice growing season in Bangladesh</b>  <b>Research Progress:</b></p> <ul style="list-style-type: none"> <li>• Aman 2022 experiment data processing is continuing.</li> </ul> <p>Boro 2022-23 experiment is now on the field of different regional stations of BRRI and HQ.</p>	<p>Dynamics of Multi-trait stability index (MTSI)</p>
	<p><b>Rice database and analysis system (RDAS)</b></p>	<p>Automated informative and user-friendly</p>

<p><b>Research Progress:</b></p> <ul style="list-style-type: none"> <li>• Used Programming &amp; Scripting Languages for RDAS</li> <li>• R script (3.5.1) <ul style="list-style-type: none"> <li>• For analytical processing</li> </ul> </li> <li>• Python (v3.7) <ul style="list-style-type: none"> <li>• For backend processing.</li> </ul> </li> <li>• PHP (v7.1) <ul style="list-style-type: none"> <li>• Front end application</li> </ul> </li> <li>• Javascript (ES2015) <ul style="list-style-type: none"> <li>• For plotting and frontend application</li> </ul> </li> <li>• Bash Scripting (a series of commands written in a file)</li> </ul> <p>For system Integration</p>	<p>rice database and analysis system (RDAS)</p>
<p><b>Maintenance of Rice and related Database</b></p> <p><b>Research Progress:</b></p> <ul style="list-style-type: none"> <li>• Rice area increased about one and half folds but the production</li> <li>• increased about four folds during 1971-72 to 2020-21.</li> <li>• Growth rate of rice area was 3.96 in year 1972-73 and in 2020-21 is</li> <li>• 0.27.</li> <li>• But, growth rate of rice production was 1.30 in year 1972-73 and</li> <li>• in 2020 is 3.56</li> <li>• Rice and related data have been updating regularly</li> <li>• Collected Data are being available in BIRRI website</li> <li>• Producing different types of graph &amp; trends and climatic map of</li> <li>• Bangladesh by using the data as per requirement of BIRRI authority and BIRRI scientists.</li> </ul>	<ol style="list-style-type: none"> <li>1. Database on rice and related crops.</li> <li>2. Year wise GR of Rice Production in Bangladesh</li> <li>3. Database on climatic factors</li> <li>4. Various climatic maps.</li> </ol> <p>Growth rate and trend scenario of area, production and yield of rice in Bangladesh.</p>
<p><b>Minimizing agro micro climatological risk factors for maximizing sustainable rice production in Bangladesh</b></p> <p><b>Research Progress:</b></p> <p>Agro meteorological research of BIRRI has been updated through automation for weather forecasting and agro-advisory system as well as its dissemination.</p>	<p>Important information (weather induced risk, solution, and effective dissemination way) and feedback will be generated from the field level stakeholders to incorporate in to the IRAS for further improvement.</p>

	<p><b>Suitability Mapping of BRRI Varieties</b>  <b>Research Progress:</b></p> <ul style="list-style-type: none"> <li>• Agro Edaphic (Based on Soil and Land type) Suitability maps of Bangabandhu dhan100 has been completed.</li> <li>• Necessary information for suitability mapping of BRRI dhan96 to BRRI dhan99 has been collect from ARD</li> </ul>	<p>Farmers, policy makers and research will come to know suitable area for respective rice varieties.</p>
	<p><b>Climate Mapping of Temperature and Rainfall in Bangladesh</b>  <b>Research Progress:</b></p> <ul style="list-style-type: none"> <li>• Maps of maximum temperature, minimum temperature and total rainfall 2020 have been completed.</li> <li>• Climatic data for 2021 has been collected from BMD.</li> </ul>	<p>Find-out critical climatic area.</p>
	<p><b>Season wise rice area mapping of Bangladesh</b>  <b>Research Progress:</b>  Rice Area maps of Aman 2022 and Boro 2022-23 have been completed.</p>	<p>Policy makers and research will come to know season wise exact rice cultivated area.</p>
	<p><b>Projected Climatic Factors (2050) Maps of Bangladesh</b>  <b>Research Progress:</b></p> <ul style="list-style-type: none"> <li>• Projected Precipitation Maps of Bangladesh (January to July month) for 2050 have been completed.</li> </ul>	<p>Policy makers and research will able to make proper agricultural plan based on future precipitation.</p>
	<p><b>Suitability Mapping of Various Cropping Pattern</b>  <b>Research Progress:</b>  45 Cropping Pattern Suitability Maps have been completed</p>	<p>1. Farmers, policy makers and research will come to know suitable area for respective cropping pattern.</p>
	<p><b>Training Program on Experimental Data Analysis</b>  <b>Research Progress:</b>  Through the training 32 participants received training in four batches of which 16 SO, ten SSO, five PSO and one officers of BRRI. The duration of this training was five days.</p>	<p>1. Skills of BRRI personal on experimental data analysis will be enriched.</p>
	<p><b>Training Program on Multivariate Data Analysis</b>  <b>Research Progress:</b></p>	<p>1. Knowledge and skills of BRRI scientists on multivariate data</p>

	Through the training 32 participants received training in four batches of which 16 SO, ten SSO, five PSO and one CSO of BRRRI. The duration of this training was five days.	analysis will be enriched.
	<b>Develop a web application to calculate the Stability Index for BRRRI Stability Model</b> <i>Research Progress</i> <ul style="list-style-type: none"> <li>• Web Design Completed</li> </ul> Not hosting yet	1. A web application for calculation the stability index using BRRRI stability model.
	<b>Develop a Platform for BRRRI Developed Management Information System (MIS)</b> <i>Research Progress</i> Web Design Completed	A unique platform for BRRRI developed all management information system (MIS)
	<b>Digitalized Budget Management System of BRRRI</b> <i>Research Progress</i> <ul style="list-style-type: none"> <li>• Budget Management Software Development Complete</li> </ul> Budget report for BRRRI prepared using this software now	1. Updated digital budget management system for BRRRI
	<b>Digitalized Quota Management System of BRRRI</b> <i>Research Progress</i> <ul style="list-style-type: none"> <li>• Quota management system software already been Developed and hosted in BRRRI LAN</li> </ul> Quota calculation and report preparation already start by this software (Two report already prepared)	1. Updated digital quota management system of BRRRI
	<b>Digitalized Salary Management System of BRRRI</b> <i>Research Progress</i> <ul style="list-style-type: none"> <li>• New Salary management system software already been Developed and hosted in BRRRI LAN</li> <li>• Salary report preparation already start by this software</li> </ul> A new menu “Personal” were introduced	<ul style="list-style-type: none"> <li>•Pay Slip and Yearly Salary Statement report generate form</li> <li>•Updated the digital salary management system of BRRRI Service in the door step of BRRRI HQ employee under service process simplification</li> </ul>
	<b>Digitalized Labour Management System of BRRRI</b> <i>Research Progress</i> <ul style="list-style-type: none"> <li>• Unique Login System, User Profile</li> <li>• Easier the Username and Password changing system, Menu System</li> <li>• Signature with date and time add</li> <li>• Attendance Correction System</li> </ul>	<ol style="list-style-type: none"> <li>1. Software user report generate form</li> <li>2. Updated digitalized labour management system of BRRRI</li> </ol>

	<ul style="list-style-type: none"> <li>• Entry Deduction at time</li> <li>• Independent Electricity and Gas bill</li> </ul> <p>Accurate report for the previous month</p>	
	<p><b>Digitalized Casual Leave Application System</b> <i>Research Progress</i></p> <ul style="list-style-type: none"> <li>• Web Application software already been developed only for Agricultural Statistics Division and this Software hosted in BRRI LAN.</li> <li>• Need training for the users to run the application</li> </ul> <p>It can be applicable for others Division/Section/ Cell</p>	<p>Updated the digital casual leave application management system of Agricultural Statistics Division</p>
	<p><b>Sensor-based rice pest management through Artificial Intelligence (AI) technology of BRRI.</b> <i>Research Progress:</i></p> <p>Already developed this mobile and web application. This app inaugurated by honorable minister, Ministry of Agriculture on 31/12/2022 at BRRI premises. It's automatically providing the necessary solutions to rice disease and pest related problem with proper management within one to one and a half minutes through AI and image analysis technology.</p>	<ol style="list-style-type: none"> <li>1. Time, Cost and Visit (TCV) will be less and quality (Q) will be increased.</li> <li>2. Adopt precision agriculture and automations solutions to close rice yield gaps.</li> </ol>
	<p><b>Develop a new website for BRRI</b> <i>Research Progress:</i></p> <p>Develop of the new website is going on.</p>	<p>A new website for national and international seminars and symposiums. Domain or sub-domain for the new website.</p>
	<p><b>“BRRI Alapon” Telephone Directory Mobile App of BRRI.</b> <i>Research Progress:</i></p> <p>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.</p>	<ol style="list-style-type: none"> <li>1. Digitalize internal communication system to each other of BRRI.</li> <li>2. Minimize time, cost and visit (TCV) for sharing instant information using the app.</li> </ol>
	<p><b>Vehicle Requisition Management System of BRRI.</b> <i>Research Progress:</i></p> <p>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.</p>	<ol style="list-style-type: none"> <li>1. Digitalize Transport division using SMS based VRMS service.</li> <li>2. Manage and maintain the VRMS system.</li> </ol>

<p><b>Training on Innovation, Service Process Simplification (SPS) and e-Nothi system for enhancing capacity of BIRRI employee.</b>  <b>Research Progress:</b>  Day-long ‘e-Governance and Vision 2021 &amp; 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 BIRRI premises.</p>	<ol style="list-style-type: none"> <li>1. Enrich capacity of BIRRI scientists and officers through various PSI and SPS training.</li> <li>2. Skills of implementation process will be developed through innovative approach.</li> </ol>
<p><b>“BIRRI Rice Doctor” Apps for BIRRI.</b>  <b>Research Progress:</b>  Developed final version of BIRRI rice doctor mobile app and web application. Included diagnosis tool technique on BIRRI Rice doctor mobile and web application.</p>	<p>Manage and maintain rice doctor.</p>
<p><b>Strengthen and dissemination of modern rice technology and its management information at the farmer door step through RKB Mobile Apps</b>  <b>Research Progress:</b>  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. It has included rice cultivation methods, rice production methods, soil and fertilizer management, insects and their management, diseases and their management, irrigation &amp; water management and call center.</p>	<ol style="list-style-type: none"> <li>1. Disseminate RKB at all regional stations of BIRRI as well as in almost all corners of Bangladesh.</li> <li>2. Extend and update regularly as routine work.</li> </ol>
<p><b>BRKB Website Management</b>  <b>Research Progress:</b></p> <ul style="list-style-type: none"> <li>• 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.</li> <li>• Updated with the latest information of Aman, Aus and Boro rice varieties included the latest variety of BIRRI dhan99, BIRRI dhan98 and BIRRI dhan97.</li> </ul> <p>All types of information i.e. soil and fertilizer management, insects and rice diseases management etc. also updated regularly. It is routine work.</p>	<ol style="list-style-type: none"> <li>1. Provide more benefit to all users specially farmers, extension workers, researchers etc.</li> </ol> <p>Include more information as well as national issues associated with rice production and training.</p>
<p><b>Dynamic view connectivity system, Bangla searching system and inner banner system for BRKB Website</b>  <b>Research Progress:</b></p>	<ol style="list-style-type: none"> <li>1. Dynamic view connectivity system in BRKB.</li> </ol>

<ul style="list-style-type: none"> <li>In this reporting year we have developed an inner banner system and also integrated in BRKB website.</li> </ul> <p>We have developed a dynamic view connectivity system in BRKB. That helps us about our present activities and actions. Also, developed the Bangla Searching system in BRKB. Now anyone can search using both Bangla and English content.</p>	<ol style="list-style-type: none"> <li>Bangla searching system in BRKB.</li> <li>Inner banner system in BRKB.</li> </ol>
<p><b>BRRRI Web Mail and Group Mail</b> <i>Research Progress:</i></p> <ul style="list-style-type: none"> <li>Updated the BRRRI 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.</li> <li>Provided 120 webmail related solutions in this reporting year.</li> </ul>	<ol style="list-style-type: none"> <li>Create web mail ID and group mail as per requirement of BRRRI scientists and officer's usage.</li> <li>Manage, maintain and update regularly web mail ID, password and group mail for security purpose.</li> </ol>
<p><b>Developing secure system for BRRRI Web Mail and Group Mail</b> <i>Research Progress:</i></p> <ul style="list-style-type: none"> <li>In the reporting year we have developed spamming filtering system in mail server.</li> <li>We incorporated Secure Sockets Layer (SSL) system in BRRRI web mail, now our web mail is more secure.</li> </ul>	<ol style="list-style-type: none"> <li>Spamming filtering system (SFS) in BRRRI web mail and group mail.</li> <li>Automatic active &amp; close system (AACS) in BRRRI web mail and group mail.</li> </ol> <p>Secure Sockets Layer system in BRRRI web mail and group mail.</p>
<p><b>Online Application System of BRRRI</b> <i>Research Progress:</i></p> <p>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.</p>	<ol style="list-style-type: none"> <li>Digital and paperless recruitment system for BRRRI.</li> <li>Manage and maintain online application system of BRRRI.</li> </ol>
<p><b>e-Nothi System of BRRRI.</b> <i>Research Progress:</i></p> <p>BRRRI has taken initiative to ensure a paperless office management system through e-Nothi system on 24 September 2016. At present, BRRRI 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 BRRRI as well as regional stations.</p>	<ol style="list-style-type: none"> <li>Establishing uninerrupt and paperless office system.</li> <li>Manage and maintain e-File (Nothi) system of BRRRI.</li> </ol>
<p><b>LAN and internet connectivity of BRRRI regional station(R/S)</b> <i>Research Progress:</i></p>	<p>maintain Internet connectivity of BRRRI on</p>

	<ul style="list-style-type: none"> <li>Established Local Area Network (LAN) connectivity at five regional stations i.e. Sonagazi, Cumilla, Rangpur, Barishal and Habigonj.</li> <li>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. Also, established WiFi connection at five regional stations i.e. Rangpur, Barishal, Sonagazi, Cumilla and Habigonj.</li> </ul>	maintain local Area Network of BRRIon.
	<p><b>BRRI Web Portal Management</b> <i>Research Progress:</i></p> <ul style="list-style-type: none"> <li>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.</li> <li>We sent twelve website reports to the ministry of agriculture (MoA).</li> </ul>	1. New features for BRRI web portal. To increase hosting spaces gradually
	<p><b>Management of BRRI HQ Local Area Network and Internet Connectivity</b> <i>Research Progress:</i></p> <ul style="list-style-type: none"> <li>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.</li> <li>Established new and high configured Router where internet speed capacity increased 1000 Mbps; the internet speed capacity was 25 Mbps previous device.</li> </ul> <p>Already given internet connection in 360 computers. But we want to increase more internet connection.</p>	1. High speed internet connectivity for BRRI. 2. Secure Local Area Network for BRRI.
	<p><b>BRRI Networks Update, Maintenance and Extension.</b> <i>Research Progress:</i></p> <p>To build a linkage among all scientists, officers and staffs, where <i>BRRI Networks</i> (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.</p>	<ul style="list-style-type: none"> <li>Store more research related activities post and necessary documents.</li> <li>Boost and extend the group with adding more members and introducing newer feature for noble purpose.</li> </ul>
	<p><b>Personal Data Sheet of BRRI</b> <i>Research Progress:</i></p> <ul style="list-style-type: none"> <li>Created Personal Data Sheet (PDS) database including various information fields for all scientists, officers, staffs as per requirement of the Ministry of Agriculture (MoA).</li> </ul> <p>We have distributed 360 user ID and password to all scientists, officers &amp; staffs personal mail and published user id list into BRRI website.</p>	Creating Personal Data Sheet (PDS) database including various information fields for all scientists, officers, staffs as per requirement of the Ministry of Agriculture (MoA).

	<p><b>Video Conference System of BIRRI (skype system)</b>  <b>Research Progress:</b></p> <ul style="list-style-type: none"> <li>We have established video conferencing system at BIRRI to communicate with MoA and others government organization.</li> </ul> <p>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.</p>	Creating Skype account for all scientists.				
	<p><b>New version of management Information System (MIS) of BIRRI</b>  <b>Research Progress:</b></p> <ul style="list-style-type: none"> <li>Ten workshops have been completed at Bangladesh agricultural research council (BARC).</li> <li>Feedback workshop has been completed.</li> </ul>	1. Establishing e-Governance. Setup management information system at BIRRI				
	<p><b>Rice Pest Corner</b>  <b>Research Progress:</b></p> <p>Developed 'Rice pest corner' with the information of insect and pest and disease management.</p>	1. Web Application for Rice Pest Corner to identify timely pest problems in rice and control to manage them.				
	<p><b>Heritage of BIRRI</b>  <b>Research Progress:</b></p> <ul style="list-style-type: none"> <li>Developed Heritage for all scientists, officers, staffs, and workers of BIRRI as per requirement of the BIRRI authority.</li> <li>Developed individual webpage including picture of all scientists, officers, staffs and workers of BIRRI</li> <li></li> </ul>	1. Managing and maintaining BIRRI heritage. 2. Adding all ex. Scientists, ex. officers and ex. Staffs in BIRRI heritage.				
	<b>Farm Management Division</b>					
	<b>Project: Rice production management</b>					
1	<p><b>Expt. 1. Influence of different dates of transplanting on growth, yield performance and quality of fine rice varieties</b>  <b>Treatments:</b></p> <table border="1"> <thead> <tr> <th>Factor A: Transplanting date</th> <th>Factor B: Variety</th> </tr> </thead> <tbody> <tr> <td>T<sub>1</sub> = 1 July</td> <td>V<sub>1</sub> = BIRRI dhan34</td> </tr> </tbody> </table>	Factor A: Transplanting date	Factor B: Variety	T <sub>1</sub> = 1 July	V <sub>1</sub> = BIRRI dhan34	15 to 30 August transplanting might be produced better yield for fine rice variety.
Factor A: Transplanting date	Factor B: Variety					
T <sub>1</sub> = 1 July	V <sub>1</sub> = BIRRI dhan34					

	<table border="1"> <tr> <td>T<sub>2</sub> = 15 July</td> <td>V<sub>2</sub> = BRRRI dhan90</td> </tr> <tr> <td>T<sub>3</sub> = 30 July</td> <td>V<sub>3</sub> = Binadhan-13</td> </tr> <tr> <td>T<sub>4</sub> = 15 August</td> <td></td> </tr> <tr> <td>T<sub>5</sub> = 30 August</td> <td></td> </tr> <tr> <td>T<sub>6</sub> = 15 September</td> <td></td> </tr> </table> <p><b>Progress:</b> In T. Aman 2023 season, 30 July to 15 August transplanting plants produced statistically identical yield of tested fine rice varieties and grain quality and other parameter data are being processed.</p>	T <sub>2</sub> = 15 July	V <sub>2</sub> = BRRRI dhan90	T <sub>3</sub> = 30 July	V <sub>3</sub> = Binadhan-13	T <sub>4</sub> = 15 August		T <sub>5</sub> = 30 August		T <sub>6</sub> = 15 September				
T <sub>2</sub> = 15 July	V <sub>2</sub> = BRRRI dhan90													
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2	<p><b>Expt. 2. Effect of storage time in different storage technologies on quality of rice</b></p> <p><b>Treatments:</b></p> <table border="1"> <thead> <tr> <th>Factor A: Storage time</th> <th>Factor B: Storage container</th> </tr> </thead> <tbody> <tr> <td>T<sub>1</sub> = Milling after immediate of harvesting</td> <td>C<sub>1</sub> = Plastic container</td> </tr> <tr> <td>T<sub>2</sub> = Milling after 3 months</td> <td>C<sub>2</sub> = Jute sacks</td> </tr> <tr> <td>T<sub>3</sub> = Milling after 6 months</td> <td>C<sub>3</sub> = Plastic bag</td> </tr> <tr> <td>T<sub>4</sub> = Milling after 9 months</td> <td>C<sub>4</sub> = Motka</td> </tr> <tr> <td></td> <td>C<sub>5</sub> = Grain Pro bag</td> </tr> </tbody> </table> <p><b>Progress:</b> The experiment was conducted during Boro 2023. The results of Boro 2023 grain quality data are being processed.</p>	Factor A: Storage time	Factor B: Storage container	T <sub>1</sub> = Milling after immediate of harvesting	C <sub>1</sub> = Plastic container	T <sub>2</sub> = Milling after 3 months	C <sub>2</sub> = Jute sacks	T <sub>3</sub> = Milling after 6 months	C <sub>3</sub> = Plastic bag	T <sub>4</sub> = Milling after 9 months	C <sub>4</sub> = Motka		C <sub>5</sub> = Grain Pro bag	All storage technologies gave higher germination% and seedling vigor index% at 3 months storage time
Factor A: Storage time	Factor B: Storage container													
T <sub>1</sub> = Milling after immediate of harvesting	C <sub>1</sub> = Plastic container													
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T <sub>4</sub> = Milling after 9 months	C <sub>4</sub> = Motka													
	C <sub>5</sub> = Grain Pro bag													
3	<p><b>Expt. 3. Effect of foliar application of silicon on yield of aromatic rice</b></p> <p><b>Progress:</b> In T. Aman season, 1.50% silicon's solution spray plot gave the highest grain yield (4.31t ha<sup>-1</sup>) and protects the plant against pests and diseases. Boro season experiment is in the field. Data are being collected</p>	Effectiveness of silicon foliar application can vary depending on factors such as soil type, rice variety, application timing, dosage etc. Foliar application of silicon has significant effect on yield of aromatic rice (BRRRI dhan50).												
4	<p><b>Expt. 4. Effect of nitrogen levels on protein quality of rice at different regions</b></p> <p><b>Treatments:</b></p> <table border="1"> <thead> <tr> <th>N fertilizer levels (Kg/ha in T. Aman season)</th> <th>N fertilizer levels (Kg/ha in Boro season)</th> </tr> </thead> <tbody> <tr> <td>T<sub>1</sub> = No N</td> <td>T<sub>1</sub> = No N</td> </tr> <tr> <td>T<sub>2</sub> = 50</td> <td>T<sub>2</sub> = 100</td> </tr> </tbody> </table>	N fertilizer levels (Kg/ha in T. Aman season)	N fertilizer levels (Kg/ha in Boro season)	T <sub>1</sub> = No N	T <sub>1</sub> = No N	T <sub>2</sub> = 50	T <sub>2</sub> = 100	In different N levels: 100 Kg N ha <sup>-1</sup> fertilizer was used in T. Aman season at different regions to ensure maximum grain yield.						
N fertilizer levels (Kg/ha in T. Aman season)	N fertilizer levels (Kg/ha in Boro season)													
T <sub>1</sub> = No N	T <sub>1</sub> = No N													
T <sub>2</sub> = 50	T <sub>2</sub> = 100													

	<table border="1"> <tr> <td>T<sub>3</sub> = 75</td> <td>T<sub>3</sub> = 125</td> </tr> <tr> <td>T<sub>4</sub> = 100</td> <td>T<sub>4</sub> = 150</td> </tr> <tr> <td>T<sub>5</sub> = 125</td> <td>T<sub>5</sub> = 175</td> </tr> </table> <p><b>Progress:</b> Results of T. Aman 2023 are being processed.</p>	T <sub>3</sub> = 75	T <sub>3</sub> = 125	T <sub>4</sub> = 100	T <sub>4</sub> = 150	T <sub>5</sub> = 125	T <sub>5</sub> = 175	
T <sub>3</sub> = 75	T <sub>3</sub> = 125							
T <sub>4</sub> = 100	T <sub>4</sub> = 150							
T <sub>5</sub> = 125	T <sub>5</sub> = 175							
5	<p><b>Expt. 5. Efficacy of mechanical seedling transplanter and deep placement of mixed fertilizer on rice yield</b></p> <p><b>Progress:</b> In T. Aman season, mechanical transplanting with 80% urea ,100% TSP &amp; MoP deep placementby transplanter cum fertilizer applicator plot gave the highest (6.14 t ha<sup>-1</sup>) grain yield. Also 20% urea being saved and time and labour required was lower than hand transplanting with fertilizer hand broadcasting practice. But in Boro season, mechanical transplanting + 100% urea, TSP and MoP hand broadcasting gave the highest grain yield (7.2 tha<sup>-1</sup>).</p>	Mechanical transplanting of rice is the most vital issue to overcome the labour shortage and high labour wage rate during transplanting.						
6	<p><b>Expt.6. Artificial Plough Pan Development for Facilitating Modern Farm Machineries</b></p> <p><b>Treatment combinations</b></p> <table border="1"> <thead> <tr> <th>Treatment A (Methods)</th> <th>Treatment B (Water management)</th> </tr> </thead> <tbody> <tr> <td> M1: Control (normal practice).  M2: Compaction of soil by tractor<sup>1</sup> after harvesting.  M3: Placing a 3inch fine sand layer at 8 inch (20cm) below soil surface and compaction.  M4: Compaction of soil by tractor<sup>1</sup> after T. Aman harvesting and fallow in Boro season. </td> <td> W1: Continuous flooding  W2: Alternate Wetting and Drying </td> </tr> </tbody> </table> <p>(<sup>1</sup> The soil will be artificially compacted by a wheel-to-wheel tractor passage. The tractor weight approximately 3000 Kg. Double rear wheels with normal tire type with inflation pressure around 100 kPa. Soil moisture content will be at suitable range between 15-20%. Compaction will be two times at 7-10 days interval).</p> <p><b>Progress:</b> Experiment is going on. Treatments were allotted according to the design. Three cm fine sand layer is placed at 9 cm from surface of the field. Experiment is going on from Boro 2022-23. Also, when soil penetrometer is available, then it could be measured whether artificial plough pan developed or not.</p>	Treatment A (Methods)	Treatment B (Water management)	M1: Control (normal practice). M2: Compaction of soil by tractor <sup>1</sup> after harvesting. M3: Placing a 3inch fine sand layer at 8 inch (20cm) below soil surface and compaction. M4: Compaction of soil by tractor <sup>1</sup> after T. Aman harvesting and fallow in Boro season.	W1: Continuous flooding W2: Alternate Wetting and Drying	It clearly indicated that compaction of soil does not have any negative influence on yield and yield contributing characters of rice grown.		
Treatment A (Methods)	Treatment B (Water management)							
M1: Control (normal practice). M2: Compaction of soil by tractor <sup>1</sup> after harvesting. M3: Placing a 3inch fine sand layer at 8 inch (20cm) below soil surface and compaction. M4: Compaction of soil by tractor <sup>1</sup> after T. Aman harvesting and fallow in Boro season.	W1: Continuous flooding W2: Alternate Wetting and Drying							
7	<p><b>Expt.7. Determination of Fertilizer Management to Control Algae Infestation in Rice Field</b></p> <p><b>Treatments</b></p> <p>I. Full dose basal fertilizer of DAP, MoP, Gypsum &amp; Zinc (BRRI recommended)</p>	It seems that full dose basal of DAP or TSP with basal urea dose influence algae infestation in rice field.						

	<p>II. Full dose basal fertilizer of TSP, MoP, Gypsum &amp; Zinc (BRRI recommended)</p> <p>III. Half dose basal fertilizer of DAP and Full dose MoP, Gypsum &amp; Zinc</p> <p>IV. Half dose basal fertilizer of TSP and Full dose MoP, Gypsum &amp; Zinc</p> <p>V. Basal fertilizer of full dose TSP, MoP, Gypsum &amp; Zinc, and 1/3<sup>rd</sup> Urea</p> <p>For treatment III and IV, rest half dose DAP/TSP will be applied at second urea top-dress.</p> <p><b>Progress:</b> Data of Boro season are collecting and is being under implementation (Algal infestation is absent this year).</p>	
	<b>Project: Labor Management System</b>	
8	<p><b>Expt. 1. Monitoring labor wage rate at different locations of Bangladesh</b></p> <p><b>Progress:</b> Data of Boro season has collected and is being under process.</p>	The average wage rate per day (8.0 hrs) was Tk. 573-648 at different locations around BRRI HQ and regional stations by conducted a survey of labourers' wage rate throughout the year.
	<b>Project: Rice Seed Production.</b>	
10	<p><b>Expt. 1. Performance of BRRI varieties in seed production plots during 2022-23</b></p> <p><b>Progress:</b> Data of T. Aman season has collected and is being under process and also data of Boro season will be collected.</p>	The yield of different BRRI varieties at BRRI farm will be found. In T. Aman season, BRRI dhan103 produced the highest grain yield (5.92 tha <sup>-1</sup> ) followed by BRRI dhan87.
	<b>Project: Management and utilization of resources</b>	
11	<p><b>Expt. 1.</b> Management and utilization of land, labour and other resources.</p> <p>Progress: Data has been collecting.</p>	
	<b>Adaptive Research Division</b>	
<b>1.0</b>	<b>Technology Validation</b>	
<b>Title</b>	<b>ALART, Superior High Yielding Rice-1 (SHR-1) in T. Aman 2022.</b>	
1.1	<p><b>Genotype/variety:</b> Five advanced lines i.e., BRH15-24-7B, BRH13-1-9-7B, BRH13-2-4-7-2B, BRH10-1-14-6-2B, BR10247-4-7-4B, along with the check varieties BRRI dhan57 and Jirashail.</p>	The advanced line V3 (comparatively lower irregularities was found both at flowering and maturity stages i.e. 10-15%

	<p><b>Locations:</b> Satkhira (Sadar), Dinajpur (Parbatipur), Rangpur (Pirganj), Dinajpur (Chiribandor), Gazipur (West Byde), Bogura (Sadar), Kushtia (Sadar), Meherpur (Gangni), Rajshahi (Godagari), Natore (Bagatipara), Naogaon (Mohadebpur).</p> <p>Three advanced lines produced significantly higher grain than both the check varieties (as a check BRRI dhan57 and Jirashail produced 4.33 and 3.91 t/ha grain yield respectively).</p>	in case of V3) could be consider for PVT after must making the advanced line uniform both at flowering & maturity stage.
<b>Title</b>	<b>ALART, Superior High Yielding Rice-2 (SHR-2) in T. Aman 2022</b>	
1.2	<p><b>Genotype/variety:</b> Five superior high yielding rice (SHR) advanced lines i.e., BR9392-1-9-7-5B; BR10247-14-18-4; BR9392-40-50-1B; IR12A-177 and BR10238-5-1-4-2, along with the check varieties BRRI dhan62 and BRRI dhan75.</p> <p><b>Location:</b> Kustia (Sadar), Meherpur (Kustia), Sarsha (Jessore), Godagari (Rajshahi), Mohadebpur (Nagaon), Bagatipara (Natore), Chirirbandar (Dinajpur), Parbotipur (Dinajpur), Peerganj (Rangpur), Sadar (Bogura), and HQ Gazipur.</p> <p>Among the genotypes highest mean grain yield (4.79 t/ha) was obtained in BRRI dhan75 (Std. Ck) followed by IR12A-177 (4.67 t/ha), BR10238-5-1-4-2 (4.53 t/ha), BR9392-1-9-7-5B (4.25 t/ha), BR10247-14-18-4 (4.18 t/ha), BR9392-40-50-1B (3.95 t/ha) and BRRI dhan62 (ck) (3.92 t/ha).</p>	Considering the above results and phenotypic acceptance, grain type, disease reaction, insect infestation, lodging tendency, and farmers' opinion, none of the advanced lines was found suitable for PVT
<b>Title</b>	<b>ALART, Drought Tolerant Rice (DTR), in T. Aman 2022.</b>	
1.3	<p><b>Genotype/variety:</b> Two drought tolerant advanced lines BR10538-2-1-2-32, BR10540-4-1-2-41 along with BRRI dhan71 and BRRI dhan75 as checks were evaluated.</p> <p><b>Location:</b> Gazipur (West byde); Taraganj and Pirganj, Rangpur; Sadar, Bogura; Sadar, Kustia; Gangni, Meherpr; Debiddar, Cumilla; Mohadevpur, Naogoan; Godagari, Rajshahi; and Nachole, Chapainababganj.</p> <p>The checks variety (BRRI dhan71) gave statistically higher mean yield (4.78 t/ha) than the two advance lines BR10538-2-1-2-32 and BR10540-4-1-2-41 was (4.42 t/ha and 4.55 t/ha) and other check variety BRRI dhan75 (4.43 t/ha).</p>	Considering the above results and phenotypic acceptance, grain type, disease reaction, insect infestation, lodging tendency, and farmers' opinion, none of the advanced lines was found suitable for PVT.

<b>Title</b>	<b>ALART, Premium Quality Rice (PQR), in T. Aman 2022.</b>	
1.4	<p><b>Genotype/variety:</b> Two advanced line i.e., BR8493-3-5-1-P1 and BR9590-45-1-3-2-P2 were evaluated along with along with the two check varieties, BRRI dhan34 and BRRI dhan70.</p> <p><b>Location:</b> Kustia (Sadar), Cumilla (Debeddar), Naogaon (Mohadebpur), Dinajpur (Parbotipur), Satkhira (Kolaroa), Habiganj (Sadar), Feni (Sonagazi), Faridpur (Bhanga), Bogura (Sadar), and Gazipur (BRRI research farm).</p> <p>The highest mean grain yield (4.44 t ha<sup>-1</sup>) was obtained in the advanced line BR8493-3-5-1-P1 which was statically higher than both the check variety BRRI dhan34 (2.98 t ha<sup>-1</sup>) &amp; BRRI dan70 (3.84 t ha<sup>-1</sup>)</p>	Considering the growth duration and phenotypic acceptance, grain type, disease reaction, insect infestation, lodging tendency, and farmers' opinion, none of the advanced lines was found suitable for PVT.
<b>Title</b>	<b>ALART, Salt Tolerant Rice (STR) in T. Aman 2022.</b>	
1.5	<p><b>Genotype/variety:</b> Three salt tolerant advanced lines: BR11712-4R-218, BR11716-4R-102, &amp; BR11723-4R-172 along with BRRI dhan73 (Tol. Ck) &amp; BRRI dhan87(Sus. Ck) were evaluated.</p> <p><b>Locations:</b> BRRI research farm (Gazipur), Satkhira (Kaliganj) Satkhira (Debhata) Bagerhat (Sadar) Sonagazi (Feni) Noakhali (Companiganj) and Patuakhali (Kalapara).</p> <p>The highest mean GY (4.71 t/ha) was found in BR11716-4R-102 followed by BR11712-4R-218(4.47 t/ha), BR11723-4R-172(4.32 t/ha), BRRI dhan87(4.24 t/ha) and BRRI dhan73(3.66 t/ha).</p>	The entry no 2 i.e., BR11716-4R-102 could be recommended for PVT if the irregularity of flowering & maturity is corrected by any means.
<b>Title</b>	<b>Re-ALART, Submergence tolerance rice; Long duration in T. Aman 2022.</b>	
1.6	<p><b>Genotype/variety:</b> Two advanced lines: BR9158-19-9-6-50-2-HR1 and IR13F441 along with BRRI dhan44 (Sus. Ck) and BRRI dhan52 (Tol. Ck) as checks were evaluated.</p> <p><b>Locations:</b> Barishal Sadar (Dhopakathi), Barishal Sadar (Dinar), Borguna (Amtoli), Patuakhali (Kolapara), Jhalakathi (Nalchiti), Pirojpur (Kaukhali), Chattogram (Mirsarai), Chattogram (Rangunia), Gopalganj, Gazipur (WB).</p> <p>Both the lines (BR9158-19-9-6-50-2-HR1 and IR13F441) gave higherhigher yields (4.89 tha<sup>-1</sup> &amp; 4.92 tha<sup>-1</sup> respectively) than the two check varieties BRRI dhan44 (4.31 tha<sup>-1</sup>) and BRRI dhan52</p>	Considering the above results and, grain type, disease reaction, insect infestation, the line BR9158-19-9-6-50-2-HR1 was recommended for for proposed variety trial (PVT).

	(4.49 t ha <sup>-1</sup> ).	
<b>Title</b>	<b>ALART, Deep water Rice (DWR) in B. Aman 2022.</b>	
1.7	<p><b>Genotype/variety:</b> Six advanced lines bred for deep flooded (1 to 2 meter water depth) condition i.e., V1= BR10230-7-19-2B, V2= BR9892-6-2-2B, V3= BR9376-6-2-2B, V4= BR9392-6-2-1B , V5= BR-KM(Mun)-PL-5-7-3-B and V6= BR-DL(Hbj)-PL-12-4-7-B with V7= Fulkori (local ck.)as checks were tested.</p> <p><b>Locations:</b> Faridpur (Sadar), Gopalganj (Moksedpur), Chandur (Kachua), Habiganj (Baniachang), Manikganj (Harirampur), Sirajganj (Tarash), BIRRI Gazipur (Shibbari Deep water tank).</p> <p>All the tested lines performed better in Faridpur and Gopalganj where the water depth was 20-53cm which was below our expected level. Our desired water depth was 100-150 cm. However, their performance was not good in Sirajganj and Gazipur where the water depth ranges from 26-84 cm in the trial sites. Manikganj sites was totally water free. Experiments from Cumilla and Habiganj were totally damaged due to flood which arose the question of elongation capacity.</p>	Considering yield potentiality of the advanced lines, this trial was recommended for conducting again in coming B. Aman season (Re-ALART) since there was not much water at the experimental sites in B. Aman 2022.
<b>Title</b>	<b>ALART, Blast Resistant Rice (BRR) in Boro 2022-23.</b>	
1.8	<p><b>Genotype/variety:</b> Four advanced lines i.e., BR12454-BC2-56-81-27-3-30, BR12454-BC2-69-97-39-5-44, BR12454-BC2-71-91-6-23-26, BR12454-BC2-75-32-31-39-7 along with the check varieties BIRRI dhan29 and BIRRI dhan89.</p> <p><b>Locations:</b> Faridpur (Nagarkanda), Barishal (Sadar), Rajshahi (Paba), Rangpur (Sadar), Lalmonirhat (Sadar), Bagura (Sadar), Cumilla (Deveder), Habiganj (Baniachong) and Jessore (Kesobpur).</p> <p>Grain yield of tested lines V2=BR12454-BC2-69-97-39-5-44 &amp; V4=BR12454-BC2-75-32-31-39-7 were higher than standard check and susceptible check BIRRI dhan29 BIRRI dhan89. More lodging tolerance was observed in V2=BR12454-BC2-69-97-39-5-44 &amp; V4=BR12454-BC2-75-32-31-39-7 than the other entries.</p>	Considering the above results and phenotypic acceptance, grain type, disease reaction, insect infestation, lodging tendency, and farmers' opinion, tested lines V2=BR12454-BC2-69-97-39-5-44 & V4=BR12454-BC2-75-32-31-39-7 were found suitable for PVT.
<b>Title</b>	<b>ALART, Blast Resistant Rice (BRR) (Re-ALART), in Boro 2022-23.</b>	

1.9	<p><b>Genotype/variety:</b> Four advanced lines i.e., BR(Path)12452-BC3-42-22-11-4, BR(Path)12452-BC6-53-21-11, BR(Path)13784-BC3-61-1-6-HR3, BR(Path)13784-BC3-63-6-4-HR6 along with the check varieties BRR1 dhan28 and BRR1 dhan88.</p> <p><b>Locations:</b> Faridpur (Nagarkanda), Barishal (Sadar), Rajshahi (Paba), Rangpur (Sadar), Lalmonirhat (Sadar), Bagura (Sadar), Cumilla (Deveder), Habiganj (Baniachong), Jessore (Kesobpur) and Kishoreganj (Mithamoin).</p> <p>Grain yield of tested lines V1= BR(Path)12452-BC3-42-22-11-4 (6.8 t/ha) &amp; V2= BR(Path)12452-BC6-53-21-11 (7.0 t/ha) were higher than standard check BRR1 dhan28 (5.4 t/ha). Average growth duration of tested lines was 1 days higher or lower than standard check BRR1 dhan88. Grain type is medium slender.</p>	Considering the above results, grain type, disease reaction, insect infestation, and farmers' opinion, tested lines V1= BR(Path)12452-BC3-42-22-11-4 & V2= BR(Path)12452-BC6-53-21-11 were found suitable for PVT.
<b>Title</b>	<b>ALART, Short Duration Favorable Boro Rice (FBR-SD), in Boro 2022-23.</b>	
1.10	<p><b>Genotype/variety:</b> Four advanced lines i.e. BR11318-5R-63, BR11337-5R-72, SVIN109, IR17A1723 along with the check varieties BRR1 dhan81 and BRR1 dhan96.</p> <p><b>Locations:</b> Rangpur (Sadar), Gopalganj (Kotalipara), Faridpur (Nagarkanda), Barishal (Sadar), Natore (Singra), Sirajganj (Tarash), Cumilla (Burichang), Feni (Fulgazi), Kushtia (Sadar), Habiganj (Baniachang), Manikganj (Harirampur) and Gazipur (BRR1 H/Q).</p> <p>The advanced lines V1=BR11318-5R-63 (7.3 t/ha) and V2=BR11337-5R-72 (7.21 t/ha) gave significantly higher yield than the both check varieties BRR1 dhan81 (5.98 t/ha) and BRR1 dhan96 (6.79) but the duration of the lines was 4-5 days higher than the check. Less disease and insect infestation in these two lines. No lodging was record.</p>	Considering the above results and phenotypic acceptance, disease reaction, insect infestation, lodging tendency, and farmers' opinion, tested lines V1=BR11318-5R-63 (7.3 t/ha) and V2=BR11337-5R-72 (7.21 t/ha) were found suitable for PVT.
<b>Title</b>	<b>ALART, Medium Duration Favorable Boro Rice (FBR-MD), in Boro 2022-23.</b>	
1.11	<p><b>Genotype/variety:</b> Two advanced lines i.e., IR12A173, IR17A1694 along with the check varieties BRR1 dhan58 and BRR1 dhan96.</p> <p><b>Locations:</b> Rangpur (Sadar), Gopalganj (Kotalipara), Faridpur (Nagarkanda), Barishal (Sadar), Natore (Singra), Sirajganj (Tarash), Cumilla (Burichang), Feni (Fulgazi), Kushtia (Sadar),</p>	Considering the above results and phenotypic acceptance, grain type, disease reaction, insect infestation and farmers' opinion, none of the advanced lines was found suitable for PVT.

	Habiganj (Baniachang), Manikganj (Harirampur) and Gazipur (BRRI H/Q).	
	The mean grain yield of both the tested entries (6.72 t/ha & 6.45 t/ha) was lower than both of the check varieties (6.73 t/ha). Growth duration of the tested entries were 4-8 days longer than check varieties at most of the locations. Uneven flowering and maturity were observed in both of the entries.	
<b>Title</b>	<b>ALART, Superior High Yielding Rice (SHR-1; Zira type), in Boro 2022-23.</b>	
1.12	<p><b>Genotype/variety:</b> Three advanced lines i.e., BRH10-1-14-2-6, BRH13-2-4-7-2B, BRH15-24-7B, along with the check variety BRRI dhan81.</p> <p><b>Locations:</b> Bogura (Sherpur), Kushtia (Sadar, Meherpur), Jessore (Sharsha), Rajshahi (Paba), Habiganj (Baniachang), Cumilla (Sadar), Rangpur (Sadar, Mithapukur) and Gazipur (BRRI H/Q).</p> <p>Among the 3 advanced lines V1= BRH10-1-14-2-6 (6.78 t/ha) &amp; V2= BRH13-2-4-7-2B (6.75 t/ha) gave significantly higher grain yield than Check variety. Average growth duration of tested lines were 2-4 days higher than standard check BRRI dhan81. Uniform flowering but un synchronized maturity was found in several locations like West byde Gazipur, Satkhira according to ALART monitoring team report.</p>	Considering the above results, growth duration, phenotypic acceptance, and farmers' opinion, V1= BRH10-1-14-2-6 & V2= BRH13-2-4-7-2B may be recommended for PVT after confirmation of uniform maturity.
<b>Title</b>	<b>ALART, Superior High Yielding Rice (SHR-2; ELS &amp; LS type), in Boro 2022-23.</b>	
1.13	<p><b>Genotype/variety:</b> Three advanced lines i.e., BRH11-2-4-7B, BRH13-2-4-2-1B, BRH238-5-1-4-2 along with the check variety BRRI dhan88.</p> <p><b>Locations:</b> Bogura (Sherpur), Kushtia (Sadar, Meherpur), Jessore (Sharsha), Rajshahi (Paba), Habiganj (Baniachang), Cumilla (Sadar), Rangpur (Sadar, Mithapukur) and Gazipur (BRRI H/Q).</p> <p>Yield of the V2 = BRH13-2-4-2-1B line is statistically higher than the check variety BRRI dhan88. But yield was not 10% higher over the check variety. Besides, the highest growth duration was found in the entry no. V2 which was 152 days and 5-7 days higher than the other entries. Irregularities in plant height, during flowering and maturity were found in all tested entries as stated by the ALART monitoring team.</p>	Considering the above results and phenotypic acceptance, Irregularities in plant height, during flowering and maturity and farmers' opinion, none of the advanced lines was found suitable for PVT.
<b>Title</b>	<b>ALART, Favorable Boro Rice (FBR-Barishal), (Re-ALART), in Boro 2022-23.</b>	

1.14	<p><b>Genotype/variety:</b> Four advanced lines i.e., BRBa 1-4-9, BRBa 2-5-3, BRBa 3-1-7, BRBa 3-2-4, along with the check variety BRRi dhan58 and BRRi dhan89.</p> <p><b>Locations:</b> Rangpur (Sadar), Gopalganj (Kotalipara), Faridpur (Nagarkanda), Barishal (Sadar), Natore (Singra), Sirajganj (Tarash), Cumilla (Burichang), Feni (Fulgazi), Kushtia (Sadar), Habiganj (Baniachang), Mymensingh (Fulbaria), and Gazipur (BRRi H/Q).</p> <p>Grain yield of advanced lines (7.71 to 7.24 t/ha) were almost similar to standard check variety BRRi dhan89 (7.50 t/ha). Average growth duration of tested lines was almost similar to the Check variety BRRi dhan89. Irregularities during flowering and maturity stage were observed in V1=BRBa 1-4-9 and V2= BRBa14-NGR414-1 at Mymensingh and Faridpur.</p>	<p>Considering the above results and phenotypic acceptance, growth duration, Irregularities in plant height, during flowering and maturity and farmers' opinion, none of the advanced lines was found suitable for PVT.</p>
1.15	<p><b>Head to Head Adaptive Trial (HHAT) during T. Aman 2022 under TRB.</b></p> <p>No. of HHAT: 200; Area/HHAT: 1 bigha  Variety: BR10 BR11, BR23, BR32, BR33, BR34, BR39, BRRi dhan49, BRRi dhan51, BRRi dhan52, BRRi dhan70, BRRi dhan71, BRRi dhan72, BRRi dhan73, BRRi dhan75, BRRi dhan76, BRRi dhan77, BRRi dhan78, BRRi dhan79, BRRi dhan80 BRRi dhan87, BRRi dhan90, BRRi dhan93, BRRi dhan94, BRRi dhan95, Binadhan-7, Binadhan-11, Binadhan-16, Binadhan-17, Binadhan-22 and Binadhan-27, Swarna, Kataribhog and Lalmota.</p> <p>4 to 8 varieties were used in a HHAT based on rice environments Long growth duration rice variety (Swarna-Growing areas), Long growth duration rice variety (Dinajpur areas), Long growth duration rice variety (Rangpur areas), Long growth duration rice variety (Mymensingh areas), Short growth duration rice variety, Coastal Ecosystem (CE), Flash Flood Submergence (FFS), Tidal Submergence (TS).</p>	<p>In HHAT (LD-Swarna), BRRi dhan87 was found as highest yielder (5.61 t/ha) having growth duration 127 days. (LD-Dinajpur), BRRi dhan80 was found as highest yielder (4.63 t/ha) having growth duration 133 days followed by BRRi dhan70 (4.63 t/ha). In the category HHAT (LD-Rangpur), BRRi dhan87 produced the highest grain yield (5.71 t/ha) having also the shortest growth duration 146 days only. In HHAT (LD-Mymensingh), BRRi dhan49 produced the highest grain yield (5.70 t/ha) having also the shortest growth duration 146 days. BRRi dhan87 and BRRi dhan94 produced the statistically similar yield and the similar growth duration respectively.</p>

		In the category HHAT (SD), average highest yield of Binadhan-17 was recorded 5.57 t/ha followed by BRRIdhan75 producing grain yield 5.40 t/ha. Binadhan-22 also performed well (5.35 t/ha). In Coastal Ecosystem (CE) areas, the average highest yield was in BRRIdhan79 (5.28t/ha) followed by BR10 (5.04 t/ha) with longest 146 days growth duration. Among the Flash flood submergence tolerant var. BR11 produced the highest mean yield (5.35 t/ha) having the GD 144 days followed by BRRIdhan52 producing grain yield 5.30 t/ha with 147 days growth duration. Among the Tidal Submergence tolerant var. BRRIdhan76 produced the highest mean yield 5.27 t/ha having the GD 155 days followed by BRRIdhan52 producing grain yield 5.04 t/ha with 143 days growth duration.
2.0	<b>Technology Dissemination</b>	
<b>Title</b>	<b>SPDP during T. Aus, 2022 under GoB</b>	
2.1	No. of SPDP: 116; Area/SPDP: 1bigha Varieties name: BRRIdhan48, BRRIdhan82, and BRRIdhan98.  Location: 29 upzillas of 10 districts (Gazipur, Narshingdhi, Manikganj, Kishoreganj, Netrokona, Mymensingh, Sherpur, Bhola, Sylhet, B. Baria and Gaibandha).	A total of 44,968 kg grains was produced from all demonstrated plots and 4405 kg quality seeds were retained by the farmers for the next year use. A total of 1326 farmers were motivated and showed their interest to cultivate these varieties in the next year.
<b>Title</b>	<b>Special SPDP of BRRIdhan83 for rapid dissemination in Bhola district during B. Aus, 2022</b>	

	<b>under GoB.</b>	
2.2	No. of SPDP: 6; Area/SPDP: 1 bigha  Varieties name: BRRI dhan83.  Location: 6 upzillas of Bhola district	A total of 3,114 kg grains was produced from all demonstrated plots and 258 kg quality seeds were retained by the farmers for the next year use. A total of 72 farmers were motivated and showed their interest to cultivate these varieties in the next year.
<b>Title</b>	<b>SPDP in <i>Jhum</i> of BRRI dhan83 in the hill districts during B. Aus, 2022 under GoB</b>	
2.3	No. of SPDP: 42; Area/SPDP: 1 bigha  Varieties name: BRRI dhan83.  Location: 6 upzillas of 3 hilly districts (Khagrachari, Rangamati, Banderban).	A total of 19,236 kg grains was produced from all demonstrated plots and 1890 kg quality seeds were retained by the farmers for the next year use. A total of 378 farmers were motivated and showed their interest to cultivate these varieties in the next year.
<b>Title</b>	<b>SPDP in the Valley of the Hill districts during T. Aus 2022 under GoB</b>	
2.4	No. of SPDP: 6 ; Area/SPDP: 1 bigha  Varieties name: BRRI dhan48, BRRI dhan82 and BRRI dhan98.  Location: 6 upzillas of 3 hilly districts (Khagrachari, Bandarban and Rangamati)	A total of 11,242 kg grains was produced from all demonstrated plots and 928 kg quality seeds were retained by the farmers for the next year use. A total of 153 farmers were motivated and showed their interest to cultivate these varieties in the next year.
<b>Title</b>	<b>Special program of BRRI hybrid dhan7 for rapid dissemination in the different locations of Bangladesh in T. Aus, 2022 under GoB.</b>	
2.5	No. of demonstration: 35; Area/SPDP: 1 bigha Varieties name: BRRI hybrid dhan7. Location: 21 upzillas of 8 districts (Gazipur, Gaibandha, Manikganj, Chattagram, borguna, Bhola,	A total of 30,205 kg grains was produced from all demonstrated plots and Farmers did not retained any seed after

	Pirojpur and Jhalokathi) Location: Khagrachari, Rangamati and Bandarban.	harvesting, as because hybrid seed cannot be used in the next season. A total of 735 farmers were motivated and showed their interest to cultivate BRRI hybrid dhan7 in the next year.
<b>Title</b>	Special program of BRRI hybrid dhan7 for rapid dissemination in the hill tract region of Bangladesh during T. Aus, 2022 under GoB.	
2.6	No. of demonstration: 12; Area/SPDP: 2 bigha  Varieties name: BRRI hybrid dhan7.  Location: 6 upzillas of 3 districts (Bandarban, Rangamati and Khagrachari)	A total of 9,216 kg grains was produced from all demonstrated plots and Farmers did not retained any seed after harvesting, as because hybrid seed cannot be used in the next season. A total of 156 farmers were motivated and showed their interest to cultivate BRRI hybrid dhan7 in the next year.
<b>Title</b>	SPDP during T. Aman 2022 under GoB	
2.7	No. of SPDP: 710; Area/SPDP: 1 bigha Variety: BRRI dhan52, BRRI dhan71, BRRI dhan72, BRRI dhan75, BRRI dhan78, BRRI dhan80, BRRI dhan87, BRRI dhan93, BRRI dhan94, BRRI dhan95. Location: 30 upazilas of 15 districts (Tangail, Gazipur, Narshingdhi, Manikganj, Kishoreganj, Netrokona, Mymensingh, Gaibandha, Sherpur, Bagerhat, Pirozpur, Chattagram, Cox's Bazar, Khagrachari, Rangamati and Bandarban).	A total of 4,77,273 kg grains was produced from all demonstrated plots and 55,023 kg quality seeds were retained by the farmers for the next year cultivation. A total of 13,569 farmers were motivated and showed their interest to cultivate these varieties in the next year.
<b>Title</b>	BRRI Hybrid Varieties Dissemination Program in T. Aman 2022.	
2.8	No. of demonstration: 46; Area/SPDP: 1 bigha  Varieties name: BRRI Hybrid dhan4 and BRRI Hybrid dhan6.  Location: 23 upazilas of 12 districts (Gazipur, Narshingdhi, Manikganj, Kishoreganj, Netrokona,	A total of 13,923 kg grains was produced from all demonstrated plots. About 1525 farmers farmers acquired awareness and knowledge about the varieties through field visits, discussion and knowledge

	Mymensingh, Gaibandha, Chattagram, Cox's Bazar, Khagrachari, Rangamati and Bandarban).	sharing were and around 874 farmers were motivated and showed their interest to cultivate these varieties in the next year.
<b>Title</b>	Seed Production and Dissemination Program (SPDP) during T. Aman, 2022 under TRB.	
2.9	No. of SPDP: 78 ; Area/SPDP: 1 bigha Varieties name: BRRI dhan75, BRRI dhan87, BRRI dhan94 and BRRI dhan95. Location: 20 upazila of 12 districts (Gazipur, Netrakona, Mymensingh, Tangail, Kishoreganj, Chuadanga, Jhenidah, Khulna, Bagura, Gaibandha, Narsingdhiand Bandarban).	A total of 56,538 kg grains was produced from all demonstrated plots and 9,120 kg quality seeds were retained by the farmers for the next year use. A total of 970 farmers were motivated and showed their interest to cultivate these varieties in the next year.
<b>Title</b>	SPDP during Boro 2022-23 under GoB	
2.10	No. of SPDP: 72; Area/SPDP: 1 bigha Variety: BRRI dhan67, BRRI dhan74, BRRI dhan81, BRRI dhan84, BRRI dhan88, BRRI dhan89, BRRI dhan92, BRRI dhan96, BRRI dhan99 and and Bongabondhu dhan100. Location: 28 upazilas of 14 districts (Tangail, Gazipur, Narshingdhi, Manikganj, Kishoreganj, Mymensingh, Netrokona, Sherpur, Bagerhat, Gaibandha, Khagrachari, Bandarban, Rangamati and Cox's Bazar).	A total of 7,98,265 kg grains was produced from all demonstrated plots and 1,10,817 kg quality seeds were retained by the farmers for the next year cultivation. A total of 15,889 farmers were motivated and showed their interest to cultivate these varieties in the next year.
<b>Title</b>	BRRI Hybrid Varieties Dissemination Program in Boro 2022-23.	
2.11	No. of demonstration: 56; Area/SPDP: 1 bigha Varieties name: BRRI Hybrid dhan3 and BRRI Hybrid dhan5.  Location: 28 upazilas of 14 districts (Tangail, Gazipur, Narshingdhi, Manikganj, Kishoreganj, Mymensingh, Netrokona, Sherpur, Bagerhat, Gaibandha, Khagrachari, Bandarban, Rangamati and Cox's Bazar).	A total of 28,706 kg grains was produced from all demonstrated plots. About 1234 farmers farmers acquired awareness and knowledge about the varieties through field visits, discussion and knowledge sharing were and around 552 farmers were motivated and showed their interest to cultivate these varieties in the next

		year.
<b>Title</b>	SPDP in the Valley of Chattagram hill tract region in Boro 2022-23 under GoB.	
2.12	No. of SPDP: 736; Area/SPDP: 1 bigha Variety: BRRI dhan74, BRRI dhan88, BRRI dhan89, BRRI dhan92, BRRI dhan96, BRRI dhan99 and Bongabondhu dhan100.  Location: 6 upazilas of 3 hill districts (Khagrachari, Bandarban and Rangamati).	A total of 48,735 kg grains was produced from all demonstrated plots and 4415 kg quality seeds were retained by the farmers for the next year cultivation. A total of 759 farmers were motivated and showed their interest to cultivate these varieties in the next year.
3.0	<b>Promotional Activities</b>	
<b>Title</b>	<b>Farmers' Training on Rice production technology</b>	
3.1	ARD conducted 71 farmer's training under GoB and one project (TRB) at different locations of the country.	A total of 2,130 trainees (1,923 farmers and 207 SAAOs of DAE) were participated Farmers' training during the reporting period of 2022-23. They were trained up and updated their knowledge and skill on modern rice technologies.
<b>Title</b>	<b>Field day</b>	
3.2	ARD conducted 70 field days at different locations in different seasons of the country under GoB and one project (TRB).	Around 7,000 farmers participants ants including farmers, local leaders and DAE personnel were participated in the field days. These programs also generated much enthusiasm about modern rice production technologies and BRRI varieties which helped rapid dissemination of technologies.
<b>Title</b>	<b>Seed Production at BRRI farm</b>	
3.3	Quality seeds of promising rice varieties were multiplied in Aman 2022 and Boro 2022-23 at BRRI farm of Adaptive Research Division.	A total of 6,169 kg quality seeds of BRRI varieties were produced which were used to conduct research activities and dissemination program.

<b>Title</b>	<b>Seed support to farmers and stakeholders</b>	
3.4	After utilization of the seeds in the pre-set program, the rest of the truthfully labeled seeds (TLS) of modern rice varieties was distributed to the farmers and stakeholders with free of cost under TRB project.	Adaptive research division distributed 10.28 tons seeds among the farmers and stakeholders. Around 250 farmers will be benefitted through getting seed and technologies directly and indirectly.
<b>Title</b>	<b>Establishment of Farmers seed center under TRB.</b>	
3.5	A total of eight seed centers for farmers were established at different project implementing areas of the country in T. aman 2022 and Boro 2022-23. ARD provided plastic drums in each farmers' seed center for preservation of good quality seed of promising rice varieties by Farmers.	48 plastic drums were provided in 08 seed center of 6 districts. Around 80 kg seeds were preserved in each drum.
	<b>Training Division</b>	
	<b>1. Technology Transfer through training</b>	Knowledge and skill of the trained personnel of the subject matter will be increased.
	<b>1.1 Two months Rice Production Training for BRRI Scientists</b> Participants: BRRI Scientist No. of participants: 30 Duration: 1- months Batch: 01 Progress: Completed	Trained scientists could able to identify and solve problems of rice cultivation. Capable to do research planning, program development and report writing. They can also understand the present and future challenges of rice research and prepared themselves accordingly.
	<b>1.2. Training on Modern Rice Production Technologies for SAAO (Yield maximization)</b> Participant : SAAO (DAE) No. of participants: 400 Duration: 1 week Batch: 16	Trained SAAO will be able to identify and solve field problems of rice cultivation and help the farmers to increase productivity.

	Progress: Completed	
	<b>1.3. Training on research data management using spread sheet</b> Participant: BRRRI Scientists No. of participants: 30 Duration: 1 week Batch: 01 (Completed)	Knowledge of the participant's on data management will be enriched.
	<b>1.4. Training on advance research data management using R</b> Participant : BRRRI Scientists No. of participants: 30 Duration: 1 week Batch: 01 (Completed)	Knowledge and skill of the participants on scientific article writing will be enriched
	<b>1.5. One month training on modern rice production technologies</b> Participant : DAE Officers No. of participants: 30 Duration: One month Batch: 1 (Completed)	Trained officers could able to identify and solve problems of rice cultivation. Capable to transfer the knowledge to the farmers and SAAO on rice cultivation. They can also understand the present and future challenges of rice research and prepared themselves accordingly.
	<b>BRRRI Regional Station, Sirajganj</b>	
1.	Determination of optimum dose of nitrogen and seedling number on growth and yield of Bangabandhu dhan100 in Sirajganj	120 kg N/ha is suitable for growth and yield of Bangabandhu dhan100 and there was no significant effect of seedling number on yield
2.	Determination of optimum dose of nitrogen on growth and yield of BRRRI dhan87 in in Sirajganj	90 kg N/ha is suitable for growth and yield of BRRRI dhan87

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 <sup>-1</sup> produced similar yield with full recom. fertilizer in Aman season and biochar @ 4 t/ha with recom. fertilizer resulted in the highest yield of BRRRI dhan89 in Boro season.
4.	Effect of transplanting date and spacing on the yield of different short duration rice varieties.	Number of panicle/hill and higher yield was observed when BRRRI dhan71 transplanted on 16 August irrespective of plant spacing in T. Aman 2022
5.	Response of latest BRRRI varieties and management practices in Char land areas of Sirajganj	In both seasons, BRRRI recommended practices gave statistical higher yield over the farmer's practices in Boro season. However highest yield was obtained from BRRRI dhan52 & BRRRI dhan92 in T. Aman & Boro season respectively among the tested varieties in both management practices.
<b>Regional Station, Sonagazi</b>		
<b>Season: Aus 2022</b>		
1	Stability Analysis of BRRRI developed rice varieties in Aus 2022	Stability data of the BRRRI developed Aus rice varieties in coastal region of Bangladesh
2	RYT-1 Favorable condition	To get suitable line for ALART
3	RYT-2 Non saline tidal condition	To get suitable line for ALART
4	PVT Tidal Submergence	To recommend for new variety
5	Seed Production and Dissemination Program (SPDP) during Aus 2022 under GOB	Rapid dissemination of newly released rice varieties
6	Mechanization BD48 & 98	Enhance farmers interest on

		mechanization
7	Breeder Seed Production of BD48, 98	To supply breeder seed
8	TLS Production	To supply TLS
9	Demonstration of BRRi hybrid dhan7	Dissemination of BRRi hybrid dhan7
	<b>Season: Aman 2022</b>	
10	Crossing of BR49, 52, 87, 94 & 103 with Rajashail and Kajalshail	Development of new advance line suitable for costal region of Bangladesh
11	Time of Planting (SD)	Best possible transplanting time for short duration varieties in southern region of Bangladesh will be identified
12	Time of Planting (LD)	Best possible transplanting time for long duration varieties in southern region of Bangladesh will be identified
13	Yield maximization	To get suitable fertilizer dose for maximum yield
14	Stability Analysis of BRRi Varieties	Stability data of the BRRi developed Aus rice varieties in coastal region of Bangladesh
15	Chemical Control of False Smut	Best chemical for false smut control will be identified
16	Evaluation of Tungro resistant lines	Best performing Tungro resistant advance lines will be identified
17	Multilocation trial of Promising Hybrid entries	Newly developed promising hybrid entries will be identified
18	Multilocation trial of Promising Hybrid entries	Newly developed promising hybrid entries will be identified
19	AGGRi Net Trial (ANT)	Highly saline resistant advance lines will be identified
20	QTL analysis of Saline tolerant lines AGGRi-NET	Phenotypic data of the advance lines will be obtained

21	PVT (Sallow Deep Water)	To recommend for new variety
22	RYT RLR	To get suitable line for ALART
23	RYT ZER	To get suitable line for ALART
24	RYT (Short slender)	To get suitable line for ALART
25	RYT (Swarna and long slender type)	To get suitable line for ALART
26	RYT (Dev. of disease resistant rice)	To get suitable line for ALART
27	RYT (Tidal non-saline/Stagnant water)	To get suitable line for ALART
28	RYT STR-1	To get suitable line for ALART
30	RYT STR-2	To get suitable line for ALART
31	RYT STR-1	To get suitable line for ALART
32	RYT STR-2	To get suitable line for ALART
33	ALART (STR)	To recommend advance lines for PVT
34	ALART (STR)	”
35	ALART (PQR)	”
36	Re-ALART (Submergence tolerant rice SubTR-LD)	”
37	Re-ALART (Submergence tolerant rice SubTR-LD)	”
38	Cost effective weed management	cost effective weed management strategy will be identified
39	Survey and monitoring of rice diseases in Aman 2022	Disease prevalence data of Chattogram and Rangamati region will be obtained
40	Breeder Seed Production	To supply breeder seed
41	TLS Production	To supply TLS
42	Seed Production and Dissemination Program (SPDP) during Aman 2022 under GOB	Rapid dissemination of newly released rice varieties
43	Seed Production and Dissemination Program (SPDP) during Aman 2022 under TRB	”
44	Seed Production and Dissemination Program (SPDP) during Aman 2022 under HHAT	”
45	Farmers Training on Rice Technologies 2022-23	Farmers knowledge on modern rice production technologies will be increased thus yield will be increased

46	Field Day 2022-23	Farmers awareness and interest among the varieties will be increased.
	<b>Regional Station, Bhanga</b>	
	<b>Program Area:</b> Varietal development, Farming Systems Research, Crop-soil-water management, Socio economics and Technology transfer	
1.	Breeding for developing high yielding Transplanting Aman rice varieties (Hybridization)	In Aman 2023 season, 6 crosses were made and 110 F <sub>1</sub> 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, 5 crosses were made and 368 F <sub>1</sub> seeds were produced with desirable characters with emphasis on kneeing ability, nodal tillering, earliness and awnless good grain quality.
3.	Breeding for developing Anoxia tolerant rice varieties	For developing Anoxia tolerant rice varieties 2 crosses were made and 103 F <sub>1</sub> seeds were produced.
	Breeding of high yielding rice varieties for high input responsive in single boro favorable ecosystem	For developing high yielding rice varieties for high input responsive in single Boro favorable ecosystem 21 crosses were made and 833 F <sub>1</sub> seeds were produced
4.	Confirmation of F <sub>1</sub> s	A total of 19 crosses were confirmed out of 21 crosses during T. Aman 2022-23 8 (Eight) crosses were confirmed during Boro 2022-23

5.	FRGA	<p>During Aman 2022-23 total 2549 segregating progenies from 32 crosses of F<sub>3</sub>-F<sub>4</sub> generation were grown following Field Rapid Generation Advanced (FRGA) technique and 2221 progenies of F<sub>4</sub>-F<sub>5</sub> generation were harvested.</p> <p>In Boro 2022-23 a total of 790 segregating progenies of F<sub>2</sub>, F<sub>3</sub> and F<sub>5</sub> generation were grown following FRGA technique and 633 progenies of F<sub>3</sub>, F<sub>4</sub> and F<sub>6</sub> generation were harvested.</p>
6.	Proposed Variety Trial (PVT) for inbred rice variety, T. Aman 2022 and Boro 2022-23	<p>Four sets of inbred trials were conducted under BRRI Regional Station Bhanga during T. Aman 2022-23. In Proposed Variety Trial (PVT), four sets of inbred trials were conducted under BRRI Regional Station Bhanga during T. Aman 2022-23. Among four sets, two sets (Set-I and II for deep water Aman rice) were established at Rashidpur (on farm condition) and two sets (Set-III and IV for high yielding Aman rice) were established at BRRI Bhanga. In Set- I, test entry I-044 was tested against check entry I-046 and gave higher yield (3.354 t/ha) than the check entry (3.144 t/ha). Growth duration of the test entry was 197 days whereas the check entry was 160 days.</p> <p>In Set- II, test entry I-045 was tested against check entry I-046 and gave higher yield (3.7 t/ha) than the check</p>

		<p>entry (3.143 t/ha). The test entry had growth duration of 197 days whereas the check entries was 160 days.</p> <p>In Set- III, test entry I-047 was tested against check entry I-048 and gave higher yield (6.38 t/ha) than the check entry (4.92 t/ha). Both the entries had similar growth duration.</p> <p>In Set- IV, test entry I-049 was tested against check entry I-050 and gave lower yield (5.47 t/ha) than the check entry (5.524 t/ha)</p> <p>Four sets (Set-I, Set-II, Set- III and Set-IV) of inbred trial (Boro 2022-23) were carried out at BRRRI Bhanga, Faridpur.</p> <p>Set-I: One advanced breeding line I-053 along with check I-054 were tested. The line I-053 produced 7.3 t/ha which was 9.4% lower yield than the check variety coded as I-054 (8.06 t/ha).</p> <p>Set-II: One advanced breeding line I-055 was evaluated along with check I-056. Both the entries gave similar yield (7.51 t/ha). The test entry I-055 was almost 15 days late than the check entry I-056.</p> <p>Set-III: One advanced breeding line I-057 along with check I-058 were tested. The line I-057 (7.914 t/ha) gave 10.02 % higher yield than the check I-058 (7.193 t/ha). Both the entries had similar growth duration.</p> <p>Set-IV: One advanced breeding line I-</p>
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		<p>059 along with check I-060 were tested. The line I-059 (9.38 t/ha) gave 13.42 % higher yield than the check I-060 (8.27 t/ha) (Table 6). The test entry I-059 was almost 10 days late than the check entry I-060.</p>
7.	ALART (Deep Water Aman, 2022)	<p>Two ALARTs were implemented during T. Aman 2022-23, where six (6) entries of deep water rice were evaluated against local check Fulkari at on farm condition in Rashidpur, Bhanga, Faridpur. All six entries gave higher yield than the check Fulkari. Test entry BR9392-6-2-1B gave the highest yield of 4.31 t/ha, followed by entry BR10230-7-19-2B which also gave higher yield (4.09 t/ha) than Fulkari (1.82 t/ha). Growth duration of all the entries varied from 160-162 days. Due to severe drought, the test entries did not face any water stress at all.</p> <p>Two advanced breeding lines of premium quality rice were evaluated against BRRI dhan34 and BRRI dhan70. Two advance breeding lines BR8493-3-5-1-P1 and BR9590-45-1-3-2-P2 were evaluated against two checks BRRI dhan34 and BRRI dhan70. All two entries gave lower yield due to severe drought stress. None of the entries out yielded the checks and BR8493-3-5-1-P1 was badly infected by false smut disease.</p>

8.	ALART (Boro, 2022-23)	<p>Five ALART sets were established in farmer's field under the supervision of BRRi Bhanga during Boro 2022-23.</p> <p>In ALART FBR_SD, rat damage was observed in different replications of different entries yet among the four test entries, three of them produced higher yield than both check entries; BRRi dhan81 and BRRi dhan96. In ALART, BRR_Re-ALART, some bird damage was found along with the infection of blast disease, BR(Path)13784-BC3-63-6-4-HR6 suffered severe rat damage yet among the four test entries, three of them produced higher yield than both check entries. In ALART_BRR, entries were lodged due to the occurrence of storm at early maturity stage. Severe blast infection was found in the check entries-BRRi dhan29 and BRRi dhan89. Among the four test entries advanced line BR12454-BC2-75-32-31-39-7 produced higher yield than the check varieties. In FBR_Barishal, four test entries along with two check entries were evaluated and around 5% rat damage was observed in overall all entries. In ALART FBR_MD both the test entries produced higher yield than both checks.</p>
9.	Regional Yield Trial (RYT), Aman 2022	<p>One Deep water rice RYT trial from Habiganj was established in BRRi Bhanga station. Three advanced breeding</p>

		<p>lines along with one check varieties viz. BRRI dhan91 were evaluated. Yield of all test entries varied from 0.63-1.61 t/ha and growth duration varied from 149-156 days. 90% lodging was observed in BR7919-1-1-3B. BR7730-1-1-2B, BR7919-1-1-3B were severely damaged by rat. About 50-70% rat damage was observed in these two entries. Overall all entries including the check showed poor yield due to low soil fertility level. BR7919-1-1-3B gave higher yield (1.61 t/ha) than the check BRRI dhan91 (1.44 t/ha) .</p>
10.	Regional Yield Trial (RYT), Boro 2022-2023	<p>Fourteen RYT from different breeding programs were established and evaluated in BRRI Bhanga namely, FBR_Barishal, Antioxidant enriched rice- MD, Antioxidant enriched rice- SD, Water saving rice, SHR_Zirashail, Haor Rice, DRR_BB, DRR_Blast, Salt tolerant rice, Favorable Boro_LD, Favorable Boro_MD, Favorable Boro_SD, Favorable Boro_ELS, Zinc enriched rice. In RYT_Antioxidant rice_MD among eight test entries only one entry produced higher yield (8.2 t/ha) than both the check entries BRRI dhan88 (7.6 t/ha) and Indonesian Black Rice (6.7 t/ha). In RYT_Antioxidant rice_SD, three test entries were evaluated and none of them produced higher yield than the one check</p>

		<p>entry- BRRi dhan84 (7.5 t/ha). Entries of RYT_Water saving rice suffered due to poor soil fertility yet both test entries BR11204-5B-224 (5.4 t/ha) and BR11206-5B-351 (4.7 t/ha) gave higher yield than the check BRRi dhan58 (4.0 t/ha). In RYT_FBR_Barishal, among nine test entries, four test entries NGR 270-3 (9.0 t/ha), NGR 522-2 (9.5 t/ha), NGR 968-1 (9.2 t/ha) and NGR 994-1 (9.1 t/ha) gave higher yield than both the checks BRRi dhan88 (7.3 t/ha) and BRRi dhan89 (8.8 t/ha). In RYT_Zirasail among five, four of the test entries gave higher yield than both the checks. In RYT_Haor, one test entry BR9392-6-2-1B showed photosensitivity hence did not flower and out of other five entries, four of them gave higher yield than the check BR18. In RYT_DRR_BB among eighteen, six advanced lines gave higher yield than the checks. In RYT_DRR_Blast among ten, four advanced lines gave higher yield than the checks. In RYT_STR all seven advanced lines produced higher yield than the check varieties. In RYT_ZER among three advanced line BR9674-1-4-1-3-P2 gave higher yield than the check varieties. In RYT_FBR_SD among nine, five advanced lines produced higher yield than the checks. In RYT_FBR_MD</p>
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		among nine, five advanced lines produced higher yield than the check varieties. In RYT_FBR_ELS among six advanced line BR7528-2R-19-16-RIL-52 gave higher yield than the checks. In RYT_FBR_LD among five advanced line BR11318-5R-84 resulted higher yield than the check varieties.
11.	Collection and Characterization of local rice landraces	A total of 10 local landraces and popular hybrid rice germplasm were collected in 2022-23
12.	Screening and identification of anaerobic germination (AG) tolerance rice germplasm of Bangladesh.	Forty two germplasm were screened in order to identify anaerobic germination (AG) tolerant rice germplasm. Out of 42 genotypes, six genotypes viz. IR18R1073, Indrasail, Khirari, Lal Aman, Nizersail showed more than 50% survivability. Survivability of these germplasm varied from 0-75%. Among the advanced lines suitable for direct seeding rice, survivability varied from 0-55%, <i>AG1</i> and <i>AG2</i> QTLs introgressed lines showed around 14% survivability whereas Bangladeshi local landraces showed highest survivability. Shishumoti and Lal Aman had a survivability of 75% and 69%, respectively.
13.	Head to Head Trial: VRS (Variety Replacement Strategy)	In T. Aman season, 2022, Binadhan-22 produced the highest yield (6.18 t/ha) followed by BRRI dhan3, Binadhan-17 and Binadhan-16 with growth duration of 115 days, 116 days, 116 days and 103

		<p>days, respectively. Another, location of head to head Trial, BRRi dhan75 gave the highest yield (5.68-6.6 t/ha) followed by BRRi dhan71 (5.52-6.19 t/ha).</p> <p>In Boro season 2022-23, for short duration rice varieties BRRi dhan74 produced the highest yield (8.43 t/ha) followed by BAU dhan-3, Binadhan-25 and BRRi dhan88 with growth duration of 147 days, 148 days, 143 days and 145 days, respectively.</p>
14.	Effects of planting time on <i>Aus</i> rice in Charland area of Faridpur, Bangladesh	<p>Grain yield of BRRi dhan82 planting on 5 April gave significantly higher irrespective of planting time and varieties. The minimum growth duration was found in local varieties Porangi compared to inbred varieties BRRi dhan82 and BRRi dhan83.</p>
15.	Development of weed control techniques in Boro-Fallow-Fallow cropping pattern	<p>BRRi dhan89 exhibited no significant effect on grain yield in the combination of herbicide application and hand-weeding treatments. The lowest weed density was found in three hand weeding and pre-emergence herbicide + post-emergence herbicide + hand weeding treatments.</p>
19.	Stability of yield of BRRi released Aman varieties	<p>For short duration Aman varieties, BRRi dhan39, BRRi dhan66 and BRRi dhan71 produced 4.48 t ha<sup>-1</sup>, 3.90 t ha<sup>-1</sup> and 3.76 t ha<sup>-1</sup> which was higher yield than other varieties like BRRi dhan33. In medium duration <i>Aman</i> varieties based on yield</p>

		BRRi dhan78 produced highest grain yield 5.74 t ha <sup>-1</sup> followed by BRRi dhan52 and BRRi dhan72. In long duration T. Aman varieties BRRi dhan34 yielded high (4.25 t ha <sup>-1</sup> ) followed by BR10 and BR22.
20.	Stability of yield of BRRi released Boro varieties	In Boro season, among the short duration varieties, the highest yield was found in BRRi Hybrid dhan5 (9.65 t/ha) followed by BRRi Hybrid dhan3 (8.92 t/ha), BRRi Hybrid dhan2 (8.49 t/ha) and Bangabandhu dhan100 (8.31 t/ha). In long duration Boro varieties, BRRi dhan92 produced the highest (8.95 t/ha) yield followed by BRRi dhan99 (8.60 t/ha) and BRRi dhan89 (8.59 t/ha) respectively.
21.	Introduction of intercropping system in different cropping pattern for medium high land area in Faridpur region	Among the tested cropping patterns, the highest rice equivalent yield (31.63 t/ha) was found in CP <sub>2</sub> (Onion+Pumpkin (Relay)-Jute-T. Aman) which was statistically different from the others. The highest gross margin (4,02,040 Tk/ha) was also found in CP <sub>2</sub> (Onion+Pumpkin (Relay)-Jute-T. Aman) cropping pattern followed by CP <sub>3</sub> (3,81,920 Tk/ha) and CP <sub>4</sub> (3,64,850 Tk/ha) cropping patterns.
22.	Demonstration of modern rice varieties in Aman and Boro seasons in greater Faridpur region	A total of 620 demonstrations (50 demo in T. Aus, 120 demo in T. Aman and 450 in Boro seasons) using modern rice BRRi varieties during T. Aus, T. Aman

		<p>2022 and Boro 2022-23 were carried out in different farmers' fields of 24 upazila of 4 districts (Faridpur, Madaripur, Rajbari and Shariatpur) under BIRRI RS, Bhanga, Faridpur.</p> <p>In T. Aus 2022 season, among different BIRRI released modern T. Aus varieties, BIRRI Hybrid dhan7 produced highest average grain yield 5.41 t/ha in 112 days growth duration followed by BIRRI dhan98 and BIRRI dhan83.</p> <p>Mean grain yields with growth duration of T. Aman 2022 varieties were: 5.91 t/ha with 130 days for BIRRI dhan87 followed by BIRRI Hybrid dhan6, BIRRI dhan75 and BIRRI dhan39.</p> <p>In Boro 2022-23, among the short duration varieties, BIRRI dhan96 produced the highest average grain yield (7.08 t/ha) in 145 days growth duration followed by BIRRI dhan88 and BIRRI dhan67. Maximum number of trials were yielded between 6.0-7.0 t/ha for short duration Boro varieties. In case of medium duration (146-154 days) Boro varieties the highest average grain yield was found in Bangabandhu dhan100 (7.32 t/ha with GD of 148 days) followed by BIRRI dhan74 and BIRRI dhan58. Among the long duration (155-</p>
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		160 days) varieties BRRI dhan92 produced the highest average grain yield followed by BRRI dhan89.
23.	Training	Total 16 training programs where 480 participants consisting of farmers, DAE personnel and mechanics of greater Faridpur region took part in the training on 'modern rice production technologies' with the cooperation of DAE under the financial assistance of GOB.
	<b>Regional Station, Barishal</b>	
01	Hybridization (T. Aman)	43 crosses made using 30 parents to develop rice varieties adaptive to non saline tidal ecosystem
02	F1 confirmation (T. Aman)	23 F1 genotypes out of 27 were confirmed based on phenotypic observation to develop rice varieties adaptive to non saline tidal ecosystem
03	F2 population (Pedigree) (T. Aman)	257 progenies from 24 crosses were selected
04	F3 population (Pedigree) (T. Aman)	600 progenies from 24 crosses were selected
05	Observational yield trial (OYT) (T. Aman)	36 genotypes were selected out of 213 comparing with 4 standard checks
06	Preliminary yield trial (PYT) (T. Aman)	4 genotypes were selected out of 11 comparing with 5 standard checks
07	Advanced Yield Trial (AYT-1) (T. Aman)	None of the genotypes were selected due to climatic hazard (Retrial is needed)
08	Advanced Yield Trial (AYT-2) (T. Aman)	None of the genotypes were selected due

		to climatic hazard (Retrial is needed)
08	Advanced Yield Trial (AYT-3) (T. Aman)	None of the genotypes were selected due to climatic hazard (Retrial is needed)
09	Hybridization (Boro)	43 crosses made using 20 parents to develop rice varieties adaptive to favorable ecosystem
10	F1 confirmation (Boro)	23 F1 genotypes out of 27 were confirmed based on phenotypic observation to develop rice varieties adaptive to favorable ecosystem
11	F4 population (Boro)	1516 progenies from 44 crosses were selected
12	F6 population (Boro)	304 progenies from 05 crosses were selected and bulked for further evaluation
13	F2 population (Hybrids) (Boro)	185 genotypes from 44 plant progenies were selected
14	F6 population (Hybrids) (Boro)	1042 genotypes from 47 plant progenies were selected
15	Observational yield trial (OYT) (Boro)	49 genotypes were selected out of 245 comparing with 5 standard checks
16	Preliminary yield trial (PYT)	05 genotypes were selected out of 15 comparing with 4 standard checks
17	AYT#1 (NGR) (Boro)	None genotypes were selected
18	AYT#2 (NGR) (Boro)	6 genotypes were selected out of 18 comparing with 3 standard checks
19	AYT#3 (NGR) (Boro)	5 genotypes were selected out of 18 comparing with 3 standard checks
20	AYT#4 (NGR) (Boro)	5 genotypes were selected out of 17 comparing with 4 standard checks
21	RYT# Barishal-1 (Boro)	None genotypes found out-yielded over

		highest yielded check
	<b>Regional Station, Rajshahi</b>	
1.0	<b>Varietal Development Program</b>	
1.1	Hybridization	In T. Aman, 947 F1 seeds were produced from 12 crosses In Boro, a total of 555 F1 seeds were produced from 9 crosses
1.2	F1 confirmation	15 crosses confirmed as true F <sub>1</sub> s.
1.3	Growing RGA Population	In total 24,000 individual progenies were harvested from rapid generation advanced of segregating populations of F <sub>2</sub> -F <sub>5</sub> generations
1.4	Regional Yield Trial	36 RYT were conducted and 40 genotypes were selected for further advancement
1.5	Collection and maintenance of local landraces	Enriching local germplasm for further research advancement
2.0	<b>Rice Farming System</b>	
2.1	Evaluation of Zero Tillage Mustard Based Cropping Patterns in Rajshahi region	Considering system yield and productivity, the higher REY (15.69 t/ha) was found in CP <sub>1</sub> followed by CP <sub>3</sub> (15.09 t/ha). Out of four, mustard based cropping patterns like CP <sub>1</sub> , CP <sub>2</sub> and CP <sub>3</sub> gave higher rice equivalent yield (REY) than the existing one. On the other hand, rice equivalent yield (REY) of zero tillage mustard based cropping pattern like CP <sub>2</sub> and CP <sub>3</sub> are closer to CP <sub>1</sub> .
2.2	Evaluation of three and four cropped cropping patterns for Rajshahi region	Considering cropping system yield and

		<p>productivity, the highest rice equivalent yield (26.33 t ha<sup>-1</sup>) was observed in Mustard-Boro-Vegetable-T.Aman treatment followed by Mustard-Boro-Aus-Blackgram cropping pattern and the lowest value (13.39 t ha<sup>-1</sup>) was recorded in Boro (BRRI dhan92)-Fallow -T. Aman (BRRI dhan71) cropping pattern. Therefore, it was observed that systemic yield of cropping pattern is higher in rice-non rice cropping pattern than rice-rice cropping pattern. On the other hand, if high valued crops like mustard, blackgram, vegetables etc are cultivated in farmer's practiced rice-rice cropping pattern, systemic yield as well as profitability will increase.</p>
	<b>Regional Station, Satkhira</b>	
	Regional Yield Trial (RYT) for Short/Medium Durated Rice (SD/MD) (RYT- SD/MD)	IR19A1788 performed better over the highest yielder check, BRRI dhan87 but they are identical to each other, specifically grain yield in RYT
	Regional Yield Trial (RYT) for Rainfed Lowland Rice (RYT-RLR)	BR10475-1-2-3-5-5 was statistically similar to all the checks except BRRI dhan71 for grain yield.
	Regional Yield Trial (RYT) for Swarna and Long Slender Type	The entry BR9396-6-2-2B and BR10238-5-1-4-2 performed better over the two checks but they are the statistically similar to each other for the

		grain yield
	Regional Yield Trial for Short Slender Grain Type (RYT-SS)	The entry BRH13-2-14-2-1B gave statistically higher yield over the check, BRRi dhan49
	Regional Yield Trial for Development of Zirashail Type Grain	In RYT-Zirashail type grain, no entry performed statistically better over the local check
	Regional Yield Trial for Development of Zinc Enriched Rice (RYT-ZER)	The entry, BR9674-1-4-1-3-P1 gave statistically higher yield over BRRi dhan74, BRRi dhan84 and BRRi dhan29
	Regional Yield Trial (Barishal) for Favorable Boro Rice (RYT-FBR#Bari)	The entry NGR 522-2 performed better statistically higher yields over BRRi dhan88 & BRRi dhan89
	Regional Yield Trial for Short Duration (RYT-SD)	The entry, BR12180-5R-17 and BR11900-5R-56 gave statistically higher yield over the two checks
	Regional Yield Trial for Premium Quality Rice-1 (RYT-PQR-1)	In RYT (PQR-1), the genotypes, Zira, Nachol & Miniket, Ballobpur performed better in terms of grain yield over the check varieties of BRRi dhan63 & BRRi dhan81
	Advanced Line Adaptive Research Trial (ALART) for Superior High Yielding (SHR-1) Zirashail Type	In ALART-SHR-1, the tested entry BRH13-2-4-7-2B and BRH10-1-14-6-2B showed statistically better yield compared to their respective check varieties. There was a little variation regarding growth duration among entries
	Advanced Line Adaptive Research Trial (ALART) for Superior High Yielding Rice (SHR-2) Extra-long and long slender	In ALART-SHR-2, the tested entry BR9392-1-9-7-5B showed statistically better yield over the check variety, BRRi dhan62. BR10247-14-18-4 was also

		good. It maybe also alternative to BRRI dhan62 although there are similar to each other
	Effect of missing nutrient on rice production in southern coastal area during T. Aman 2022 and Boro 2022-23	In T. Aman 2022, nutrient controlled plot and N omitted plot gave the lowest yield compared to other fertilizer treatments. Control plot (without fertilization) reduced the highest yield level of 35% followed by N omitted plot (30%), where other nutrient omitted plots reduced the yield level of 9-21% compared to complete fertilizer dose.
	Effects of Bio-coated urea on rice yield in Boro season in the south western costal ecosystem.	From the study report we may have hypothesized that bio-coated zeolite based urea granule may reduce reactive N loss, improve N fertilizer use efficiency along with crop productivity for sustainable rice production in saline soil.
	Stability Analysis of BRRI Varieties at Satkhira	
	Head-to-head adaptive trial (HHAT) of Modern Rice Varieties	BRRI dhan99 and Bangabandhu dhan100 might be suitable for southern Bangladesh and can be recommended for this area, but more trial should be needed for a concrete recommendation.
	<b>Regional Station, Habiganj</b>	
	Regional Yield Trial (Deep water rice), B. Aman 2022-23	The advanced breeding line BR7730-1-1-2B (2.79 t/ha) produced the highest grain yield followed by genotypes BR7919-1-1-3B (2.32 t/ha) and BR7918-

		1-2-3B (2.09) than the standard check BRR I dhan91 (1.94 t/ha) and local checks (1.59 – 2.07 t/ha)
	Regional Yield Trial for Tall materials, T. Aman 2022-23	Among these entries, the genotype BR10247-14-18-7-3B (5.56 t/ha) produced the highest grain yield followed by genotypes BR9892-8-2-2B (5.35 t/ha) and BR10238-5-1-9-3B (5.30) than the check BRR I dhan91 (3.42 t/ha)
	Regional Yield Trial (Short Slender) under recommended management practices, T. Aman 2022-23	The genotype BRH13-2-14-2-1B (5.19 t/ha and 131 days) produced the highest grain yield and 5 days earlier growth duration than the check BRR I dhan49 (5.03 t/ha and 136 days)
	Regional Yield Trial (Swarna and long slender type) under recommended management practices, T. Aman 2022	The genotype BR9392-6-2-3-4 (5.36 t/ha and 133 days) showed the highest grain yield with similar growth duration to the checks BRR I dhan94 (5.00 t/ha and 134 days) and BRR I dhan87 (5.05 t/ha and 136 days). Furthermore, the genotype BR10238-5-1-4-2 (5.01 t/ha and 135 days) produced a comparable grain yield and growth duration to the check BRR I dhan94 (5.00 t/ha and 134 days).
	Improvement of local popular cultivars, Boro 2022-23	A total of 12 crosses were made using seven indigenous cultivars (Pashushail, Tepi boro, Rata boro, Lal beruin, Kalo beruin, Pani beruin, & Mihi beruin) with two high-yielding varieties BRR I dhan88 and BRR I dhan92. A total of 1735 F <sub>1</sub> seeds were harvested during Boro 2022-

		23
	Observational Yield Trial (OYT#1-BPH), Boro 2022-23	The genotype BR12679-4R-111 (7.50 t/ha and 153 days) produced a higher grain yield but 8-11 days longer growth duration than the checks BRR1 dhan67 (6.33 t/ha and 145 days) and BRR1 dhan28 (5.52 t/ha and 142 days). Furthermore, the three genotypes BR12670-4R-93 (6.61 t/ha and 147 days), BR12679-4R-168 (6.62 t/ha and 147 days), and BR12682-4R-46 (6.71 t/ha and 148 days) produced a comparable grain yield and growth duration with the check BRR1 dhan67 (6.33 t/ha and 145 days).
	Observational Yield Trial (OYT#2-Barishal), Boro 2022-23	The two genotypes NGR 453-1 (6.97 t/ha and 139 days) and NGR 240-1 (7.28 t/ha and 138 days) produced a similar grain yield but 12 days earlier growth duration than the check BRR1 dhan89 (6.93 t/ha and 151 days). The nine genotypes (6.28 – 6.63 t/ha), gave a higher grain yield than the check BRR1 dhan67 (5.67 t/ha).
	Regional yield trial (RYT) for favorable Boro rice (FBR-Long duration), Boro 2022-23	Only the genotype BR11894-5R-260 (8.86 t/ha and 151 days) exhibited a significantly superior grain yield compared to all the check varieties (5.78-8.12 t/ha).
	Regional yield trial (RYT) for favorable Boro rice (FBR-Medium duration), Boro 2022-23	The genotype BR8899-14-4-1-2-2-1 (7.67 t/ha and 149 days) produced a

		similar grain yield but 8 days earlier growth duration than the check BRRIdhan89 (7.57 t/ha and 157 days).
	Regional yield trial (RYT) for favorable Boro rice (FBR-Short duration), Boro 2022-23	The tested entries did not exhibit superior performance in comparison to the check BRRIdhan96.
	Regional yield trial (RYT) for favorable Boro rice (FBR-ELS), Boro 2022-23	The four genotypes IR18A2102 (5.62 t/ha), BR10604-5R-58 (5.63 t/ha), BR7528-2R-19-16-RIL-55 (5.82 t/ha), and BR9994-5R-21 (6.31 t/ha) produced the highest grain yield than all the check varieties (4.80-5.28 t/ha).
	Regional yield trial (RYT) for favorable Boro rice (FBR-Barishal), Boro 2022-23	Five genotypes, namely NGR 418-1 (6.80 t/ha), NGR 994-1 (6.84 t/ha), NGR 522-2 (7.02 t/ha), NGR 745-2 (7.39 t/ha) and NGR 590-2 (7.44 t/ha) produced the highest grain yield but took 4-8 days longer growth duration than the check BRRIdhan88 (6.48 t/ha).
	Regional yield trial (RYT) for antioxidant-enriched rice black rice, Boro 2022-23	None of the genotypes performed superior to Indonesian black rice and BRRIdhan88 check varieties.
	Regional yield trial (RYT) for water saving rice (WS), Boro 2022-23	No genotype performed superior to the check BRRIdhan58.
	Regional yield trial (RYT-Tall) for haor areas, Boro 2022-23	The genotype BR9396-6-2-2B (5.60 t/ha and 146 days) exhibited the highest grain yield and 12 days earlier than the check BR18 (5.03 t/ha and 158 days) (Table 16). Furthermore, the genotype BR9392-6-2-1-3-4 (5.32 t/ha and 157 days) produced a higher grain yield and a

		comparable growth duration to the check BR18 (5.03 t/ha and 158 days).
	Regional yield trial (RYT) for zira type, Boro 2022-23	The three genotypes BR10247-4-7-4B (5.13 t/ha), BRH9-3-1-14-2B (5.33 t/ha), and BRH13-9-5-3B (6.33 t/ha) produced the highest grain yield than the checks BRRi dhan28 (4.10 t/ha) and Zirashail (4.39 t/ha).
	Regional yield trial (RYT) for Salt tolerant rice (STR), Boro 2022-23	The genotype BR11712-4R-12 (6.73 t/ha) gave a higher grain yield with similar growth duration compared to the tolerant check BRRi dhan99 (6.51 t/ha). Similarly, the genotype BR11712-4R-6 (6.10 t/ha) produced a higher grain yield but 4 days longer growth duration than the tolerant check BRRi dhan67 (5.77 t/ha).
	Regional yield trial (RYT) for disease-resistant rice (DRR-BB), Boro 2022-23	The genotype BR(Path)13800-BC3-8-7 (7.17 t/ha and 154 days) produced a similar grain yield and 3 days earlier growth duration than the check BRRi dhan92 (7.17 t/ha and 157 days). The genotype BR(Path)13800-BC3-224-28 (6.90 t/ha and 153 days) gave a higher grain yield with comparable growth duration than the checks BRRi dhan58 (6.49 t/ha and 153 days) and BRRi dhan101 (6.53 t/ha and 153 days).
	Regional yield trial (RYT) for disease-resistant rice (DRR-BB & Blast), Boro 2022-23	The genotype BR(Path)13800-BC3-110-4 (7.26 t/ha and 152 days) exhibited a

		higher grain yield and 3 days earlier growth duration than the check BRRIdhan89 (7.02 t/ha and 155 days). Similarly, the genotype BR(Path)13800-BC3-8-11 (7.05 t/ha and 151 days) produced a comparable grain yield but 4 days earlier growth duration than the check BRRIdhan89 (7.02 t/ha and 155 days).
	Regional yield trial (RYT) for zinc enriched rice (ZER), Boro 2022-23	The genotype BR9674-1-4-1-3-P1 (6.11 t/ha) produced a comparable grain yield but took 14 days longer to mature than the check BRRIdhan74 (6.03 t/ha)
	G x E interaction of Basmati rice on physio-chemical and cooking properties, Boro 2022-23	The entry Basmati (1230) (7.76 t/ha) produced the highest grain yield of all the checks (4.34-6.58 t/ha) (Table 22). Similarly, the genotype Indian Basmati (6.04 t/ha and 156 days) produced a significantly higher grain yield but 6 days longer growth duration than the check BRRIdhan50 (5.38 t/ha and 150 days).
	International Irrigated Rice Observational Nursery (IIRON), Boro 2022-23	The seven entries SV0202, SV0806, SV0434, SV0436, SV0856, SV0147, and SV0193 (7.33-7.67 t/ha) exhibited a higher grain yield than the check BRRIdhan101 (6.57 t/ha) but produced a similar grain yield with the check BRRIdhan67 (7.12 t/ha). Similarly, the grain yield of eleven entries (6.58-7.01 t/ha) was on par with the check BRRIdhan

		dhan101 (6.57 t/ha). A total of seven entries were selected for advancement to the yield trial stage.
	ALART (PQR), T. Aman 2022-23	None of the advanced lines was better.
	ALART_BRR, Boro 2022-23	None of the advanced lines was better.
	ALART_BRR Re, Boro 2022-23	Two advanced lines were recommended for further testing.
	ALART_FBR Barishal, Boro 2022-23	None of the advanced lines was better.
	ALART_FBR SD, Boro 2022-23	The advanced line BR11337-5R-72 (V2) was recommended for further testing.
	ALART_FBR MD, Boro 2022-23	The advanced line IR12A173 (V1) was recommended for further testing.
	ALART_SHR 1, Boro 2022-23	None of the advanced lines was better.
	ALART_SHR 2, Boro 2022-23	None of the advanced lines was better.
	Monitoring of insect pest and natural enemy incidence by using light trap	Among the insect pests, BPH population was found highest followed by GLH, green mirid bug and YSB. Highest peak of BPH, GLH and YSB were recorded in the month of October- November. Green mirid bug population was also increased according to the increase of BPH population. Among the natural enemies, Lady Bird Beetle (LBB) population were found highest followed by Carabid Beetle (CDB). Peak period of Lady Bird Beetle (LBB) and Carabid Beetle (CBB) was observed in the month of May.
	<b>Regional Station Rangpur</b>	

1	Development of rice varieties suitable in Rangpur region	10 germplasms were collected from farmers' field for maintenance breeding, ten single crosses were made and 109 progenies were bulked from 4F <sub>5</sub> , 2F <sub>6</sub> and 3F <sub>8</sub> generations during 2022-23
2	Breeding of Photoperiod-sensitive rice varieties (PSR) for lowland and Charland ecosystem	250 progenies from 2 F <sub>2</sub> populations were selected. Two genotypes were selected from OYT. BRrang13-1-9-8-2 produced 2.4 t/ha yields advantage over Gainja (3.8 t/ha).
3	Breeding for Second Generation Rice (SGR)	280 individual plants and four fixed genotypes were selected from observational yield trial under the program of breeding for second generation rice. In OYT, BRrang13-RGA-1-1-3 produced 9.48 t/ha which was higher than BRRRI dhan88 (7.05 t/ha).
4	Breeding for Basmati Rice	270 individual plants and five fixed genotypes were selected from OYT. BRrang55-RGA-3-2 gave highest yield (7.66 t/ha) over BRRRI dhan50 (6.50 t/ha) in OYT
5	Development of hybrid rice parental lines and hybrids	295 testcross F <sub>1</sub> s were made from source nursery by testcross.
6	Effect of Time of Planting of Newly Developed BRRRI Varieties in Different Regional Stations	Appreciable better yield was achieved in T. Aman season when BRRRI dhan87 and BRRRI dhan90 transplanted on 20 <sup>th</sup> of August. BRRRI dhan93 gave higher yield on 20 <sup>th</sup> July – 05 <sup>th</sup> August. BRRRI dhan75 should preferably be transplanted on 20 <sup>th</sup>

		July- 20 <sup>th</sup> August. In Boro season, grain yield was higher for BRRi dhan89 and all the varieties produced higher grain yield on 16 January and 01 February planting.
	<b>Regional Station, Kushtia</b>	
	<b>Varietal Development program area</b>	
	<b>T. Aus, 2022</b>	
1.	Regional yield trial (RYT#Favorable)	The advanced line, BR11864-5R-31 (6.14 t/ha) gave highest yield over all other advanced lines and check varieties BRRi dhan48 (5.53 t/ha) and BRRi dhan98 (5.66 t/ha) with similar growth duration
	<b>T. Aman, 2022</b>	
1	Regional Yield Trial of Diseases Resistant Rice (DRR-BB)	None of them yielded higher than susceptible check variety BRRi dhan87
2	Regional Yield Trial of Short Slender (SS) lines	BRH13-2-14-2-1B was the highest yielder (6.33 t/ha) among tested breeding lines and check variety.
3	Regional Yield Trial of Swarna Type Long Slender (SLS) lines	BR9396-6-2-2B line significantly performed better (7.56 t/ha) than check variety BRRi dhan94 where it was identical to another check BRRi dhan87
4	Regional Yield Trial, Zinc Enriched Rice (ZER)	All the tested breeding lines found very short duration (<115 days) type. Among them yield of BR10471-1-2-3-15-1 was highest (6.29 t/ha).
5	Regional Yield Trial, Rainfed Lowland Rice (RLR)	Among four tested advanced breeding lines only BR10458-20-2-3-1-3 yielded

		(5.84 t/ha) very close to BRR I dhan87 (5.97 t/ha)
6	Regional Yield Trial (RYT_SD/MD)	The advanced line IR19A7068 (6.07 t/ha) performed better than the other lines and check variety BRR I dhan75
7	Regional Yield Trial, RYT_zirashail type	The advanced line BRH11-7-17-10B (4.78 t/ha) performed significantly better than other lines and check variety Zirashail
8	ALART for Premium Quality Rice (PQR)	Advanced line BR8493-3-5-1-P1 gave statistically higher yield (4.68t/ha) than other advanced line and check varieties
9	ALART for Drought Tolerant Rice (DTR)	None of the advanced lines gave higher yield than the check variety BRR I dhan71
10	ALART for SHR-1 (Zirashail type)	The advanced lines BRH13-1-9-7B (5.13t/ha) and BRH10-1-14-6-2B (5.13t/ha) gave statistically higher yield than check variety BRR I dhan57
11	ALART for SHR-2 (Extra-long and long slender)	The grain yield of advanced line BR10238-5-1-4-2 (5.16 t/ha) was significantly similar to BRR I dhan75 (5.34 t/ha)
12	ALART for Drought Tolerant Rice (DTR)	None of the entries exhibited a superior yield compared to BRR I dhan71
13	ALART for SHR-1 (Zirashail type)	BRH15-24-7B, BRH13-1-9-7B and BRH13-2-4-7-2B were statistically similar and their yield performance better than both of the standard check and local check
14	ALART for SHR-2 (Extra-long and long slender)	The advanced line, BR10238-5-1-4-2

		(5.80 t/ha) gave highest yield than the other advanced lines and check varieties
	<b>Boro, 2022-23</b>	
15	Regional Yield Trial, Short Duration (SD)	The yield of BR11903-5R-56 line given highest (6.58 t/ha) which was statistically higher yield over the check varieties
16	Regional Yield Trial, Medium Duration (MD)	None of the entries exhibited a superior yield compared to BRR dhan89
17	Regional Yield Trial, Long Duration (LD)	None of the entries demonstrated a higher yield than BRR dhan89 and BRR dhan92
18	Regional Yield Trial, Extra Long Slender Rice (ELS)	The yield of BR10604-5R-58 was the highest (6.4 t/ha) which was statistically higher yield over the check varieties, BRR dhan50
19	Regional Yield Trial, Short Slender Rice (SS)	BRH18-9-4-2-3B had the highest yield (5.92 t/ha), followed by BRH13-5-12-2-2B (5.83 t/ha) and BRH9-3-2B
20	Regional Yield Trial, Zira type Rice (Zira-type)	BRH13-9-5-3B had the highest yield (6.03 t/ha which was statistically significant over the check variety Zirashail
21	Regional Yield Trial, Late Transplanted Rice (LTR)	BRH13-2-4-6-4B exhibited the highest yield (5.43 t/ha), which was statistically significant compared to the check variety BRR dhan28
22	Regional Yield Trial, Salt tolerant Rice (STR)	None of the entries exhibited a superior yield compared to BRR dhan67, BRR dhan89 & BRR dhan99
23	Regional Yield Trial, Zinc Enriched Rice (ZER)	None of the entries showed a better yield

		than BRRi dhan74 & BRRi dhan29
24	Regional Yield Trial, Premium Quality Rice (PQR-1)	None of the entries showed statistically better yield than BRRi dhan63 & BRRi dhan81
25	Regional Yield Trial, Premium Quality Rice (PQR-2)	None of the entries showed statistically better yield over BRRi dhan63
26	Regional Yield Trial, Anti-oxidant Enriched Rice (AER-1)	The entry, BR12839-4R-138-4 (6.58 t/ha) yielded significantly more than Indonesian Black Rice (5.46 t/ha) and BRRi dhan88 (5.93 t/ha)
27	Regional Yield Trial, Anti-oxidant Enriched Rice (AER-2)	None of the entries gave statistically higher yield over BRRi dhan88
28	Regional Yield Trial, Water Saving Rice (WSR)	None of the entries gave statistically higher yield over BRRi dhan58
29	Regional Yield Trial, Favourable Boro Rice (Bio)	None of the entries gave statistically higher yield over BRRi dhan86
30	Regional Yield Trial, Favourable Boro Rice (FBR-Barishal)	Among the tested entries, NGR 745-2 gave the highest yield of 6.98 t/ha (Table 24) over BRRi dhan89 (6.78 t/ha) & BRRi dhan88 (5.74 t/ha).
31	Advanced Yield Trial, Heat Tolerance Rice (HTR-1)	The entries, BR11991-6R-58-1 (6.2 t/ha) and BR12605-4R-275-1 (5.56 t/ha) exhibited statistically significant higher yield compared to BRRi dhan28 (4.96 t/ha), Bina dhan14 (4.36 t/ha), and N22 (3.41 t/ha)
32	Advanced Yield Trial, High Day-Night Temperature Rice (HDNTR)	None of the entries performed statistically better over BRRi dhan98
33	G×E interaction of Basmati Rice Trial, Premium Quality Rice (PQR-3)	None of the entries performed better than BRRi dhan63 in terms of yield
34	ALART for Favorable Boro Rice (FBR-Barishal) (Re-ALART)	The advanced line BRBa 3-1-7 (7.17

		t/ha) gave highest yield over all other advanced lines and check varieties with shortest growth duration
35	ALART for Short Duration Favorable Boro Rice	None of the advanced line gave better performance than the check variety BRRi dhan96
36	ALART for Superior High Yielding Rice (SHR-1)	The grain yield of advanced lines BRH 10-1-14-2-6B (6.57 t/ha) and BRH13-2-4-7-2B (6.56 t/ha) were significantly higher than the check variety
37	ALART for Superior High Yielding Rice (SHR-2)	The advanced line BR238-5-1-4-2 also gave higher yield than the check variety BRRi dhan88
38	ALART for Medium Duration Boro Rice (FBR-MD)	None of the advanced lines gave higher yield than the check variety BRRi dhan96
39	ALART for Superior High Yielding Rice (SHR-1)	The grain yield of advanced lines BRH 10-1-14-2-6B (6.38 t/ha) and BRH13-2-4-7-2B (6.34 t/ha) were higher than the check variety BRRi dhan81
40	ALART for Superior High Yielding Rice (SHR-2)	None of the advanced lines gave better performance than the check variety BRRi dhan88
	<b>Socio-Economics and Policy</b>	
1.	Stability analysis of BRRi varieties (T. Aus, T. Aman and Boro season)	In Aus season, BRRi dhan48 was the height yielder. In Aman season, BRRi dhan87 (short duration), BRRi dhan72 (medium duration) and BR10 (long duration) stand out as the highest yielders and in Boro Season, BRRi Hybrid dhan3 (short duration) & BRRi

		dhan89 (long duration) highest yielders
	<b>Crop-soil-water management</b>	
1.	Determination of the optimum time of planting for yield maximization of BRRRI dhan87 at the Kushtia region	The optimal planting window for BRRRI dhan87 August 15th for best growth and yield.
2.	Effect of Missing Nutrient Elements on Growth and Grain Yield of Rice in BRRRI Farm, Kushtia	N is the most limiting factor for yield reduction
	<b>Rice Farming Systems</b>	
1	Yield response of rice to different rates of Nitrogen and Potassium fertilizer in Boro-Fallow -T. Aman cropping pattern in Kushtia	The highest REY (14.68 t/ha) was recorded from the plot which was treated with Urea@STB+20% and MoP@STB+60% additional among 16 combinations
2	Increasing the system productivity of the dominant cropping pattern in Kushtia region (Boro-Fallow-T. Aman)	Maximum REY yield (16.09 t/ha) was recorded from CP 2 where fallow period was managed with BARI Sorisha-14 and check aman variety was replaced by a promising HYV, BRRRI dhan87
3	Performance of different cropping patterns for year-round vegetable production under agro-forestry systems with exotic date palm ( <i>Phoenix dactylifera</i> ).	Among the four cropping pattern Carrot – Mukhikachu gave the highest gross margin of 513.22 thousand taka (Table 39.2) which was followed by Fallow – Mukhikachu cropping pattern (454.4 thousand taka)
4	Evaluation of different rice-based cropping patterns under agro-forestry systems with exotic date palm ( <i>Phoenix dactylifera</i> ).	Among the five cropping pattern DS Aman (BRRRI dhan71) – Lentil gave the highest gross margin of 174.44 thousand taka which was followed by DS Aman (BRRRI dhan71) – Grass pea cropping pattern (57.82 thousand taka)
	<b>Technology transfer</b>	

1.	Demonstrations of newly released BRRRI varieties	In Aus season, BRRRI dhan48, BRRRI dhan85, BRRRI dhan98, and BRRRI Hybrid dhan7 were demonstrated. The highest yield was observed in BRRRI Hybrid dhan7 (6.03 t/ha) and In Aman season, BRRRI dhan71, BRRRI dhan75, BRRRI dhan87, BRRRI dhan90, and BRRRI Hybrid dhan6 were demonstrated. The highest yield was observed in BRRRI dhan87 (6.01 t/ha). BRRRI dhan63, BRRRI dhan81, BRRRI dhan84, BRRRI dhan89, BRRRI dhan92, BRRRI dhan96, Bangabandhu dhan100, BRRRI dhan101, BRRRI Hybrid dhan5 and BRRRI Hybrid dhan8 were demonstrated in Boro season. The highest yield was observed in BRRRI Hybrid dhan8 (8.85 t/ha)
2	Head-to-Head Adaptive Trial	In the Aman 2023 season, BRRRI dhan75 demonstrated superior performance with a yield of 5.32 t/ha and in Boro season, BRRRI dhan74 (Short duration) & BRRRI dhan92 (Long duration) demonstrated superior performance with a yield of 6.38 t/ha & 9.26 t/ha, respectively.
3	Training, Field Day and Workshop	A total of 10 batches of farmer trainings were conducted, engaging approximately 300 farmers. Alongside ten field days were organized.
	<b>Regional Station, Cumilla</b>	
	<b>Program Area: Varietal Development</b>	

1	OYT	79
2	AYT#1	
3	AYT#3	
4	RYT	
5	OYT (Cum)	11
6	PYT (Cum)	
7	RYT (RLR)	12
8	RYT (ZER)	
9	RYT (SS)	
10	RYT (Swarna, LS)	
11	RYT (DRR)	
12	RYT (SD/MD)	
13	OYT (IRR)	111
14	PYT#1 (IRR)	
15	PYT#2 (IRR)	
16	AYT (IRR)	
17	OYT (DRR)	
18	AYT (DRR)	
19	OYT#1 (RLR)	
20	OYT#2 (RLR)	
21	AYT#1 (RLR)	
22	AYT#2 (RLR)	
	<b>2. Program Area: Pest Management</b>	
2.1	Survey and monitoring of major rice diseases in Cumilla district	Management of major rice disease will be developed for increasing rice production and ensure food security
2.2	Demonstration of rice neck blast disease management technology under farmer's field condition	
2.3	Varietal reaction and recovering ability of BRRI released rice varieties	

2.4	Validation of Rice Tungro disease management technology from seedbed in Cumilla region	
2.5	Tracking the infection source(s) of rice false smut disease	
2.6	Evaluation of new chemicals against Blast disease of rice	
2.7	Evaluation of new chemicals against Sheath blight disease of rice	
2.8	Multi-Location Trial (MLT) of blast resistant advanced lines	
2.9	Evaluation of tungro resistant advanced lines in hot spot areas in Cumilla region	
2.10	Evaluation of direct seeded rice for less infection of tungro disease in hot spot area in Cumilla	
2.11	Advisory services to the farmers	
	<b>3. Program Area: Crop-Soil-Water management</b>	
3.1	Effect of nursery management on the performance of rice variety grown under water stagnant condition.	Healthy seedling raising techniques will be identified under stagnant conditions; The Response of BRRi dhan98 at various seedling age and fertilizer management could be explored; Appropriate fertilizer rate and time of planting on new rice varieties will be determined; Suitability of Low land rice in stagnant condition will be developed.
3.2	Effect of seedling age and fertilizer management on growth and yield of rice variety.	
3.3	Effect of time of planting on growth and yield of BRRi developed new T. Aman and Boro varieties.	
3.4	Effects of Potassium fertilization at different growth stages on growth and yield of rice.	
3.5	Long-term missing element trials for diagnosing the limiting nutrient in soil in BRRi R/S Cumilla	
3.6	Effects of N rates on the yield of BRRi released new varieties in BRRi Cumilla	
3.7	Effects of P rates on the yield of BRRi released new varieties in BRRi Farm Cumilla	
3.8	Effects of K rates on the yield of BRRi released new varieties/ advanced lines in BRRi Farm Cumilla	
3.9	Determination of appropriate time of DAP application to control Algal growth	
3.10	Effect of DAP and urea rates on growth and yield of rice	

	<b>4. Program Area: Socio Economic and Policy</b>	
4.1	Stability analysis of BRRI released rice varieties	Stability and suitability of BRRI released rice varieties will be determined in greater Cumilla region
	<b>5. Program Area: Technology Transfer</b>	
5.1	Field demonstration of different BRRI released new rice varieties in Cumilla region (GoB, PPNB, TRB)	Variety/ technology dissemination and awareness build up for increasing rice yield as well as food security
5.2	Farmer's and SAAOs training on modern rice cultivation and disease management technology (PPNB/GoB)	
5.3	Field day on modern rice cultivation (GoB & PPNB)	
	<b>Regional Station, Gopalganj</b>	
1.	Germplasm collection and rejuvenation.	Two hundred and sixteen Aman rice germplasm were collected from Faridpur and Khulna regions. This rice germplasm was rejuvenated to produce more seed for further evaluation and utilization at BRRI RS Gopalganj during T. Aman 2022.
2.	Morphological Characterization	One experiment was conducted to characterize 50 T. Aman rice germplasm through 51 agro-morphological traits. A UPGMA dendrogram was generated using 50 T. Aman rice germplasm, and the Euclidean distance was estimated using quantitative data. Using the Euclidean distance of 0.18 as the cutoff, cluster analysis indicated that the 50 T. Aman rice germplasm was divided into three categories. Cluster III consisted of

		a maximum of 32 germplasm samples, while Cluster II comprised 16 genotypes. The cluster I had the fewest (2) germplasm.
3.	PVT (Inbred trial) T. Aman	In the proposed variety trial, two advanced breeding lines I-044, I045 and check (I-046) was tested. Two advanced lines produced higher yield (5.17-6.47 t ha <sup>-1</sup> ) than the line coded as 1-064 (2.97 t ha <sup>-1</sup> ) with 20-21 days longer growth durations
4.	ALART (STR), T. Aman	In STR-1, both the advanced lines BR11712-4R-218 and BR11716-4R-102 produced higher yield (4.6-4.9 t ha <sup>-1</sup> ) than the standard check varieties BRR dhan73 (4.0 t ha <sup>-1</sup> ) and BRR dhan87 (4.4 t ha <sup>-1</sup> ) with 4-6 days shorter growth durations. In the case of STR-2, the trial was damaged due to heavy rainfall.
5.	ALART (DWR), Aman	Three advanced lines BR10230-7-19-2B, BR9376-6-2-2B and BR9392-6-2-1B gave a higher yield (3.1-3.5 t ha <sup>-1</sup> ) than the standard checks Fulkori (2.7 t ha <sup>-1</sup> ) with 11-12 days longer growth durations.
6.	ALART(SubTR-LD), Aman	One advanced line namely BR9158-19-9-6-50-2-HR1 produced a higher yield (5.4 t ha <sup>-1</sup> ) than the standard checks BRR dhan44 (3.7 t ha <sup>-1</sup> ) and BRR dhan52 (4.6 t ha <sup>-1</sup> ) with similar growth durations.

7.	ALART (FBR-Barishal), Boro	Two advanced lines BRBa1-4-9 and BRBa 3-1-7 produced higher yields (7.89-8.06 t ha <sup>-1</sup> ) than the standard checks BRRi dhan58 (6.90 t ha <sup>-1</sup> ) and BRRi dhan89 (7.69 t ha <sup>-1</sup> ) with similar growth duration.
8.	ALART (FBR, MD), Boro	One advanced line IR12A173 produced a higher yield (7.90 t ha <sup>-1</sup> ) than the standard checks BRRi dhan58 (7.64 t ha <sup>-1</sup> ) and BRRi dhan96 (6.88 t ha <sup>-1</sup> ).
9.	ALART (FBR, SD), Boro	Three advanced lines BR11318-5R-63, BR11337-5R-72 and SVIN109 produced higher yields (7.64-8.16 t ha <sup>-1</sup> ) than the standard checks BRRi dhan81 (7.05 t ha <sup>-1</sup> ) and BRRi dhan96 (7.15 t ha <sup>-1</sup> ) with similar growth duration.
10.	RYT (Swarna and long slender type), Aman	None of the advanced lines produced higher yield (5.15-6.03 t ha <sup>-1</sup> ) than the standard check BRRi dhan87 (6.37 t ha <sup>-1</sup> ). On the other hand, one advanced line BRH9392-6-2-1-3-4 gave a higher yield (6.03 t ha <sup>-1</sup> ) than the check BRRi dhan94 (5.37 t ha <sup>-1</sup> ).
11.	RYT (Short Slender), Aman	Three advanced lines produced a slightly higher yield (5.37-5.60 t ha <sup>-1</sup> ) than the standard check BRRi dhan49 (5.03 t ha <sup>-1</sup> ) (Table 9).
12.	RYT (Tall Breeding Materials), Aman	The average grain yield of all advanced lines (3.38-3.77 t ha <sup>-1</sup> ) was higher than the checks BRRi dhan91 (2.27 t ha <sup>-1</sup> )

		with similar growth durations.
13.	RYT (DWR-Hbg), Aman	Three advance lines gave a higher yield (2.93-3.23 t ha <sup>-1</sup> ) than the standard checks BRRI dhan91 (2.43 t ha <sup>-1</sup> ) and Sada Jabra (2.07 t ha <sup>-1</sup> ) with similar growth durations.
14.	OYT (DWR-Gpg), Aman	Seven local deep water varieties gave a lower yield (1.80-2.28 t ha <sup>-1</sup> ) than the standard check BRRI dhan91 (2.35 t ha <sup>-1</sup> ) (Table 12). The yield of deep-water rice varieties was reduced due to rat damage.
15.	PYT (Jhum), AUS	Two jhum rice genotypes along with BRRI dhan83 as check were grown. Chibingshe gave higher yield (4.50 t ha <sup>-1</sup> ) than the standard check BRRI dhan83 (4.03 t ha <sup>-1</sup> ) with three days longer growth durations (Table 13). On the other hand, Galong produced a similar yield (4.15 t ha <sup>-1</sup> ) than the standard check BRRI dhan83 (4.03 t ha <sup>-1</sup> ).
16.	RYT (FBR-Barishal), Boro	Three advance lines gave a higher yield (8.06-8.23 t ha <sup>-1</sup> ) than the standard check BRRI dhan89 (7.7 t ha <sup>-1</sup> ) with similar growth durations. On the other hand, all the advanced lines produced higher yield (7.43-8.23 t ha <sup>-1</sup> ) than the standard check BRRI dhan88 (6.53 t ha <sup>-1</sup> ).
17.	RYT (STR), Boro	Three advanced lines gave higher yields (7.18-7.33 t ha <sup>-1</sup> ) than three standard

		checks (BRRI dhan89, BRRI dhan67 and BRRI dhan99).
18.	RYT (Zira Type), Boro	Three advanced lines gave higher yields (6.65-7.27 t ha <sup>-1</sup> ) than two standard checks Zirasail (6.54 t ha <sup>-1</sup> ) and BRRI dha28(6.34 t ha <sup>-1</sup> ) with similar growth duration.
19.	RYT (Tall), Boro	Three advanced lines produced higher yield (6.63-7.00 t ha <sup>-1</sup> ) than the standard check BR18 (6.1 t ha <sup>-1</sup> ) with 4-5 days shorter growth durations.
20.	RYT (FBR), Boro	One advanced line BR(Bio)13028-AC24-1-2 performed better (7.23 t ha <sup>-1</sup> ) over the checks BRRI dhan86(6.56 t ha <sup>-1</sup> ) and BRRI dhan96 (6.86 t ha <sup>-1</sup> ) with similar growth duration.
21.	RYT (PQR), Boro	A total of 20 premium quality rice including checks BRRI dhan50, BRRI dhan63, BRRI dhan81, BRRI dhan104, Tepi Boro and Rata Boro were evaluated. Results revealed that Indian Basmati produced the highest yield (4.76 t ha <sup>-1</sup> ) than six standard checks. On the other hand, Basmati (1230) gave the lowest yield (2.64 t ha <sup>-1</sup> ) than six standard checks