Research Progress 2024-2025

Program Area: Varietal Development program (VDP)

Plant Breeding Division

Research Progress 2024-2025 (Aus, T. Aman and Boro)

Sl. No.	Research Progress	Expected Output
Program Area/Project (Duration): Varietal Development program (VDP)		
1. Rice Breeding		
1.1a	**Development of Upland Rice** Twenty-four crosses were made using 30 parents. Out of 23, 20 crosses were confirmed as true F_1. A total of 3008 segregating progenies from 18 crosses were advanced following standardized RGA (Rapid generation advance technique) protocol. Nineteen entries were selected considering growth duration, yield, uniformity of morpho-agronomic traits and superiority in one or more traits over the standard checks from 301 advanced breeding lines in OYT. Fifteen genotypes were selected from 34 tested entries on the basis of yield and short growth duration in PYT. Eight genotypes such as BR12859-5R-31, BR12860-5R-79, BR12862-5R-3, BR12867-5R-125, BR12873-5R-60, BR12880-5R-266, BR12880-5R-291 and BR12880-5R-308 were selected in AYT on the basis of yield and growth duration (earliness) for further trial. In RYT, four genotypes viz; BR12248-5R-22, BR12248-5R-37, BR10756-2B-8-72 and BR12860-5R-79 were selected for ALART at next upland rice season among 11 tested entries.	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.
1.1b	**Development of Jhum Rice** Improvement of Jhum rice under upland rice program was implemented to develop high yielding rice variety with low (10-19%) to high (>25%) grain amylose content and drought tolerance along with good eating quality for jhum cultivation acceptable to tribal of Chattogram hill districts. Seventeen crosses were made involving parental genotypes from local Jhum cultivars, exotic varieties, single BRRI variety, promising advanced breeding lines having low to high level amylose content. Thirty crosses were made involving 17 parental genotypes from local Jhum cultivars, exotic varieties, single BRRI variety, promising advanced breeding lines having low to high level amylose content. Six F_1s were confirmed as true F_1. A total of 5222 progenies from 23 crosses were	For Jhum rice, high yielding rice variety with low (10-19%) to high (>25%) grain amylose content and drought tolerance along with less fertilizer use efficiency, good eating quality acceptable to tribal people of Chattogram hill

	advanced through field RGA (Rapid generation advance). Advanced yield trial (AYT) was conducted in six locations of three hilly districts (Khagrachori, Rangamati and Bandarban) of Bangladesh. Twelve genotypes were evaluated in AYT-1 but no entries were selected due to partial damage of all entries caused by stem borer attack. Three entries viz; BRRI dhan66, BRRI dhan71 and BRRI dhan83 out of seven tested entries were selected in AYT-2. Among all the entries, despite of heterogenity in climatic condition and topographic architecture, BRRI dhan66, BRRI dhan71 and BRRI dhan83 were the top yielder entry in every trial.	districts following their traditional cultivation practices (Dibbling method of planting associated with other crop species) will be developed.
1.2	**Development of T. Aus** In total, 30 crosses were made using 36 parents, and 2,373 F_1 seeds were obtained, 17 crosses were confirmed as true F_1; In RGA nursery, 74,600 progenies of 143 crosses in T. Aus season were advanced through modified-FRGA. Out of 5,200 lines of 17 crosses, 312 uniform lines were identified from LST based on uniformity in heading, plant height, and acceptable grain type in the field condition. Twenty genotypes were selected from 256 entries of the observational yield trial (OYT) based on homogeneity for plant height, and phenotypic acceptability at vegetative and maturity stages. In advanced yield trial (AYT#1), four genotypes were selected from 38 entries compared to three standard checks. In advanced yield trial (AYT#2), nine entries were selected from 20 lines, showing superior performance over four standard checks. In AYT#3, which focused on Aus-based cropping patterns in non-saline tidal areas, eight entries were selected from 18 tested lines compared to the check varieties BRRI dhan27, BRRI dhan106, and Gota IRRI under non-saline tidal condition. Two genotypes were selected from ten entries in RYT#1 along with the check varieties BRRI dhan48 and BRRI dhan98. In addition, one genotype was selected from nine entries in RYT#2 (RTV resistance) along with the check varieties BRRI dhan48, BRRI dhan85, and BRRI dhan98. An advanced line adaptive research trial (ALART) for BB was conducted at eight BB hotspot areas using three breeding lines viz. BR11866-5R-147, BR11867-5R-103 and BR11867-5R-442. The breeding lines showed similar yield with the standard check varieties. Therefore, the genotypes were not recommended for further trial.	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.
1.3	**Development of rice for shallow flooded and deep-water environment** In total, 14 crosses were made by utilizing 14 parents and produced 630 F_1 seeds. In total five F_1 crosses were confirmed through QC SNP panel genotyping and analysis. A total of 12,743 progenies out of 16,111 progenies of 61 crosses (8,376 progenies of 22 F_2 crosses, 2,128 progenies	High yielding (4.0-5.0 t/ha) rice varieties for shallow flooded area (up to 1.0 m depth),

	of 7 F_3 crosses, 1,075 progenies of 15 F_4 crosses, 1,164 progenies of 19 F_5 crosses) were advanced through RGA. From LST population, 1,122 lines from 20 crosses were genotyped with ten trait markers using custom SNP panel among which 232 lines were selected based on uniformity and priority traits markers. From yield trial, a total of 420 genotypes were tested out of which 88 genotypes were selected based on phenotypic acceptance, growth duration, survivability and higher yield performance. In OYT, the genotype BR12932-5R-18 produced the highest yield (3.6 t/ha) which is significantly higher than the check variety BRRI dhan91 (1.9 t/ha) whereas in PYT, the genotype BR12485-5R-42 (3.28 t/h) produced the highest yield which was significantly higher than the check variety BRRI dhan91 (1.85 t/ha). In AYT#1, the genotype BR10260-7-19-2B produced the highest yield (3.73 t/h) which was significantly higher than the check variety BRRI dhan91 (2.59 t/ha). In AYT, the genotype BR11186-5R-119 produced the highest yield (2.94 t/h) which was significantly higher than the check variety BRRI dhan91 (2.09 t/ha). The heritability obtained for growth duration, plant height and yield were ranged from 77-88%; 74-89% and 60-93% indicating high level of precision in these experiments. Through maintenance breeding 20 shallow flood tolerant genotypes and land races were grown and maintained for future use.	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.
1.4	**Development of Rainfed Lowland Rice (RLR)** The project aims to develop genotypes superior to standard varieties and adaptable to rainfed lowland environment in T. Aman season. In T. Aman 2024-25, 26 crosses using 27 parents for forward breeding, nine crosses for photosensitive and four back crosses were made, and 30 crosses were confirmed as true hybrids using 10-SNP *indica* QC panel. In Boro 2024-25, 30 crosses for forward breeding and 14 crosses for heat tolerance were made, and 25 crosses were confirmed as true hybrids using 10-SNP *indica* QC panel. A total of 13,657 individual progenies from 66 crosses of F_2 and F_5 generations and total 14,712 progenies from 55 crosses of F_2-F_3 generations were advanced during T. Aman and Boro seasons, respectively through field RGA method. Out of 7,210 $F_{5:6}$ LST lines derived from 23 different crosses, 1028 genotypes were selected with selection intensity of 14.3%. Most of the selected materials from LST contained genes of high amylose as well as the presence of the favorable alleles of *xa5, xa13* and *Xa21* for bacterial leaf blight (BLB), *BPH32* for BPH, and *Gm4* for gall midge (GM). A total of 64 genotypes were evaluated in observation yield trials (OYT) at Gazipur, Cumilla and Rangpur. Among the tested genotypes, 24 genotypes were selected and forwarded in advanced yield trial (AYT). In AYT, 40 genotypes were evaluated in two trials at Gazipur,	Short duration varieties (105-115 days) with 4.5-5.0 t/ha yield potential and medium duration (116-130 days) varieties with 6.0-7.0 t/ha yield potential will be developed.

	Cumilla and Rangpur, and 13 genotypes were found promising to advance. Among the 35 tested genotypes under regional yield trials (RYTs), three was selected for re-trial. Genetic trend of the genotypes from 2016 to 2024 showed the pBLUP (grain yield) in respect of trial year indicated an annual 93.84 kg/ha equivalent to about 2.23% increase in grain yield per year based on yield of 2016 (4.19 t/ha).	
1.5	**Development of Heat Tolerant Rice (HTR)** Ten crosses were made using 17 parents for the development of heat tolerant rice (HTR) from Boro 2024-25 and 1,367 F_1 seeds were collected. Eight F_1s were confirmed as true crosses for heat tolerant rice development. Heat tolerant rice (HTR) breeding program consisting 14,800 progenies of 28 crosses in Boro season was advanced through modified FRGA. Out of 2700 lines of nine crosses, 275 uniform lines were selected from LST based on uniformity in heading, plant height and acceptable grain type under the field condition. Selection intensity applied for selecting LST lines was 10%. Three genotypes out of 12 from advanced yield trial (AYT#1), three advanced lines out of 12 from AYT#2; and two advanced lines out of 10 were selected from AYT#3. Two advanced lines from RYT#1 and two advanced lines from RYT#2 were selected on the basis of homogeneity with respect to plant height, phenotypic acceptability at maturity stages.	Short duration varieties (110-115 days) with 6.0-6.5 t/ha yield potential will be developed.
1.6	**Development of Salt Tolerant Rice (STR)** The objective of this project is to develop high yielding salt tolerant rice cultivars based on product profile. Salinity is one of the major constraints for the Rainfed lowland and Boro rice ecosystem in the southern coastal zone of Bangladesh. Sixty crosses were made using 42 well characterized elite parents with higher genetic merit/breeding values and various alleles of interest. A total of 29 F_1s were confirmed as true hybrids through hybridity test via F_1 verification by quality check (QC) genotyping with purity SNP panel during T. Aman season. In FRGA (F_2-F_5) nursery, a total of 34172 progenies were harvested from 153 crosses. In LST, 4633 lines from 23 crosses were tested but all entries were damaged due to flood, so no entry was selected. Yield trials were carried out in Gazipur, Debhata, Kaliganj and BRRI Farm, Satkhira in T. Aman season. Out of 745 genotypes, 266 genotypes were selected from OYT. Two PYTs (PYT-1 and PYT-2) were conducted using 141 breeding lines by following alpha lattice design. A total of 58 genotypes were selected from these trials depending on grain yield, salinity tolerance and phenotypic acceptability. Thirty-two genotypes, out of 69	Promising salt tolerant lines/salt tolerant varieties will be developed with seedling stage (EC 14 dS/m) & reproductive stage tolerance (EC 8-10 dS/m) and better yield potential (5.5-6.5 t/ha for T. Aman and 7.5-8.0 for Boro season) in comparison to existing varieties

	genotypes were selected from AYT-1 and AYT-2. In RYT's (RYT-1 to RYT-3), out of 62 breeding lines, 13 best performing lines were selected. In Boro Season, 93 crosses were made using 60 elite parents. A total of 59 F_1s was confirmed as true hybrid through F_1 verification by quality check (QC) genotyping with purity SNP panel. Total 36182 segregating progenies from 152 crosses (F_2-F_5 generation) were harvested from FRGA nursery and grown in the subsequent generation. In LST trial, 619 lines out of 5796 lines were selected on the basis of desirable plant type, grain quality and uniformity at flowering under field condition. A total of 182 genotypes selected out of 442 from OYT based on growth duration, grain yield, and homogeneity in different morpho-agronomic traits. Out of 246 genotypes, 95 genotypes were selected from three PYTs. A total of 87 genotypes were selected from three AYT's out of 144 genotypes. A total of 28 genotypes were selected from 35 tested entries of two RYTs. In ALART (advanced line adaptive research trial) BR13113-4R-63, BR13113-4R-116 were evaluated under ALART-1 (Short duration) & BR13106-4R-184, BR13113-4R-185 and BR13122-4R-136 were evaluated under ALART-2 (Mid duration) were. Among these entries, BR13113-4R-63 and BR13113-4R-116 from ALART-1 (SD) and BR13113-4R-185 and BR13122-4R-136 from ALART-2 (MD) got recommended for the Proposed Variety Trial (PVT). One PVT was conducted by SCA with the line BR11712-4R-44 which passed at nine locations of PVT out of ten with more than 10% yield advantage that check varieties BRRI dhan67 and BRRI dhan89. .	
1.7a	**Development of Premium Quality Rice (PQR), T. Aman** During the T. Aman 2024-25, significant efforts were made for the development of high yielding (>3.5 t/ha) national grade aromatic rice varieties (BRRI dhan34, Kalizira, Chinigura, Kataribhog, Radhunipagol, Tulshimala and Bashful type) for domestic consumption. A total of 32 crosses (30 single crosses and 2 backcrosses) were made using 17 parents. A total of 26 crosses (17 single crosses and 9 backcrosses) were confirmed as true hybrids using 10 SNP *indica* QC genotyping panel. Overall, 13,868 progenies from 112 crosses (7704 progenies of 19 F_2 crosses, 1062 progenies of 17 F_3 crosses, 1325 progenies of 18 F_4 crosses, 3050 progenies of 47 F_5 crosses, 105 Progenies from one BC_1F_4, 404 progenies from four BC_2F_4, 102 progenies from one BC_3F_4, 336 progenies from four BC_1F_4, and 140 progenies from one BC_2F_5) were harvested from FRGA. In Line Stage Testing (LST) Trial, 393 genetically fixed lines of 30 crosses were selected out of 5,753 progenies through the combination of visual phenotypic assessment and trait genotyping with 2.063 (6.38%) selection intensity.	National and international grade (Kalizira, Chinigura, Kataribhog, Basmati, Jasmine, Banglamati and BRRI dhan34 type) high yielding aromatic varieties with earliness, good plant type, anti-oxidant potential will be developed.

	In Observational Yield Trial (OYT), 66 genotypes out of 148 were selected based on homogeneity, phenotypic acceptance (PAcp), grain type, presence of aroma, and grain yield where yield was ranged from 1.27 t/ha to 5.43 t/ha with 67%, 88%, 78% and 72% heritability for plant height (cm), days to maturity, phenotypic acceptance (PAcp), and grain yield, respectively. In this trial, tested breeding line BR14189-5R-49 produced highest yield (5.43 t/ha) with 134 days growth duration and presence of aroma where the best performing aromatic check variety gave 3.81 t/ha grain yield with a 130-days growth duration. In T. Aman 2024-25 season, two PYT (PYT#1 and PYT#2) trials were conducted in BRRI (HQ). A total of 21 advanced lines out of 52 (17 from PYT#1 and 4 from PYT#2) were selected based on phenotypic acceptance (PAcp), grain type, presence of aroma, and grain yield. Among the selected advanced lines, BR13943-3R-64 gave 4.62 t/ha grain yield with 128 days growth duration, whereas aromatic standard check variety with similar grain type gave 4.06 t/ha grain yield with 132 days growth duration in PYT#1. In PYT#2, the highest yielding genotypes BR11811-9-2-2-P2 produced 3.74 t/ha grain yield with aroma but was not selected due to lodging tendency. The 2nd best performing genotype BR9178-7-2-4-4-P2-10 gave 3.06 t/ha grain yield with 139 days growth duration, while the highest-yielding check was BRRI dhan70 exhibiting 3.02 t/ha grain yield. Heritability estimates were 96% for plant height (cm), 96% for days to maturity, and 70% for yield in PYT#1, whereas 88% heritability for plant height (cm), 54% for days to maturity, 77% for phenotypic acceptance (PAcp), and 78% for yield in PYT#2. In Advanced Yield Trial (AYT), six advanced lines (three from AYT#1 and three from AYT#2) were selected out of 23 genotypes. Three genotypes were selected based on presence of aroma, phenotypic acceptance (PAcp) and grain yield. The advanced line BR10812-8-4-3-2-P2 gave highest grain yield (3.91 t/ha) with a 122-days growth duration and aroma in AYT#1, whereas best performing check variety BRRI dhan80 gave 3.58 t/ha grain yield with a 124 days growth duration with 93% heritability for plant height (cm), 94% for days to maturity, and 73% for grain yield. In AYT#2, the advanced line BR10824-5-6-4-1 gave 3.05 t/ha grain yield with 141 days growth duration, whereas the check variety BRRI dhan34 produced 2.21 t/ha grain yield with 136 days growth duration. Under maintenance breeding program, 442 genotypes, including 135 aromatic rice landraces, were evaluated and purified using systematic arrangement of panicle-to-row method to be maintained as nucleus stock for future use. During Boro 2024-25, a total of 66 genotypes was selected out of 315 genotypes based on homogeneity in the population, phenotypic acceptance,	

	plant type, grain type, presence/absence of aroma, and higher yield in OYT. The yield ranged from 2.48-8.69 t/ha with a growth duration of 115-156 days. The genotype BR14191-4R-14 produced the highest yield of 8.52 t/ha with a growth duration of 136. The heritability obtained for the plant height, growth duration and yield were 88%, 98% and 70%, respectively, indicating high level of precision in this experiment. Three Advanced Yield Trials (AYT) were conducted in Boro 2024-25 season at Parbatipur, Dinajpur and BRRI (HQ). In AYT#1, five genotypes were selected out of 17 genotypes based on phenotypic acceptance, plant type, grain type, photosensitivity, and higher yield. All the selected genotypes had aroma containing the *fgr-1* gene. The genotype BR14193-5R-87 produced significantly higher yield (6.18 t/ha) with 102 days of growth duration. The yield of the genotypes ranged from 1.98 t/ha to 6.18 t/ha. The heritability obtained for the plant height, growth duration, and yield were 77%, 76% and 76%, respectively. In AYT#2, eight genotypes were selected out of 32 genotypes based on phenotypic acceptance, plant type, grain type, photosensitivity, and higher yield. All the selected genotypes had aroma containing the *fgr-1* gene. The genotype BR13723-3R-114 produced significantly higher yield (8.19 t/ha) with 122 days of growth. The yield of the genotypes ranged from 3.36 t/ha to 8.19 t/ha. In AYT#3_Jira type, 13 genotypes were selected out of 58 genotypes based on phenotypic acceptance, plant type, grain type, photosensitivity, aroma and higher yield. The genotype BR18-7-14B produced significantly higher yield (8.66 t/ha) with 119 days of growth. The yield of the genotypes ranged from 2.84 t/ha to 8.66 t/ha.	
1.7b	**Development of Premium Quality Rice (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. Totally 1,011 F_1 seeds were obtained from 15 crosses. Twelve F_1's was confirmed as true hybrid using 10-SNP *indica* QC panel. In total 27,618 progenies of 86 crosses from F_2 to F_4 generations were advanced through RGA method. A total 541 genotypes were selected from 6,502 progenies of 18 crosses of LST trial. Selection intensity of LST lines was found 8.32%. The trait marker profile of the genotypes of LST showed the genes of high amylose, aroma and high grain no. per panicle. Frequency of the lines with disease and insect tolerance genes were limited. A total of 370 genotypes were evaluated in two OYTs in Gazipur, Rajshahi and Rangpur and among them 40 genotypes were selected to forward in AYT based on the performance. From the two AYTs, among the 40 tested genotypes only eight genotypes	National grade premium quality rice variety/line(s) of higher yield potential (>7.0 t/ha) with or without aroma will be developed for Boro season.

	were selected for RYT. In RYT three genotypes were selected from fourteen lines to forward in ALART. Two genotypes in ALART were evaluated and among them none were recommended by ARD.	
1.8	**Development of Favorable Boro Rice (FBR)** A total of 53 single crosses and 19 backcrosses were made using 41 and 22 breeding lines/varieties, respectively 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**.**). Fifty-seven single crosses and 11 backcrosses were confirmed as true F_1 through a hybridity test using KASP based QC SNP genotyping. Out of 14,161 segregating progenies of 44 crosses grown in the RGA nurseries, a total of 11,498 segregating progenies comprising 7,184 F_2 progenies of 16 crosses, 2166 F_3 progenies of 20 crosses, 540 BC_1F_2 of 1 cross, and 1,608 BC_1F_3+PSRGA progenies of 7 crosses were advanced following single seed decent method of breeding. Out of 19,901 lines of 169 crosses tested in LST, 2172 uniform lines in terms of plant height, days to flowering, grain size and shape were selected for genotyping to track the favorable alleles of key target genes for BB (*xa5, xa13* and *Xa21*), blast (*Pi9, Pita, Pita2* and *Pb1*) and BPH (*Bph17* and *BPH32*) resistance and *grain quality (Wx-a, Wx-10, chalk5, BADH2*). One hundred nineteen genotypes out of 1982 fixed lines tested in OYT at 12 locations following sparse testing model of genomic selection were selected based on plant height, growth durations and grain yield. The selected lines yielded 4.58 t/ha to 10.57 t/ha with growth duration of 117 – 160 days. Out of 140 breeding lines tested in an OYT under AGGRiNet trial network, 19 breeding lines showing 7.0 t/ha to 8.7 t/ha yield with 125 – 142 days growth duration across four sites (Gazipur, Cumilla, Habiganj and Rajshali) were selected for further evaluation. Nine early maturing lines (131 -138 days) yielding 23.3 % to 50.7% higher than BRRI dhan88 (134 days, 6.35 t/ha) and two medium maturing lines (148-150 days) yielding 15.0% to 15.2% higher than BRRI dhan102 (153 days, 6.14 t/ha) were selected from 146 advanced breeding lines tested in two AYT trials. Two medium duration breeding lines (138 days, 7.12 -7.28 t/ha) showed 10.2 - 12.7% yield advantage over the check variety BRRI dhan102 (145 days, 6.71 t/ha) that were selected for further advancement. Besides, five short duration breeding lines yielded 5.8-9.0 % over BRRI dhan88 and 10.9-14.3 % over BRRI dhan28 and four medium duration breeding lines were selected for further trial in RYT. Four medium maturing lines (150-151 days) and one early maturing line (147 days) yielding at least 0.5 t/ha higher	Development of improved genotypes with high yield potential (≥8.0 t/ha), acceptable growth duration (Short < 140 days, Medium 140-150 days and Long > 150 days) and better grain quality for irrigated ecosystems in Bangladesh.

	yield over the contemporary check varieties (BRRI dhan28 and BRRI dhan88) were selected from 31 breeding lines tested in four sets of RYT at 10 locations across the country for further advancement. One long duration breeding line BR11318-5R-84 (150 days) showed 12.8% yield advantage of the check variety BRRI dhan92 across 10 locations. in proposed variety trial (PVT).	
1.9	**Development of Cold Tolerant Rice (CTR)** In total five single crosses and 36 backcrosses were made using 24 lines/varieties including five cold tolerant donors as parents targeting to develop high yielding and cold tolerant breeding lines enriched with favorable alleles of disease resistance (blast and BLB), insect resistance (BPH) and acceptable grain quality (amylose, chalkiness, palatability, zinc content, etc.). Fifty-eight crosses were confirmed as true F_1 through a hybridity test using KASP based QC SNP genotyping. From segregating RGA nurseries, in total 16,876 individual plants were harvested from 56 cross combinations of F_2-F_4, BC_1F_2, BC_1F_3, BC_1F_4 BC_2F_3, and BC_2F_4 generations following SSD method of breeding. Out of 7,069 lines under 59 crosses tested in LST, 492 uniform lines in terms of plant height, days to flowering, grain size and shape were selected for genotyping with trait markers for cold tolerance (*SCT1, qPSST6, qPSST3, qPSST7 and qPSST9*), blast resistance (*Pi9, Pita, Pita2, pb1*), BB resistance (*xa5, xa13, Xa21*) and grain quality traits (*Wx-a, Wx-10*). Out of 190 breeding lines tested under natural cold stress (at booting stage) and non-stress conditions at two locations in OYT-1 and OYT-2, 12 breeding lines showing 12.1-75.4 % yield advantage under cold stress condition and 13 breeding lines showing 6.94-43 % yield advantage under non-stress condition over the check varieties of contemporary growth duration were selected for further yield testing. Also, two breeding lines showing 32.0 to 33.0% higher yield over the check variety BRRI dhan88 and 5 breeding lines showing 6-29% yield advantage over the check BRRI dhan67 were selected from 60 breeding lines tested in OYT-4 at Gazipur site under cold-stress (CS2) condition. Ten advanced breeding lines comprising one short duration (144 days) showed 121% yield advantage and six medium duration lines (154-161 days) showing 61.0% to 116.0% yield advantage over the contemporary check varieties BRRI dhan28 and BRRI dhan67 under cold stress were selected and three breeding lines showing 10-20% yield advantage over check BRRI dhan28 under non stress conditions were selected from AYT-1 trials conducted at four locations (Gazipur, Nikli, Tahirpur and Habiganj). On the other hand, sixteen breeding lines were selected from AYT-2 trials conducted at four	Development of high-yielding rice varieties tolerant to cold stress at the seedling and reproductive stage. Breeding Target: Growth Duration 130-135 days (Haor area) and 145-150 days (Northern region), Yield: 6.0-7.0 t/h (Haor) and 6.5-7.5 t/ha (Northern region). Cold tolerance at Seedling stage (Northern region) and Reproductive stage (Haor area).

	locations (Gazipur, Nikli, Tahirpur and Habiganj). Among them, eleven medium duration lines consisting (155-158 days) showing 61.0 to 152.0% yield advantage over the contemporary check BRRI dhan67 under cold stress were selected and five breeding lines including two short duration lines showing 15.6% yield advantage over the contemporary check BRRI dhan28 and three medium duration lines showing 8.1-23.2% yield advantage over the contemporary check BRRI dhan67 under non-strss conditions were selected for further advancement. A total of eight genotypes were selected from 17 tested entries from both stress and non-stress conditions in RYT-1 trial conducted at nine locations of Nikli, Tahirpur and Habiganj haor. Among these, four genotypes consisting of two short duration breeding lines (151 days) showed 42-46% yield advantage over check BRRI dhan28 (152 days, 1.43 t/ha) and two medium duration breeding lines (155-157 days) showed 60-104% yield advantage over check BRRI dhan67 (158 days, 2.06 t/ha) were selected under cold stress conditions. Under non-stress conditions, four short duration breeding lines showing 15-23% yield advantage over the contemporary check BRRI dhan28 were selected for further advancement. In RYT-2, three short duration advanced breeding lines showing 10-12% yield advantage over the contemporary check BRRI dhan28 were selected from 17 tested entries under non-stress conditions conducted at nine locations of Nikli, Tahirpur and Habiganj haor. One cold tolerant breeding line BR11894-R-R-R-R-169 (136 days, 6.77 t/ha) showed 22.8% yield advantage of the check variety BRRI dhan28 (133 days, 5.64 t/ha) across 10 locations of haor areas.	
1.10	**Development of Pigmented Rice with Nutraceutical Properties** During the T. Aman 2024-25 season, a total of 14 crosses were successfully made using 16 parental lines. From these crosses, 1,236 F_1 seeds were obtained. Subsequently, from 31 crosses, 27 single crosses were selected and confirmed as true F_1 hybrids through QC SNP panel analysis. A total of 26,694 progenies were advanced through Rapid Generation Advance (RGA) from 80 crosses. This included 12,808 progenies from 28 F_2 crosses, 8,714 progenies from 22 F_3 crosses, 1,361 progenies from six F_4 crosses, and 3,819 progenies from 23 F_5 crosses. From the Line Selection Trial (LST), a total of 196 fixed lines were selected from 2,167 fixed lines originating from 10 crosses, representing 9.04% selection intensity. In the Observational Yield Trial 25 genotypes were selected out of 152 genotypes. In Preliminary Yield Trial six genotypes were selected out of 43, whereas in Advanced Yield Trial, three out of 23 genotypes were selected. In the Regional Yield Trial (RYT), two advanced breeding lines were selected out	High-yielding, anthocyanin-enriched rice variety with enhanced nutraceutical properties will be developed (5.0-6.0 t/ha for T. Aman and 6.0-7.0 t/ha for Boro season).

of 10. In OYT, the genotype BR13941-4R-156 produced the highest yield of 4.35 t/ha with a growth duration of 127 days, while the standard check, BRRI dhan87, yielded 3.89 t/ha with a 126-days growth duration. For PYT#1, the highest yielding genotype was BR12839-4R-153-1, producing 3.40 t/ha grain yield with a 132-days growth duration. In PYT#2, the selected genotype was BR12839-4R-175, producing 3.10 t/ha grain yield with a 101-days growth duration. In AYT#1, the highest yielding genotype was BR12838-4R-5a, which produced 3.21 t/ha grain yield with a 130-days growth duration. For AYT#2, the highest yielding genotype was BR12839-4R-1, producing 3.71 t/ha grain yield with 136-days growth duration. This was followed by the genotype BR12839-4R-95-1, which produced 3.64 t/ha grain yield with a 112-days growth duration. In RYT, the highest yielding genotype was BR12839-4R-106, producing 3.33 t/ha grain yield with a 130-days growth duration and the total antioxidant capacity (TAC) was 615.61 μM. This was followed by the genotype BR12839-4R-137, which produced 3.25 t/ha grain yield with a 123-days growth duration and a TAC of 609.05 μM. In PVT, the proposed line BR12836-4R-63, out-yielded the check in five locations but in some locations, such as Gazipur, Bhanga, Sonagazi, and Khulna, the proposed variety had a lower yield due to factors like Bacterial Leaf Blight (BLB), rat damage, submergence, and flash flooding. The overall mean yield of the proposed variety was 3.92 t/ha, whereas the yield of BRRI dhan70 was 3.86 t/ha. The C3G content of the proposed line was 492.37 ppm, while its total antioxidant capacity was 701.21 μM AAE/100g, compared to the TAC of 371.21 μM AAE/100g for the check which do not possess C3G. The tested black rice line was not included as an agenda in the NTC meeting, as most of the trials were damaged.

In Boro 2024-25, a total of 12 crosses were made using 12 parents and 400 F_1 seeds were obtained, and six single crosses among 10 crosses were confirmed and selected through QC SNP panel analysis. Panicles of 25,464 progenies from 81 crosses (5,924 progenies of 27 F_2 crosses, 10,316 progenies of 26 F_3 crosses, 8,006 progenies of 22 F_4 crosses and 1,218 progenies of six F_5 crosses) were advanced through RGA. The harvested panicles were labeled, dried and preserved properly. A total of 402 fixed lines from 3,828 fixed lines of 23 crosses were selected from LST based on phenotypic acceptance, uniformity in flowering, plant height, grain size and shape, lodging tolerance, pigmentation, higher predicted yield and presence of expected trait markers. A total of 25 genotypes were selected out of 200 genotypes in OYT. The yield ranged from 27.13-4.98 t/ha of the selected genotypes. The highest yield was found in BR14563-4R-96 which gave

	7.13 t/ha yields with 134 days growth durations. The overall performances of the AYT genotypes were not good producing a yield ranging from 2.3 to 4.9t/ha. Only two genotypes were selected out of 33 genotypes to be repeated in AYT. A total of six materials in RYT were evaluated in eight locations. The genotype BR12839-4R-106 produced 5.53 t/ha yield with a growth duration of 139 days. The Cyanidin-3-Glucoside (C3G) Conc., Total Phenolic Compound (TPC) and Total Antioxidant Capacity (TAC) of this genotype are 351.12 mg/100g GAE; 44.7 mg GAE and 609.05 µM AAE/100g; which are very good value as a high antioxidant enriched genotype. Three materials, two for medium growth duration and one for short growth duration in ALART, were also evaluated by ARD. In medium duration trial, the genotype BR12839-4R-157-2 produced 7.27 t/ha yield with a growth duration of 148 days followed by the genotype BR12839-4R-5-2 which produced 5.20 t/ha yield with a growth duration of 147 days. The non-pigmented check variety, BRRI dhan100 produced a slightly higher yield of 7.65 t/ha which is not significantly different. The Cyanidin-3-Glucoside (C3G) Conc., Total Phenolic Compound (TPC) and Total Antioxidant Capacity (TAC) of this genotype BR12839-4R-157-2 are 459.10 mg/100g GAE; 38.80mg GAE and 691.05 µM AAE/100g; and that of for the genotype BR12839-4R-5-2 are 441.66 mg/100g GAE; 38.09mg GAE and 642.81µM AAE/100g; which are very good value as a high antioxidant enriched genotype. Any one of these two genotypes can be selected for Proposed variety trial (PVT) under the medium duration category in the next season. In short duration trial, the tested genotype BR12839-4R-137 produced 7.02 t/ha yield with a growth duration of 141 days, whereas the non-pigmented check variety, BRRI dhan88 produced a slightly higher yield of 7.54 t/ha which is not significantly different than the tested genotype. The Cyanidin-3-Glucoside (C3G) Conc., Total Phenolic Compound (TPC) and Total Antioxidant Capacity (TAC) of the genotype BR12839-4R-137 are 387.11 mg/100g GAE; 37.90mg GAE and 615.61 µM AAE/100g which is a very good value as a high antioxidant enriched genotype. The genotype can be selected for Proposed variety trial (PVT) in short duration category in the next season. Heritability obtained for growth duration and yield ranged from 80-84 % and 51-90%, respectively, indicating high level of precision in the experiments.	
1.11	**Development of Zinc Enriched Rice (ZER)** The project aims to develop high yielding rice varieties with improved nutritional quality with high zinc (Zn≥24 mg/kg) in polished grain. The project also prioritizes development of stress tolerant zinc enriched rice varieties in a combination of submergence and zinc, drought and zinc,	Rice varieties with high iron and zinc content with resistance to major insect pests

	salinity and zinc along with cold and zinc enriched rice with improved grain yield. The experiments were conducted in both T. Aman and Boro seasons. In T. Aman season, 23 single crosses were made that produced 2,218 seeds. A total of 19 crosses were selected and confirmed as true F_1 using 10-SNP *indica* QC panel. In RGA method, 29,268 segregating progenies were harvested from $F_{2\text{-}5}$ generations of 110 crosses. A total of 372 uniform lines out of 4,494 lines were harvested based on visual observation on homogeneity in flowering, plant height and grain size and shape. Selection intensity of the genotypes of LST was 8% in T. Aman season. Trait markrt profile showed that most of the selected materials from LST contained genes/QTLs of high amylose, high zinc content and drought tolerance. From the OYT, 91 genotypes were selected from 363 genotypes. A total of eight genotypes were selected out of 56 genotypes from the AYT based on yield performances. Only one genotype out of nine genotypes was selected for re-trial in RYT. In Boro 2024-25, 21 single crosses were made that produced 4,699 seeds. A total of 18 crosses were selected and confirmed as true F_1. In RGA method, 22,148 segregating progenies were harvested from $F_{2\text{-}4}$ generations from 81 crosses. From LST, a total of 963 uniform lines out of 15,046 lines were harvested based on visual observation on homogeneity in flowering, plant height and grain size and shape. Selection intensity of the genotypes of LST was 6.4%. Trait marker profile of the selected materials of LST contained genes of high amylose, high zinc content, and some lines contained genes of aroma and few lines had insect resistance genes. From two OYTs, a total of 67 were selected from 531 genotypes. Among them, 30 genotypes out of 244 from OYT#1 and 38 genotypes out of 287 from OYT#2 were selected. A total of ten genotypes were selected from two AYTs out of 50 genotypes. From the two AYTs, ten genotypes were selected from 50 genotypes. Out of four genotypes, two genotypes were selected and recommended for promoting to RYT.	and diseases and acceptable grain quality will be developed.
1.12	**Development of Insect Resistant Rice (IRR)** The main thrust of the project was to develop varieties resistant to gall midge (GM), brown plant hopper (BPH), white backed plant hopper (WBPH) and green leaf hopper (GLH). The experiments were conducted in both T. Aman and Boro seasons. In the T. Aman 2024-25 season, 33 crosses for forward breeding, 10 crosses for pre breeding, three F_1 crosses for line augmentation were made, and 25 crosses were confirmed as true hybrids using quality check (QC) genotyping with purity SNP panel. In total 17,286 segregating progenies from 109 crosses of F_2-F_5 generations were advanced through Field Rapid Generation Advanced (FRGA)	BPH, WBPH, GLH 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).

	technique. Out of 2032 $F_{5:6}$ LST lines derived from 21 different crosses, 358 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 (*bph9, bph17_1, bph17_2, bph17_3 and bph32*), Gm (*Gm4_3* and *Gm4_4*) and grain quality *(Wx-A and Wx-10*). The yield trials (OYT, PYT and AYT) were conducted at three locations of BRRI Gazipur, Cumilla and Rangpur. Sixty-two genotypes were selected from 318 breeding lines in OYT. Twenty-five genotypes were selected from 81 genotypes in PYT. Ten genotypes were selected from 25 lines in AYT for further evaluation. In Boro 2024-25 season, 24 crosses for forward breeding, three crosses for pre-breeding and three F_1 crosses for line augmentation were made, and 41 crosses were confirmed as true hybrids through F_1 verification using quality check (QC) genotyping with purity SNP panel. A total of 27,128 individual segregating plants were advanced from 112 crosses in F_2-F_5 generations by FRGA technique. In LST, 778 lines having strong plant architecture, grain quality, uniformity in heading under field condition were selected from 5,167 $F_{5:6}$ breeding lines that are the descendants of 26 crosses. Total 104 genotypes, out of 318 were selected from OYT#1 that tested at three locations of BRRI Gazipur, Cumilla and Rangpur. In OYT#2, 35 genotypes were selected from 96 genotypes at BRRI Gazipur. Thirty lines were selected from 72 lines in PYT. Out of 39 genotypes, 12 were selected from AYT for further evaluation. Total 765 genotypes from OYT, PYT, AYT, Hybridization parents were screened at natural field condition of BPH hot spot area, Tarash, Sirajganj and ‘hopper burn’ symptom was not found due to low abundance of BPH population. Total 119 parental lines were maintained in insect resistant maintenance breeding program.	
1.13	**Development of Disease Resistant Rice (DRR)** Efforts were made for developing varieties resistant to bacterial blight (BB), rice tungro virus (RTV) and blast diseases. The experiments were conducted in both T. Aman and Boro seasons. Thirty-four crosses for BB and blast in T. Aman and 17 crosses for BB, blast, tungro, false smut and bakanae were made in Boro season. Fifteen crosses for BB and blast in T. Aman and 34 for BB, blast, tungro, false smut and bakanae were confirmed in Boro season as true F_1. A total of 45,150 progenies for BB and 49,950 progenies for blast were advanced from F_{2-6} generation through field rapid generation advanced (FRGA). Five hundred seventeen uniform lines were isolated from 5,574 LST lines in T. Aman and 953 out of 5,047 lines were identified from LST in Boro season based on uniformity in heading, plant height, and grain type. Twenty genotypes were selected from observational	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).

	yield trial (OYT) in T. Aman season, whereas 20 entries out of 400 for BB during Boro season showed better yield potential and agronomic performance over the check varieties and tolerance to BB. From AYT, three advanced lines were promoted based on growth duration, grain yield, and BB score compared to the check varieties in T. Aman season and two genotypes out of 43 from AYT#1, five genotypes out of 48 from AYT#2 and four genotypes out of 25 from AYT#3 for BB were selected in Boro season. In the regional yield trial (RYT), two genotypes for BB were selected in T. Aman season and two genotypes for Boro performed better considering yield, growth duration, BB resistance, and grain quality characters. In total 180 parental lines were maintained in disease resistant maintenance breeding program. Two short duration BB resistance genotypes were recommended from ALART. One long duration BB resistance genotype BR (Path)13800-BC3-8-9 9.11 t/ha which produced 10% higher than the check variety BRRI dhan89 (8.29 t/ha) and 14.7% higher than the check variety BRRI dhan101 (7.94) in PVT during Boro 2024-25. Growth duration was 147 days that's similar to BRRI dhan89 and three days longer than BRRI dhan101. The genotype BR (Path)13800-BC3-8-9 having 27.7% amylose content and the physico-chemical properties were satisfactory**.** The results of SNP QTL fingerprinting showed that the BB resistant proposed variety obtained *Xa21* gene and additionally blast resistant dominant genes *Pi9* and *Pb1*. The genotype BR12454 (Path)-BC2-69-97-39-5-44 was released as blast resistant long duration variety BRRI dhan114 comparing the check variety BRRI dhan89 for cultivation throughout the country in Boro season. BRRI dhan114 shows highly resistant reaction to blast (Blast score-1) in artificial inoculation by blast pathogen. The results of SNP QTL fingerprinting showed that the blast resistant proposed variety obtained blast resistant dominant genes *Pi9* and *Pb1*. The average yield of BRRI dhan114 was 7.8 t/ha with 149 days growth duration, its potential yield can be attained up to 10.17 t/ha with proper management.	
1.14	**Development of Submergence and Water Stagnation Tolerant Rice varieties** During T. Aman 2024, a total of 20,644 progenies from 104 crosses (3,320 from 17 F_2 crosses, 9,248 from 43 F_3, 2,472 from 10 F_4 progenies and 5,604 from 34 F_5 progenies), whereas, in Boro 2024-25, a total of 29,9987 progenies from 110 single crosses (3,940 progenies from 6 F_2 crosses, 10,418 progenies from 32 F_3 crosses, 4238 progenies from 17 F_4 progenies and 9,591 from 45 F_5 crosses and 1800 progenies from 10 F_6 crosses) have been scaled up, processed with proper labels and preserved. The mortality percentage of different RGA generations were around 29.5%. A total of 4,796 fixed	High yielding rice varieties with different growth duration and three weeks submergence, stagnant flood tolerances and anaerobic tillering capacity with yield

	breeding lines of 21 crosses were evaluated in the Line Stage Testing (LST) among which 144 lines were selected based on visual phenotypic performance and homogeneity, presence of flash flooding tolerant *SUB1* QTLs (four diagnostic SNPs viz. snpOS0040, snpOS0041, snpOS0042 and snpOS0043 spanning the *SUB1* QTL region), presence of high amylose content SNPs viz. Wx-int, Wx-GBSS-ex10, Wx-A_group and Wx-A-NB. Along with these genes, genes for bacterial blight resistance, blast resistance were also considered. In yield trial, a total of 426 genotypes were tested out of which, 67 genotypes were selected based on phenotypic acceptance, growth duration, survivability and higher yield performance. From OYT#1, 21 genotypes out of 246 genotypes, from OYT#2, 10 genotypes out of 76 genotypes, from AYT#1, 12 genotypes out of 53 genotypes, from AYT#2, 11 genotypes out of 16 genotypes, from AYT_Early, seven genotypes out of 18 genotypes, from AYT_Late, six genotypes out of 17 genotypes were selected. In AYT#1, The genotype BR14161-4R-21 produced the highest yield of 6.5 t/ha followed by BR12484-5R-44 (6.0 t/ha) and BR12950-5R-120 (6.0 t/ha) under controlled stress condition with the 96%, 96% and 84% survivability, respectively. In AYT#2, the genotype BR12506-5R-174 produced the highest yield of 6.47 t/ha with 94% survivability in tank followed by the genotype BR12490-5R-175 (6.2 t/ha). The yield of other selected genotypes was ranged from 5.0 t/ha to 5.9 t/ha under controlled submergence condition and 5.0 to 6.2 t/ha under rainfed conditions. In AYT_Early, the genotype BR11692-5R-345 produced the highest yield of 6.5 t/ha followed by IR16F1065 (6.4 t/ha) and BR12162-5R-350-1-P1 (5.8 t/ha) under tank condition with the 99%, 99% and 81% survivability, respectively. In AYT_Late, the genotype IR16F1201 produced the highest yield of 5.78 t/ha with 98% survivability in tank followed by the genotype IR13F478-3 (5.58 t/ha) with 99% survivability. The yield range of other selected genotypes were 5.08 t/ha to 5.54 t/ha. In PVS, though the trial was conducted in four locations in submergence prone farmer's field in Rangpur, Kurigram and Lalmonirhat, Gaibandha district, there was no flood in any location. The trial will be repeated. The heritability obtained for plant height, growth duration, grain yield was ranged from 59 to 98%, indicating medium to high level of precision of these experiments. Moreover, two varieties were released by NSB, one for tidal submergence ecosystem and one for flash food submergence prone ecosystem of Bangladesh. The breeding line BR9158-19-9-6-50-2-HR1 was released as a tidal submergence tolerant variety BRRI dhan109 and the breeding line	target 6.0-6.5 t/ha in normal condition and 5.5 t/ha in stress condition.

	IR16F1148 was released as a shorter duration flash flood submergence tolerant variety namely BRRI dhan110.	
1.15	**Development of Drought Tolerant Rice (DTR)** The project aims to develop high yielding drought tolerant rice varieties under rainfed lowland rice ecosystem in T. Aman season. In T. Aman 2024-25, a total of 781 F_1 seeds were obtained from 24 crosses using 15 parents and 25 crosses were confirmed as true hybrids using 10-SNP *indica* QC panel. In RGA, a total of 13,380 individual progenies of 39 crosses from F_2 and F_5 generation were harvested from T. Aman and 15,465 progenies of 50 crosses from F_2 and F_3 generation were harvested from Boro season. From line stage testing (LST), 398 lines were selected from 4,243 progenies of 19 crosses. Selection intensity was recorded 9.38% for the LST derived lines. Trait marker profile showed that the selected materials from LST contained genes/QTLs of drought tolerance along with high amylose (*WxA*), *xa5*, *BPH32* and gall midge. A total of 43 genotypes were evaluated in two AYTs in Gazipur, Rajshahi and Rangpur. Among the tested genotypes, seven promising genotypes were selected and forwarded to RYT. During flowering stage, the least drought stress was observed in Rajshahi as it was rained frequently and moderate drought was recorded at Gazipur in AYT. In Rangpur, no drought stress was observed. Two genotypes were forwarded from RYT to ALART due to its yield and drought tolerance ability. Genetic trend of the genotypes from 2016 to 2024 showed the pBLUP (grain yield) in respect of trial year yield increase of 84.77 kg/ha/year equivalent to about 2.1% increase in grain yield per year based on yield of 2016. In Boro 2024-25, a total of 281 F_1 seeds were obtained from 17 crosses using 14 parents, and 19 crosses were confirmed as true hybrids using 10-SNP *indica* QC panel. The RGA materials were advanced in the Boro 2024-25 from T. Aman season and 15,465 progenies of 50 crosses from F_2 and F_3 generations were harvested through RGA method. Under CRCIL drought program five three-way crosses and four backcrosses were made in Boro 2024-25.	Drought Tolerant Varieties for T. Aman season will be developed with potential yield target (5.0 – 6.0 t/ha).
1.16	**Development of water saving and aerobic rice varieties** A total of 20 crosses were made using 20 parents and 1,350 F_1 seeds were obtained, and 15 single crosses were selected and confirmed through QC SNP panel analysis. A total of 10,377 individual panicles were selected from 59 crosses (1540 progenies of 6 crosses from F_2, 5276 progenies of 26 crosses from F_3, 1596 progenies of 13 crosses from F_4, and 1965 progenies of 13 crosses from F_5) were harvested through FRGA. A total of 333 lines were selected from 1884 lines of 22 crosses based on uniformity and phenotypic acceptance, strong plant type and based on the key trait markers.	Water-use-efficient rice genotypes with 10% higher yield than the check varieties under transplanted alternate wetting and drying (AWD) and

	From yield trial, 14 genotypes were selected out of 59 genotypes. In OYT, four genotypes were selected from 40 genotypes and from AYT, 10 genotypes were selected evaluating 19 genotypes. In OYT, among all selected genotypes, the line BR13400-5R-16 produced the highest yield (7.2 t/ha) having growth duration of 143 days. In AYT, the genotype IR18R1133, produced the highest yield (7.4 t/ha) with a growth duration of 143 days. Both the check varieties BRRI dhan88 and BRRI dhan58 gave almost similar yield which was 6.5 t/h and 6.6 t/ha, respectively. The heritability obtained for growth duration and grain yield of the trials conducted ranged from 84 to 95%, and 48 to 94%, respectively, indicating medium to high level of precision in these experiments.	aerobic conditions will be developed.
1.17	**Development of Transgenic High Beta-carotene Rice and High Iron & Zinc Rice (Healthier Rice), T. Aman and Boro** The main objective of the project was to develop high yielding transgenic rice varieties with enhanced pro-vitamin-A, iron and zinc content in polished rice grain. In T. Aman 2024-25, with a view to developing high iron and zinc enriched rice, five backcrosses were made where 137 seeds were produced. BC_1F_1 generation was produced utilizing BR11712-4R-93, BRRI dhan98, BRRI dhan103 and BRRI dhan107 as recipient genotypes and BC_3F_1 was produced in the background of BRRI dhan87. Eleven hemizygous plants (H-type) were found from BC_2F_1 generation (BRRI dhan87*3/IR 135160 TR-3-B-19). After confirmation of BC_2F_1 in the background of BRRI dhan87 backcrossing was accomplished. The seeds of 54 advanced lines of contained trial (CT) and 12 advanced lines of Confined Field Trial (CFT) with the GR2E gene in different backgrounds of T. Aman varieties were multiplied. In Boro 2024-25, a total of 688 seeds of BC_2F_1 generation were harvested from three backcrosses to develop high iron and zinc enriched rice in the background of BR11712-4R-93, BRRI dhan98 and BRRI dhan103. Plants of BC_1F_1 in the background of BRRI dhan103, BR11712-4R-93, BRRI dhan98 were genotyped and two B type (fixed lines) and 13 H type (hemizygous) plants were identified and allowed to backcross. BC_3F_1 plants in the background of BRRI dhan87 were genotyped and eight B type and 11 hemizygous plants were identified. F_1 plants were confirmed for the cross of BRRI dhan105 and IR 135160 TR-3-B-19. The seeds of 85 advanced lines of CT and 10 advanced lines of CFT with the GR2E gene in different backgrounds of Boro varieties were multiplied. Previously completed CFT of golden rice in the background of BRRI dhan28 and pure lines of GR2E BRRI dhan29 was multiplied for future use. The seeds of the BRRI dhan29 golden rice was multiplied as per maintenance purity.	Development of high yielding rice varieties with enhanced Provitamin A, high Iron and Zinc content in polished rice grain.

1.18	**Development of Photosensitive Rice for Charland** During the T. Aman 2024-25, a total of 22 crosses were made using 21 parent lines. A total of 13 crosses were confirmed, out of 16 as true hybrids using 10-SNP *indica* QC genotyping panel. In FRGA, a total of 6,869 progenies from 48 crosses (2,984 progenies of 10 F_2 crosses, 2,497 progenies of 23 F_3 crosses, 1,109 progenies of 10 F_4 crosses, 279 progenies of five F_5 crosses) were harvested for further advancement. In the Line Stage Testing (LST), 62 genetically fixed lines out of 1749 progenies from 13 crosses were selected through the combination of visual phenotypic assessment and trait-based genotyping with 3.54% selection intensity. In Preliminary Yield Trial (PYT), four advanced lines out of 10 were selected, whereas advanced line BR11764-5R-124 gave the highest grain yield (4.56 t/ha) with 130 days growth duration, and best-performing check variety, BR23, produced 4.29 t/ha grain yield with 131 days growth duration. In the Advanced Yield Trial (AYT), four advanced lines were selected out of nine genotypes. In AYT, advanced line BR8845-21-1-10-3-3 gave the highest grain yield (4.18 t/ha) with 126 days growth duration, whereas the high-yielding check variety BR23 produced 3.82 t/ha grain yield with 127 days growth duration. The estimated heritability of AYT was 99% for plant height (cm), 92% for days to maturity, and 52% for grain yield. In ALART for photosensitive rice, one advanced breeding line, BR10212-5-5-3 was promoted to PVT due to its higher yield (4.86 t/ha) compared to best best-performing check variety, BR23 (4.32 t/ha).	Photo-sensitive high yielding varieties will be developed

Genetic Resources and Seed Division

Research Progress for 2024-25 from Genetic Resources and Seed Division, BRRI

- Two collection missions were made during the reporting year and 632 rice germplasm of which 12 of Aus, 566 of T. Aman, 52 of Boro seasons and two wild rice were collected from different districts of Bangladesh.
- In total, 46 new germplasm accessions were registered as new accessions (from accession number 9,007 to 9,052) in BRRI Genebank after processing and duplicate sorting.
- Fifty-nine (59) germplasm accessions of Boro 2024-25 were morphologically characterized using 'Rice Germplasm Descriptors and Evaluation Form' of GRSD.
- Rejuvenation of 2,154 accessions of which 470 accessions (between Acc. 6001 to 9006) in Aus 2024; 939 accessions (between Acc. 2001 to 3104) in Aman 2024 and 791 accessions (between Acc. 4701 to 7000) in Boro 2024-25 seasons, respectively was completed and on average 500 g of fresh seeds per accession were obtained.
- In details 2,154 accessions of which 470 accessions of Aus varieties, 939 accessions of Aman varieties and 745 accessions of Boro varieties were processed and stored in their respective accession number in short-term storage. At the same time, 1,020 accessions comprising 75 accessions of Aus, 506 accessions of Aman and 439 accessions of Boro varieties were processed and stored in medium-term storage. Similarly, 476 accessions comprising 56 accessions of Aus, 371 accessions of Aman and 49 accessions of Boro varieties, respectively were processed and stored in long-term storage.
- In total, 2,748 samples of rice germplasm and BRRI developed rice varieties were supplied to 45 different users in the reporting year.
- Thirty-three similar named Nazirsail group of rice germplasm accessions along with BR4, BR22, BRRI dhan49 and Nizer Sail (DA25) were characterized through ten quantitative and 33 qualitative characters in T. Aman 2024 and were grouped into eleven clusters based on cluster analysis.
- Seventeen similar named Rata Boro group of germplasm accessions with BRRI dhan28, BRRI dhan34, BRRI dhan50, BRRI dhan104, Habiganj Boro VI, Kalizira (acc. 1589), Bangladesh Kalijira (acc. 247), Tepu IRRI (acc. 6213) and Topa (Tepi) Boro (acc. 4373) were characterized through 18 quantitative, 33 qualitative characters and 14 SSR markers. The genotypes were grouped into six clusters based on cluster analysis. Form molecular study, RM515 was found the best marker and the genotypes were grouped into four major clusters by UPGMA clustering.
- One-hundred Aus germplasm were characterized through 11 quantitative and 33 qualitative characters. G29 (RAJASAIL IRRI) was found the highest yielded germplasm. Flag leaf angle, culm angle, panicle exertion, grain awn, awn color and seed coat (bran) color showed high diversity index (1.00-1.99). Moreover, G1 (AUS DHAN-2), G5 (KHATO MALA), G6 (KATAK TARA), G10 (MINIKIT), G15 (BASHFUL IRRI) and G96 (BRRI JHUM DHAN LOWAS) showed moderately susceptible reaction against sheath blight and 14 accessions germinated under anaerobic condition.
- Sixty-four rice germplasm were characterized through 13 morphological quantitative traits and Nagra (Acc. 1146) showed the highest (11.36 mm) grain length and dehulled grain length (8.25 mm) and the highest yield (28.00 g) was found in Bash moti (Acc. 8692).

- Fifty-six wild rice germplasms were characterized morphologically during 2024-25 from live wild rice conservation net house of GRSD, BRRI, Gazipur. Most of them had longer plant height (>130 cm) with 210 cm in WR27. WR27 produced the highest panicle length (40 cm),WR23 showed the highest culm diameter (8 mm) and lodging incidence was found the lowest (0%) in WR2, WR3 and WR13. Besides, most of the plants leaf blade pubescence was intermediate and pale green, leaf sheath anthocyanin color was absent, basal leaf sheath color was green, leaf angle was erect, flag leaf angle was horizontal and grain shattering was very high.
- One hundred and thirty BRRI developed and recommended rice varieties were maintained through nucleus seed production. Besides, nucleus seeds of 68 varieties were produced to be used as the source of breeder seed (BS).
- In total 232.47 tons of breeder seed with tags in which 154.54 tons of 27 Boro varieties, 14.84 tons of nine Aus varieties and 63.09 tons of 35 T. Aman varieties and 3.25 tons of foundation seed were produced during 2024-25. Among the total production, 7.41 tons of breeder seed and 3.25 tons of foundation seed (FS) were produced under PARTNER project fund. Besides, a total of 194.890 tons of breeder seed of which 119.630 tons of 27 Boro varieties, 14.06 tons of six Aus varieties and 61.20 tons of 34 T. Aman varieties were distributed among among 675, 49 and 401 SeedNet partners (GO, NGO and PS) of 'BRRI Rice Seed Network'.
- Breeder seed plots of 11 BRRI R/S were regularly visited by the GRS scientists along with foundation seed (FS) producing farms to observe the varietal purity and performance of the respective classes of seeds.

Program Area: Farm Mechanization and Postharvest Technology

Farm Machinery and Postharvest Technology Division

Research Progress (2024-25)

Highlights of Research Activities (2024-25)

The number of experiments was approved.	Forty-three experiments were included in the annual research program/plan for 2024-25. There were 22 plans/programs for GoB, 11 plans/programs for the SFMRA project, six plans/programs for the PARTNER project, three plans/programs for the VRTHB project, and one plan/program for the SFMRA project. There were also 19 programs or plans in ARP 2024-25.
The number of experiments was executed.	A total of 13 experiments were executed during the last reporting year.

1. Research progress (2024-25) (Program/Project-wise separately)

PROJECT 1: AGRICULTURAL MACHINERY DEVELOPMENT AND TESTING

Experiment 1.1: Design, development, and performance evaluation of a BRRI head feed combine harvester (funded by SFMRA project)

Principal Investigator: Arafat Ullah Khan
Co-Investigator: AKMSI, MKP

Objectives

- To design and develop a BRRI head feed combine harvester
- To evaluate the field performance of the developed head feed combine harvester
- To compare the performance with an imported combine harvester

Achievement/Progress:

<table>
<tr><th>Sl. No.</th><th>Activities to Achieve the Objective(s)</th><th>Output/Findings</th></tr>
<tr><td>1.</td><td>Fabrication Process
The BRRI head feed combine harvester was designed with the following key considerations
• Use of locally available raw materials to reduce fabrication costs.
• Ease of repair and maintenance using locally available spare parts.
• A single delivery chute to minimize grain damage.
• Compact size for easy transportation.
• A grain tank with a minimum 500 kg capacity
• A four-cylinder engine to reduce vibration and noise.
• Mechanical power transmission via Hydrostatic Transmission (HST) to ensure efficient operation.
• Minimum harvesting capacity of 0.5 ha with minimum harvest losses.
Design Process
The harvester was designed using AutoCAD tools, carefully considering the operational requirements specific to Bangladesh's diverse farming conditions. The machine comprises a basement, engine unit, header, conveying hopper, threshing unit, and storage unit, ensuring an efficient and user-friendly working environment for the operator.
Key Design Features
• Basement and Main Body: Made from MS (Mild Steel) box material to support the machine’s weight and hold the components in place.
• Engine: A 77 hp four-cylinder diesel engine was selected based on the power requirements for the</td><td>A head feed combine harvester with a dimension of 4250mm×2030mm×2580mm , 4-cylinder engine power of 77 hp, and a cutting width of 1450 mm was designed, developed, and fabricated considering ground pressure, forward speed, ease of operation, land condition, and business viability at the FMPHT divisional research workshop and Alim Industries Ltd, Sylhet with the help of other local agricultural machinery manufacturers.</td></tr>
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machine's various units (cutting, conveying, threshing, etc.).

- **Power Transmission:** Power is transmitted through belt pulleys, chain sprockets, and shafts to the harvester's different sections.
- **Hydraulic and Cleaning Sections:** These sections ensure smooth operation, efficient grain handling, and separation of rice grains from other materials (e.g., straw).

Design and Fabrication Steps

The design was divided into several steps for systematic development.

- **Walking Section:** Includes base assembly, walking wheels, guide wheels, and crawler assembly.
- **Main Power Section:** Incorporates the gearbox assembly and engine assembly.
- **Operating Section:** Includes control panels, gearshift assemblies, and operational clutches.
- **Hydraulic Section:** Hydraulic oil systems and oil tank assembly for power transmission.
- **Cleaning Section:** Includes vibrating screens, straw-expelling plates, and fan systems for grain cleaning.
- **Grain Conveying Section:** Augers and gearboxes for smooth grain transfer to storage tanks.
- **Threshing Section:** Includes concave screens, threshing rollers, and dusting fans for efficient grain separation.
- **Large Grain Tank Section:** A large grain tank (500-550 kg capacity) to store the harvested grain.
- **Header Section:** Harvest gearboxes, pick-up frames, and crop root conveying components.

Conceptual Framework

The research followed a comprehensive conceptual framework (**Diagram 1**) that included

- Performance analysis of existing combine harvesters.
- Design considerations tailored to Bangladesh's farming needs.
- Fabrication process using locally available materials.
- Field testing under both load and unload conditions.
- Evaluation and fine-tuning of the machine based on test results.

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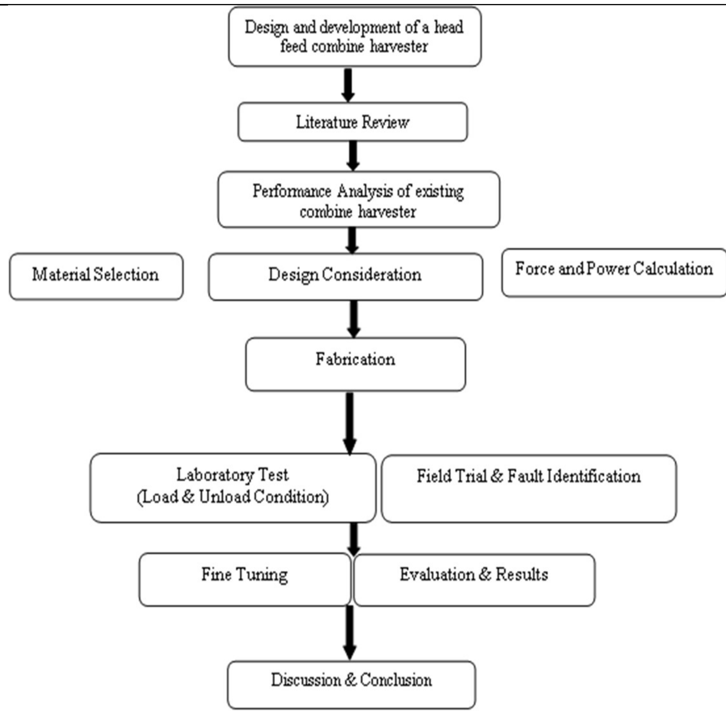

Diagram 1. Conceptual framework of the design and development Process
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<td>2.</td>
<td>Field Performance Evaluation

The BRRI head feed combine harvester was field-tested during the Aman 2023 season at the BADC Farm and farmers' fields in Sylhet District and the West Byed Research Plot at the Bangladesh Agricultural Research Institute (Plate 1). The field tests were conducted in the presence of key stakeholders, including
Honorable Secretary of the Ministry of Agriculture (MoA).
Director-General of Research Institutes and related project personnel.
Agricultural machinery operators, local manufacturers, and farmers.
For the performance study, the Kubota combine harvester and the BRRI Model (BRRI HCH2023) were tested. Data were collected on grain loss, field efficiency, plant density, and crop cutting heights to evaluate the combine's performance. Additionally, feedback from the audience present during the tests was gathered.

Plate 1. Field performance of the BRRI head feed combine harvester</td>
<td>The field tests of both combine harvesters (BRRI model and Kubota) were conducted at the BARI Farm in Gazipur and the BADC Farm in Sylhet. Forward speed during harvesting ranged from 3.0 to 4.0 km/h. The field capacity of the harvester was obtained at 1.0 - 1.20 acre/h, and fuel consumption was 10-11 l/h. The developed combine harvester is suitable for operating in the fragmented farmland.</td>
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Title of the Experiment 1.2: Design, Development, and Performance of a BRRI Automatic Seed Sower Machine for raising mat-type seedlings (funded by SFMRA project)

Principal Investigator: Arafat Ullah Khan
Co-Investigator: AKMSI, MKP

Objective

- To design, develop, and evaluate the performance of a BRRI automatic seed sower machine for raising mat-type seedlings efficiently.

Achievement/Progress:

Sl. No.	Activities to Achieve the Objective(s)	Output/Findings
1	The BRRI automatic seed sower machine was designed and fabricated using locally available materials at the Farm	The design and development of a

	Machinery and Postharvest Technology (FMPHT) divisional research workshop. The machine's components include • **Main Frame:** Supports the entire structure. • **Bed Soil Hopper and Top-soil Hopper:** Distribute soil uniformly on seedling trays. • **Seed Hopper:** Ensures precise seed distribution. • **Water Tank:** Provides consistent water supply. • **Tray Conveyor with Rollers:** Allows smooth movement of seedling trays through the sowing process. • **Motor and Power Transmission System:** A 0.5 hp motor drives the operations using a chain-sprocket system. The prototype was designed using *AutoCAD* tools. Jigs and molds were developed for quick replication. Field and laboratory performance evaluations were conducted at the FMPHT divisional research workshop in Gazipur and at farmers' fields in Dinajpur. **Design Consideration** ▪ **Compact Size:** Machine width set at 61 cm to accommodate 58 cm seedling trays. ▪ **Use of Local Materials:** Fabricated with locally available materials to reduce costs. ▪ **Precision:** Features adjustable soil and seed rate control via levers and knobs. ▪ **Efficiency:** Designed to improve sowing efficiency compared to manual methods. ▪ **User-friendly:** Simple operation, repair, and maintenance processes. ▪ **Dual operator functionality:** Can be operated by two people simultaneously. **Design and Fabrication Steps** ***Seeding Preparation*** ▪ Identified challenges in tray-based mat seedling preparation. ▪ Considered farmers' needs and existing solutions. ***Fabrication*** • **Frame:** Constructed from mild steel, bearing the machine's load with five sturdy legs for support. • **Tray Conveyor:** Ensures smooth tray movement with rollers that fit standard seedling trays. • **Soil Hoppers:** Two hoppers (80 kg and 40 kg capacities) distribute soil on trays using conveyor belts.	BRRI automatic rice seed sower machine to raise mat-type seedlings for mechanical transplanting. This machine was fabricated at the FMPHT divisional research workshop and Uttaron Engineering Workshop, Kalitola, at Dinajpur. The BRRI auto seed sower machine was tested in the FMPHT research workshop. It was fine-tuned to accommodate various soil textures and sizes of paddy seeds. The seed distribution rate can be finely tuned with a brush adjustment meter, allowing 120 to 160 grams of sprouted seeds to be placed in each tray. With the auto seed sower machine, a worker can sow seeds in 1680 trays per hour. After sowing the sprouted seeds, each tray's topsoil layer (5-6 mm) can be covered with loose soil.

- **Seed Hopper:** Positioned between soil hoppers ensures accurate seed placement (10 kg capacity).
- **Water Tank:** A 44-liter tank facilitates watering during the process.

Power Transmission

- Equipped with a 0.5 hp motor operating at 1400 rpm, connected to the machine via a chain-sprocket system.
- A gearbox with a 1:20 ratio ensures efficient power transfer.

Tray Cleaning and Leveling

- Brushes clean and level soil across trays to prepare an optimal seed base.

Field Performance

The BRRI automatic seed sower demonstrated significant efficiency improvements; its operations are shown in **Plate 2**.

- **Sowing Speed:** A single operator can manually sow seeds in 1680 trays/hour, compared to 50-60 trays.
- **Seed Distribution:** Achieved precise placement of 120-160 g of sprouted seeds per tray.
- **Top-soil Covering:** Covered trays uniformly with 6 mm of soil after seed placement.
- **Ease of Use:** Machine operation requires minimum training and can be used by both men and women.

Advantages

- Improved efficiency in preparing seedling trays.
- Reduced time and labor requirements.
- Uniform seed and soil distribution.
- Potential for community-based seedling production systems, encouraging rural entrepreneurship.

Plate 2. BRRI Automatic Seed Sower Machine in operation

Title of the Experiment 1.3: Design and development of a head feed power thresher

Principal Investigator: Subrata Paul
Co-Investigator(s): MDH, BCN, MGKB, MAH, SI

Objectives

- To design and develop a head feed thresher for more efficient rice threshing.
- To conduct a performance test of the newly fabricated thresher.
- To compare the performance of the newly developed thresher with the existing BRRI thresher.

Achievement/Progress:

Sl. No.	Activities to Achieve the Objective(s)	Output/Findings
1.	The head feed thresher prototype was developed using locally available materials to minimize costs. These included MS sheets, flat bars, angle bars, shafts, GI pipes, nuts, bolts, gears, belts, and pulleys. The design incorporated head feed combine harvester mechanism features, including a wire-loop threshing drum and feeding mechanism, belt-pulley power transmission, and structural components like chassis and grain conveying unit. **Key design considerations included** • **Dual Function Mechanism:** Operates in both head feed and whole feed modes. • **High Capacity:** Efficiently handles small bundled paddy compared to open drum threshers. • **Ease of Operation:** Simple controls for two-person operation with low maintenance. • **Farmer Acceptance:** Designed to meet farmers' performance, usability, and cost needs. **Fig. 1** provides a schematic representation of the power transmission system and **Fig. 2** illustrates the head feed thresher's drawing views.	A head feed thresher was fabricated utilizing locally available materials at the FMPHT divisional workshop, BRRI, Gazipur. The study was intended to develop, manufacture, and test the 2nd version of the prototype of the head feed thresher's performance.  **Plate 5.** Functional components/units of the developed thresher

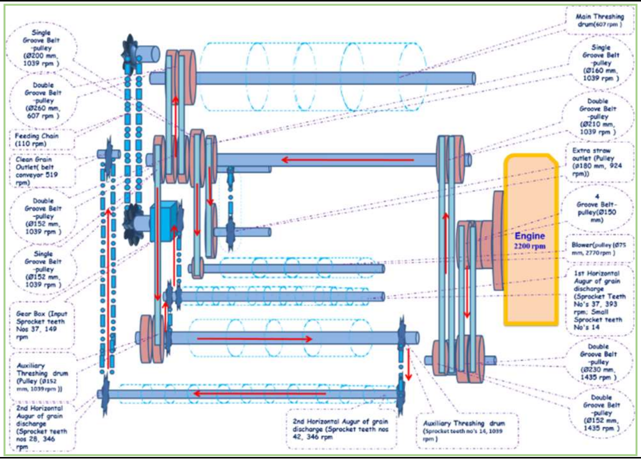
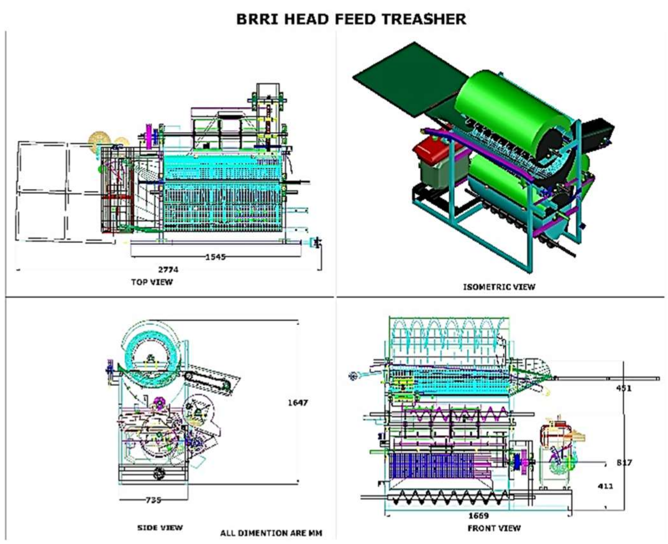
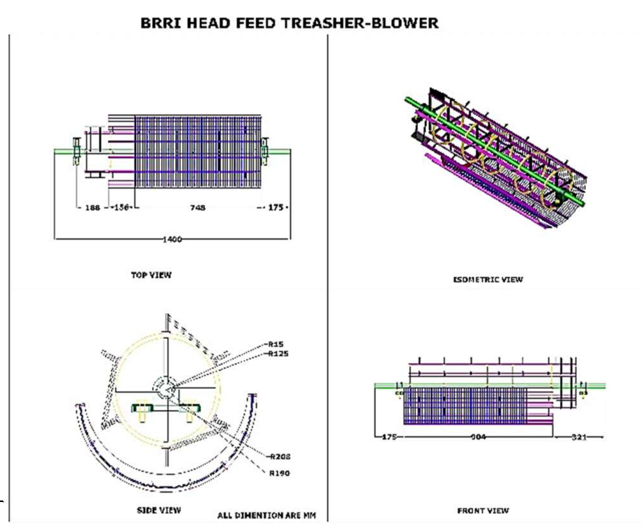


Fig. 1. Schematic Illustration of the Power Transmission System





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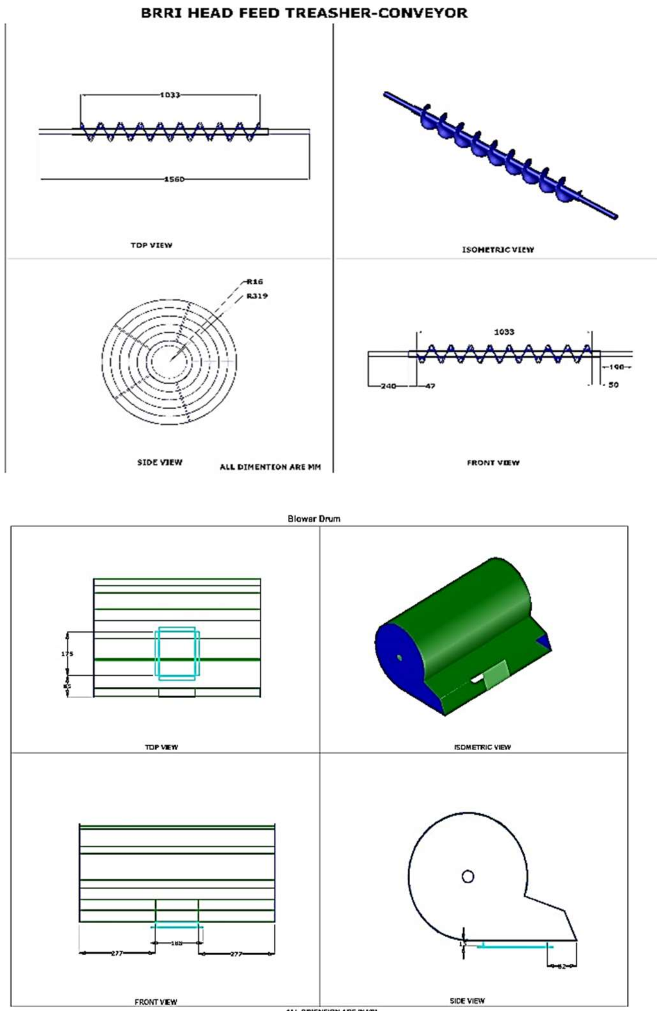

Fig. 2. Drawing Views of the Head Feed Thresher
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<td>The divisional research workshop conducted the machine's first performance test (Plate 4). Raising the drum speed improved threshing and cleaning efficiency while increasing the feed rate and seed moisture content, resulting in both efficiency losses. The higher stripping and impacting pressures applied to the grains, which tend to enhance the threshing operation and boost threshing and cleaning efficiencies, were responsible for improving the percentage of threshing and cleaning efficiencies by increasing drum speed. Lower cleaning and threshing efficiency are the result of higher moisture content. These outcomes were ascribed to the high moisture content and high</td>
<td>A few faults were found, and modifications were made to eliminate those faults. Machine capacity was adequate, but the cleaning facility did not perform satisfactorily. Some improvements were made, and a comprehensive test will be organized in the upcoming season.

Threshing Efficiency
• Increased drum speed improved threshing but reduced overall</td>
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	elastic conditions, which slightly impact the threshing materials.  **Plate 4.** Performance test of the head feed thresher	efficiency at higher feed rates and moisture levels. • The head feed mode preserved straw length, though it resulted in 3-4% unseparated paddy. **Blower Efficiency** • Cleaning was suboptimal due to insufficient blower speed, leaving some straw mixed with threshed grains. **Capacity** • The machine handled high paddy volumes efficiently but required adjustments for higher moisture content and variable plant heights. **Identified Problems** ❖ The bundle of rice is not fixed; it is torn ❖ There is some unthreshed paddy in place of paddy bundles ❖ Some pieces of straw remain with the threshed rice ❖ The blower speed is low ❖ Cleaning efficiency is low ❖ The vibration of the device is high

PROJECT 2: MILLING AND PROCESSING TECHNOLOGY

Experiment 2.1: Design and development of twisting-type manual paddy de-husker

Principal Investigator: Bidhan Chandra Nath
Co-investigator(s): S Paul, GK Bhuiyan, S Khatun, J Nayim

Objectives

- To develop a manual paddy de-husker using locally available materials for (small-scale) laboratory-scale rice de-hulling.
- To evaluate the performance in terms of efficiency and head rice recovery.

Achievement/Progress:

Sl. No.	Activities to Achieve the Objective(s)	Output/Findings
1	The **FMPHT Division of BRRI** developed the prototype, prioritizing ease of operation, lightweight construction, portability, and simple assembly. **Locally sourced materials**, including Nylon, Teflon, and Wood, were used to minimize costs while ensuring the machine's durability. The design process involved creating **3D models** using	The FMPHT Division of the Bangladesh Rice Research Institute (BRRI) has developed a twisting-type manual

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Autodesk Fusion 360 for precise fabrication. After fabrication, the de-husker underwent an initial performance evaluation using three rice varieties: BRRI dhan81, BRRI dhan89, and BRRI dhan96.

Design Considerations

The design of the twisting-type de-husker focuses on the following key aspects:

Twisting Mechanism: A manual twisting motion is used to apply shear force to the paddy grains, separating the husk.
Material Selection: Durable materials like Nylon, Teflon, and Wood were chosen for their low cost and longevity.
User Ergonomics: Designed for ease of use with minimal training required.
Pressure Adjustment: The de-husker features an adjustable mechanism for varying pressure, allowing it to process different rice varieties effectively.

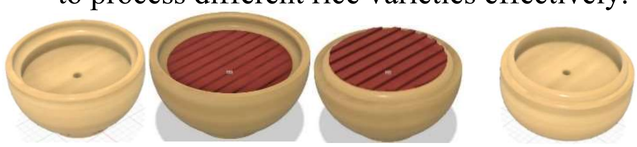

Plate 6. Main body of the de-husker

Plate 7. De-husking/ friction plates

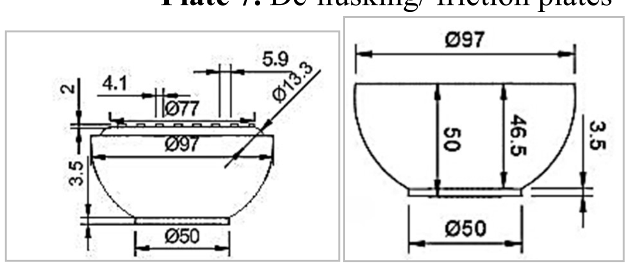

Plate 8. Dimension of de-husker chamber
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<td>paddy de-husker designed for small-scale and laboratory rice processing. This innovative tool offers an efficient, user-friendly, and cost-effective solution for removing husks from paddy. The de-husker's fabrication uses nylon, Teflon, and wood to prioritize ergonomic design, durability, and ease of operation.</td>
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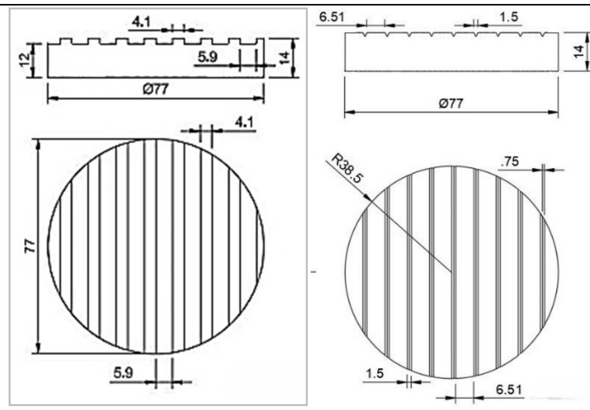


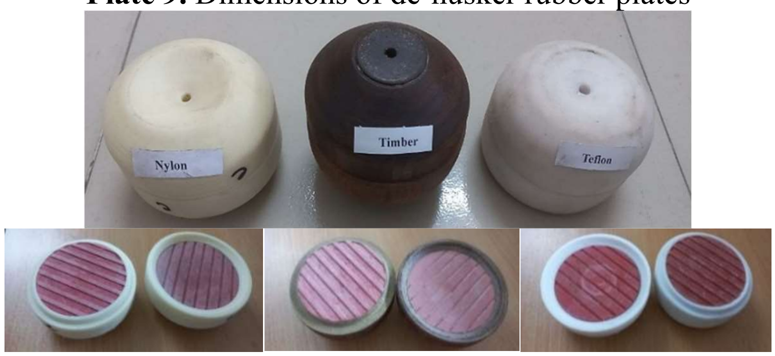
Plate 9. Dimensions of de-husker rubber plates


Plate 10. Prototypes of de-husker fabricated by different materials.
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The rubber plates that grip the paddy grains have specific dimensions and groove depths to enhance husk removal efficiency. The upper plate has a groove depth of 4.1 mm, while the lower plate has a groove depth of 0.75 mm
Weight
The weight of the de-husker varies depending on the materials used:

Teflon-made de-husker: 878 grams
Nylon-made de-husker: 561 grams
Wood-made de-husker: 472 grams

This variation in weight is determining the ease of use and portability of the device.

The performance of the de-husker was evaluated based on its efficiency in removing husks and recovering head rice. Three de-husker types, Nylon, Teflon, and Wood, were tested on three rice varieties: BRRI dhan81, BRRI dhan89, and BRRI dhan96. Performance of Developed De-Huskers

Teflon showed the highest de-husking efficiency for BRRI dhan81 with 79.81% husk removal efficiency.
Nylon exhibited a range of efficiencies, with the lowest efficiency for BRRI dhan89 at 49.38%.

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<td>The performance evaluation of the husker used three rice varieties: BRRI dhan81, BRRI dhan89, and BRRI dhan96. The results demonstrated that the de-husker fabricated with Teflon achieved the highest brown rice yield (up to 79.81%) and the lowest broken rice content (2.52%). This indicates that Teflon is the most effective material for producing high-quality rice with minimal grain breakage. While nylon de-huskers also yielded high results</td>
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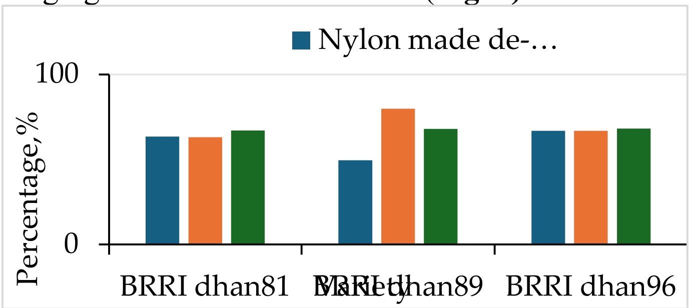
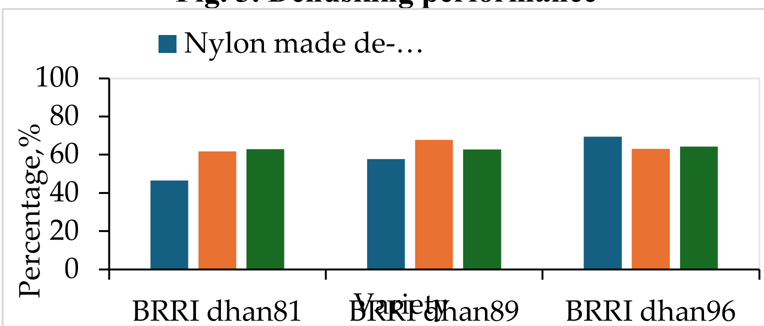
	• Wood provided moderate de-husking efficiency, ranging from 67.97% to 68.16% (**Fig. 3).**  **Fig. 3. Dehusking performance**  **Fig. 4.** Head rice recovery	(up to 74%), they exhibited higher broken rice content (up to 42%), suggesting lower suitability for applications where grain integrity is essential. Wood-made de-huskers offered moderate performance, providing a balance of yield and quality but with higher broken content than Teflon. In conclusion, the Teflon-made twisting-type manual paddy de-husker developed by BRRI is an ideal solution for small-scale and laboratory rice processing.

Experiment 2.2: Design and Development of a Two-stage Rice Mill

Principal Investigator: Md. Golam Kibria Bhuiyan
Co-investigator(s): MDH, BCN, SP, MMR, MMI, SI

Objectives

- To design and fabricate a two-stage rice mill
- To evaluate the performance of the fabricated rice mill.
- To compare the performance of the newly developed rice mill with the traditional Engelberg huller.

Achievement/Progress:

Sl. No.	Activities to Achieve the Objective(s)	Output/Findings
1	The two-stage rice mill incorporates advanced milling mechanisms designed to maximize efficiency and rice quality: • **Husking Stage:** Rubber rollers gently remove the husk from the paddy while minimizing grain breakage and preserving quality. • **Polishing Stage:** This stage removes the bran layer from brown rice using a stone polisher,	The FMPHT Division undertook a project to design and develop a two-stage rice mill to enhance rice milling efficiency and increase head rice recovery. A detailed AutoCAD design was

	resulting in clean, white rice with minimal broken grains. The mill was fabricated at the Salam Engineering Workshop of Dinajpur district under the direct supervision of BRRI expert manpower. It includes components such as a husker, polisher, husk separator, and grader. A 25-horsepower motor supplies power distributed through a belt and pulley mechanism. Paddy is loaded via a bucket elevator, and the milling process is shown schematically in Diagram 2. **Design Steps** • **Paddy cleaner fabrication:** Removes straw, dust, and foreign materials using a 5 hp motor. • **De-stoner fabrication:** Removes stones and other particles using a 5 hp motor. • **De-husking mechanism:** This mechanism features two 15 cm rubber rollers powered by a 10 hp motor and a husk aspirator for husk collection. • **Polishing mechanism:** A 15 cm diameter, 60 cm length stone polisher powered by a 25 hp motor removes the bran, while a blower collects by-products. • **Grading mechanism:** A sieve powered by a 5 hp motor separates rice into different grades. **Materials Used** • Motors: 5 hp, 10 hp, and 25 hp. • Rubber rollers, stone polisher, blower, husk aspirator, angle bars, flat bars, pulleys, shafts, and a bucket elevator. • Main body fabricated with 1.8 mm MS sheets. **Diagram 2** illustrates various views of the two-stage rice mill, highlighting its technical design and layout for operational clarity.	created to guide the manufacturing process. The mill's key components include a cyclone separator, de-husker, rubber roll polisher, and length grader.

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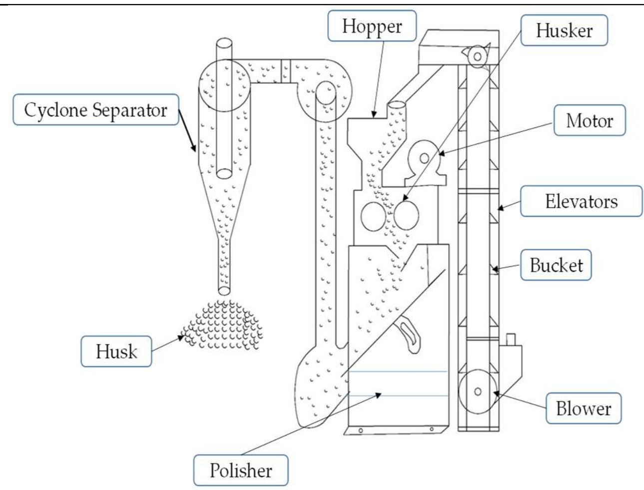
<td>

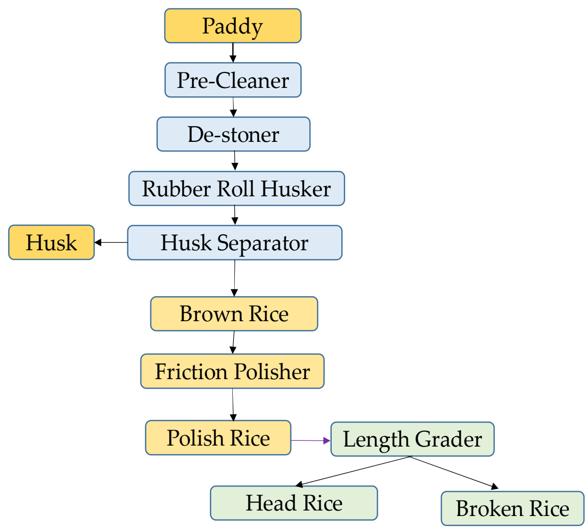


Diagram 2. Schematic Diagram and Working Principle of the Two-Stage Rice Mill</td>
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<td>Performance Evaluation
The performance evaluation will assess the mill's effectiveness and compare it with that of traditional single-stage mills, such as the Engelberg huller. Plate 11 illustrates the milling process and its operational workflow, outlining the schematic diagram and working principle of the two-stage rice mill.


Plate 11. Views of the Two-stage rice mill</td>
<td>A 25-hp motor will power the mill, and the fabrication is being carried out at Salam Engineering Workshop in Dinajpur. The primary structural elements and roller attachment have been completed and are ready for testing. The project is anticipated to be fully finished within six months, and the final test results and performance</td>
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	Key performance metrics include: • **Milling recovery:** Percentage of paddy converted into rice. • **Head and broken rice:** Proportion of whole versus broken grains. • **Husk and bran percentage:** Quantity of husk and bran separated from rice. • **Degree of milling (DoM):** Extent of rice polishing. • **Brown rice percentage:** Proportion of brown rice after de-husking. • **Electricity consumption:** Energy usage per ton of rice processed (kWh). These metrics will comprehensively analyze the two-stage rice mill's operational efficiency and impact on rice quality.	evaluation will be presented at future internal review meetings.

Experiment 2.3: Design and Development of Grain Collector

Principal Investigator: Md. Golam Kibria Bhuiyan
Co-investigator(s): MDH, BCN, SP, HR, MMA

Objectives

- To design and develop a grain collector for efficient grain collection
- To evaluate the performance of the fabricated grain collector
- To compare the performance of the grain collector with traditional manual methods
- To disseminate the grain collector for practical use in agricultural operations.

Achievement/Progress:

Sl. No.	Activities to Achieve the Objective(s)	Output/Findings
1	The grain collector was designed using AutoCAD tools to ensure precision in dimensions and specifications. The fabrication was conducted at the FMPHT Division of BRRI using the following materials • MS Sheets for the structural framework, ensuring strength and durability. • MS Sheets for fabricating collector components. • Other materials: MS bars, flat bars, angle bars, MS pipes, nuts, bolts, and bearings for the frame, support structures, and moving components. The assembly involved • Cutting and shaping sheets and bars according to the design	The FMPHT Division at BRRI has developed a Grain Collector to enhance the efficiency and cost-effectiveness of grain collection. This initiative aimed to fabricate and disseminate a grain collector that would outperform traditional methods. The performance data from the trials demonstrated the effectiveness of the grain collector. On average, the collector collected 13 kg of grain per operation,

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- Welding and assembling components
- Apply paint to protect against corrosion.

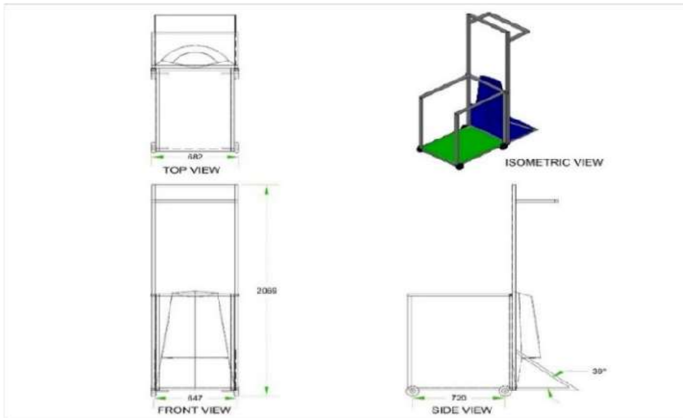

Fig. 5. Some drawing views of Grain Collector

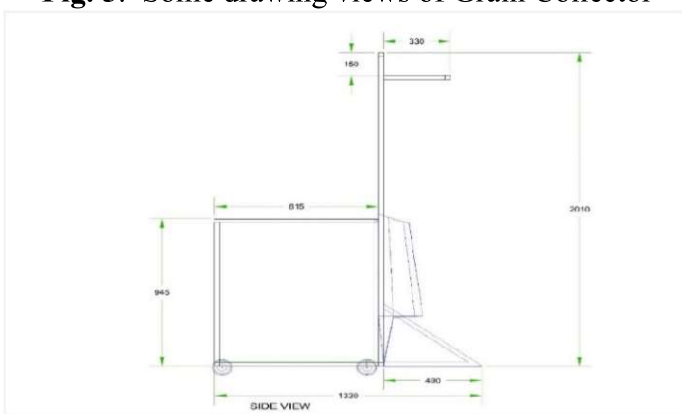

Fig. 6. Full drawing view of Grain Collector

Design Considerations

The grain collector was developed with the following considerations

- **Ease of operation:** Spontaneous controls and ergonomic handles to reduce human drudgery.
- **Durable:** Use of MS sheet for an optimal balance of weight and strength.
- **Efficient grain collection:** Maximized grain collection per operation to reduce time and effort.
- **Maintenance accessibility:** Easy-to-maintain components for longer usability.
- **Locally available materials:** Ensures quick and affordable repairs.

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<td>with 118 seconds required to fill a gunny bag. The Grain Collector operation rate was approximately 0.32 kg/sec. This compares favorably with traditional grain collection methods, which require about two workers to fill a gunny bag in 5 minutes, with an operational cost of 8 Taka/bag. The grain collector necessitates only one worker, significantly reducing labor requirements and operational costs to 4 Taka/bag. Moreover, it considerably reduces the time spent filling a gunny bag to approximately 1 minute and 32 seconds.
The performance trials yielded the following results</td>
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<td>Performance Evaluation</td>
<td>• Grain collection capacity: The average amount of grain</td>
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	The performance of the grain collector was evaluated based on the following metrics 1. **Amount of grain collected per operation:** Measured the total weight collected per pass. 2. **Time required to fill a gunny bag:** Recorded the time to fill a standard 37 kg/bag. 3. **Labor requirement:** Assessed the number of workers needed for operation. 4. **Operational cost per bag:** Calculated the cost of operation per bag, including labor and material costs.  **Plate 12.** Field Performance of Grain Collector	collected per operation was 13 kg, with a range of 11.5 - 14 kg. • **Time required:** Filling a 38 kg gunny bag required an average of 118 seconds, significantly faster than manual methods. • **Labor requirement:** The grain collector reduced labor requirements to one worker, compared to two workers for manual collection, which saved 50% of labour. • **Operational cost:** The operational cost was 2.0 Taka per bag, compared to 8 for manual methods. This saves about two-thirds of the total operational cost.

PROJECT 3: RENEWABLE ENERGY

Title of the Experiment 3.1: Design and Development of Solar-powered Operated Sprayer

Principal Investigator: Md. Moudud Ahmmed
Co-investigator(s): GKB, HR, SP, BCN

Objectives:

- To design and develop a solar-powered sprayer
- To conduct the performance test of the developed sprayer

Achievement/Progress:

Sl. No.	Activities to Achieve the Objective(s)	Output/Findings
1	The solar-powered sprayer was fabricated at the Workshop Machinery and Maintenance (WMM) Division, BRRI, Gazipur. The system harnesses solar energy to charge a 12V DC battery, which powers a DC motor to pump liquid pesticide through a nozzle. The key components include • **Solar Panel (15W):** Converts sunlight into electrical energy.	

- **12V Battery:** Stores energy for operation, enabling use during low sunlight.
- **DC Motor Pump:** Provides the pressure required to spray the liquid.
- **Tank (16L):** Holds the pesticide solution.
- **Nozzle (0.75 mm):** Dispenses the liquid in fine spray.
- **Adjustable Pipes:** Allow adjustment of the solar panel's angle and height for optimal sunlight exposure.

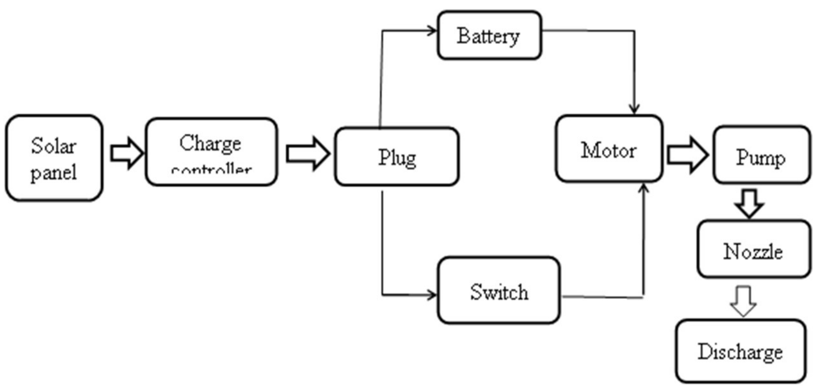

Diagram 3. Schematic chart of the solar-powered sprayer system

Development and Fabrication

The sprayer was designed using **AutoCAD**, ensuring precise dimensions and component alignment. Fabrication involved assembling the solar panel, battery, motor, and nozzle on a durable 16L tank (**Fig. 7**). The 12V DC motor and nozzle were mounted on the tank. In contrast, the solar panel was positioned for maximum sunlight exposure. The fabrication process is illustrated in **Plate 13**.

The system operates as follows

- The 15W solar panel charges the 12V battery.
- The battery powers the DC motor, which activates the pump.
- The pump pressurizes and sprays the liquid pesticide through the nozzle.

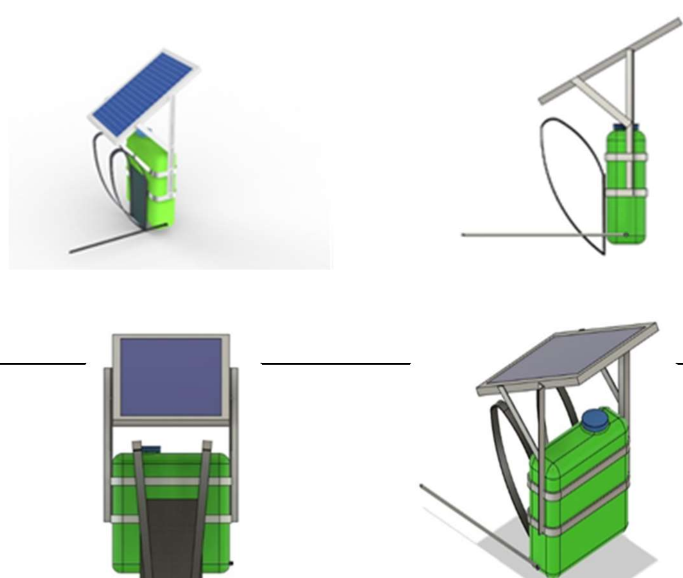

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Fig. 7. Some drawing views of the solar-powered sprayer


Plate 13. Fabrication of solar-operated sprayer at WMM workshop

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Performance Evaluation

The solar-powered sprayer was evaluated through lab-based tests at the WMM Division and field trials at the BRRI Farm, Gazipur. Key metrics included discharge rate, battery voltage, field capacity, and application rate.

Discharge Rate

The discharge rate was calculated by measuring the volume of sprayed liquid per minute at different times. Results showed the highest discharge rate at 1:00 PM (1.55 L/min) and the lowest at 5:00 PM (1.49 L/min), as shown in **Table 12**. Variations in discharge rate align with solar intensity changes, as illustrated in **Fig. 8.**

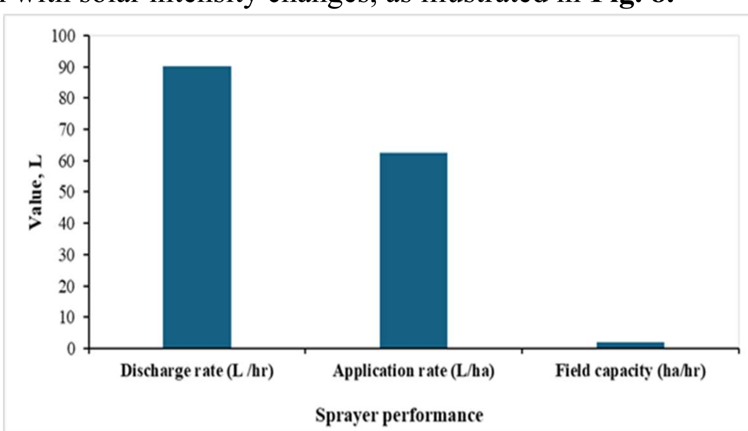

Fig. 8. Variation of sprayer discharge with daytime

Battery Voltage

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Summary of Key Findings

1. The discharge rate remained consistent throughout the day, ranging from 1.49 L/min to 1.55 L/min, with the highest rate observed at 1:00 PM.
2. Battery voltage fluctuated between 11.24V and 11.70V, indicating the solar panel's efficient charging cycle.
3. Effective field capacity decreases as

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Battery voltage was monitored throughout the day to evaluate charging efficiency. The voltage increased from 11.24V at 9:00 AM to 11.70V at 1:00 PM, then decreased to 11.51V by 5:00 PM, shown in **Fig. 9**. These fluctuations correspond to solar intensity variations, confirming efficient midday charging.

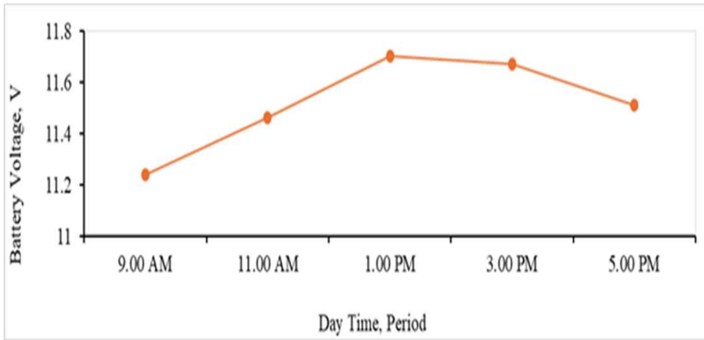

Fig. 9. Variation of battery voltage with daytime

Field Capacity

The field capacity of a sprayer covering 0.0025 ha. As the time to cover the area increases (from 64 to 68 seconds), the field capacity decreases slightly (from 0.141 to 0.132 ha/hr). The average field capacity across the three observations is 0.136 ha/hr, indicating a minor reduction in efficiency as spraying time increases

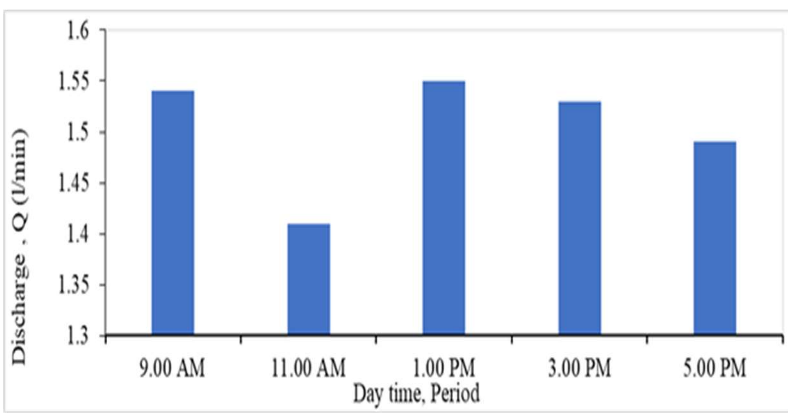

Fig. 10. Discharge rate, application rate, and field capacity of the solar-operated sprayer

spraying time increases, with an average field capacity of 0.136 ha/hr.

4. The application rate measures the amount of liquid applied per hectare. As the liquid volume increased, the application rate also increased. At 1L, the application rate was 20.83 L/ha, while at 5L, it increased to 104.16 L/ha

Problem Identification

The design of the solar-powered sprayer presents the following challenges:

- **Weight Issues:** The combination of the solar panel, battery, pump, and tank makes the sprayer cumbersome for long-distance or

	Plate 14. Lab and Field performance test of solar-operated sprayer	rough terrain usage. • **Limited Operating Time:** The sprayer may require frequent recharging or battery replacement, particularly in low-light conditions. • **Cost of Components:** High-efficiency solar panels, pumps, and batteries drive up costs, potentially making the sprayer unaffordable for small-scale farmers.

Title of the Experiment 3.2: Study on Solar Energy Utilization for Small Agricultural Machinery

Principal Investigator: Subrata Paul
Co-Investigators: BCN, MDH, MGKB, MAH, MMR, HR

Objectives

- To design a mechanism for efficient solar energy utilization.
- To assess the effectiveness of solar power integration in small agricultural machinery.
- To evaluate the performance of the developed system and machines.

Achievement/Progress:

Sl. No.	Activities to Achieve the Objective(s)	Output/Findings

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The FMPHT Division of BRRI developed a prototype self-propelled mobile solar panel carrier. The system aims to power various small agricultural machines while promoting renewable energy adoption.

Key features of the design included
• Compatibility with multiple machines (e.g., threshers, mini rice mills, water pumps).
• Lightweight, foldable structures for portability.
• Efficient solar panels and rechargeable batteries for uninterrupted operation.
The carrier system, illustrated in Fig. 11. integrates key components such as solar panels, inverters, batteries, and a power transmission unit.


Fig. 11. Overview of the developed solar power system

System Specifications
• Solar panels: 20 panels generating 150 watts each (total 3 kW).
• Inverter: 3-phase pure sine wave with MPPT (input: 300V; output: 3000VA).
• Batteries: Four 12V, 130 Ah batteries for energy storage.
• Power transmission: High-power brushless motor and differential gear mechanism for stability and efficiency.

Modifications

The initial design used a Mishuk Rickshaw motor (48V, 1000W), replaced with a brushless motor and a longer axle (137 cm). These upgrades improved weight distribution, torque, and stability (Plate 15).
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<td>A self-propelled mobile solar panel carrier was developed with a capacity of 3 kW, representing a versatile and eco-friendly solution for the on-demand use of solar energy. The prototype, fabricated using locally sourced materials, boasts an array of twenty 150-watt solar panels and a state-of-the-art solar inverter that efficiently converts direct current (DC) to alternating current (AC). The system's inverter operates at an input voltage of 300V (MPPT), delivering an output power of 3000VA. The carrier was further enhanced by integrating four 12-volt 130 Ah batteries, ensuring a reliable power supply to the carrier itself and auxiliary equipment. An MMPT battery charger, designed for optimal performance with a 48 Volt input at 300 V (MPPT) and a 10 Amp charging current, complements the system's energy storage capabilities.</td>
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(a): Previous power transmission unit

(b): Modified power transmission unit

Plate 15. Modified power transmission unit.
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Testing and Performance Evaluation

The system was tested under varied conditions to assess its efficiency and usability. The performance metrics included solar energy generation, motor speed, battery performance, and operational hours.

Key Findings

Solar Panel Carrier

The carrier can handle over 600 kg, including 20 solar panels.
Three people can fully set up the system within 10–12 minutes.
Enhanced axle length and differential gear improved maneuverability and stability (Plate 16).


Plate 16. Testing of solar panel carrier

Motor Testing

Motors with 0.5 hp, 1.0 hp, and 2.0 hp were tested for compatibility
Motor speed varied with solar radiation, peaking at 2950 rpm at midday (Figs. 12 and 13).

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Initial testing focused on the carrier's ability to drive electric motors of varying horsepower, with 2 and 1-horsepower motors being able to run all day. The system uses 2hp motor-driven BRRI open drum thresher, 0.5 hp motor-driven BRRI winnower, 2hp motor-driven BRRI mini rice mill, 0.5 hp motor-driven BRRI- Auto seed sower machine, 2hp motor-driven BRRI straw-chopper etc. was initially run and tested.

BRRI Open Drum Thresher:
Operated by a 2 HP motor; threshing drum speed ranged between 400–500 rpm
BRRI Winnower:
Powered by a 0.5 HP motor, operating at 1400 rpm
BRRI Mini Rice Mill:

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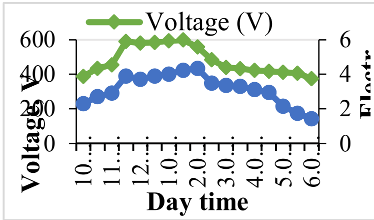
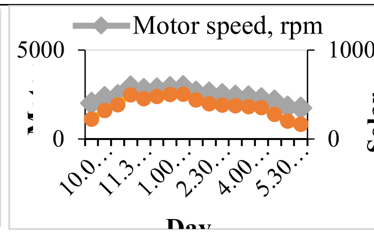
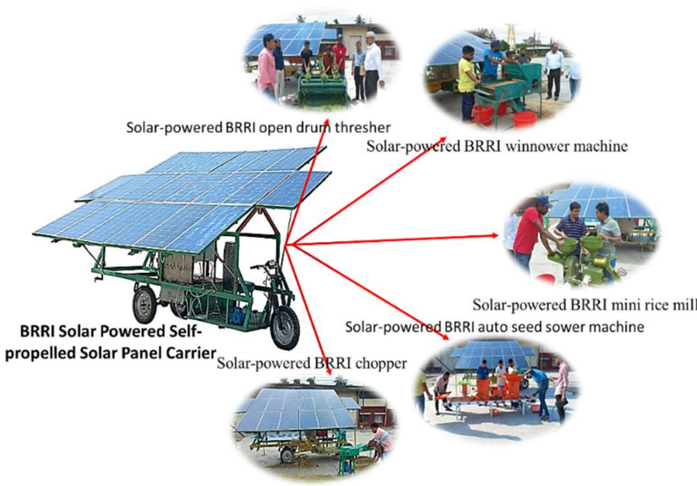
	  **Fig. 12.** Voltage without load condition **Fig. 13.** The motor speed with solar irradiation without load condition **Battery and Inverter Performance**: • Batteries maintained a consistent charge during peak solar hours. • The inverter efficiently converted DC to AC, supporting machines like threshers and mini rice mills.  **Fig. 14**. Solar-powered agricultural machinery operation	• Combined milling and grinding powered by a 2 HP motor, achieving speeds of 2500–2700 rpm 4. **BRRI Auto Seed Sower**: • Efficiently operated by a 0.5 HP motor, with a motor speed of 750–850 rpm under load 5. **BRRI Chopper Machine**: Powered by a 2 HP motor, chopping performance was optimal at midday solar intensity

Title of the Experiment 3.3: Design and Development of a Recirculating Type Dryer for Farm Holders

Principal Investigator: Dr. Mohammad Afzal Hossain
Co-investigator(s): Dr. Md. Anwar Hossen

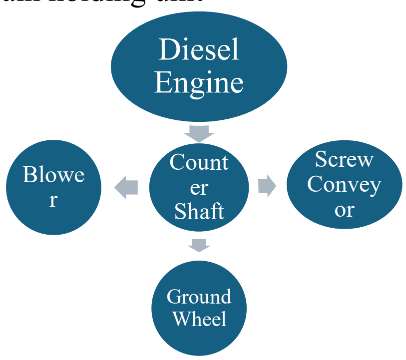
Objectives

- To design and develop a recirculating mobile dryer for small farm holders.
- To evaluate the performance of the developed dryer.

Achievement/Progress:

Sl. No.	Activities to Achieve the Objective(s)	Output/Findings
1	The dryer was designed using **Fusion 360** software and fabricated at the BRRI Farm Machinery Research Workshop, Gazipur. It will be tested under	**Grain Holding Unit** The holding unit consists of:

	field conditions during the Aus, Aman, and Boro seasons. **Materials Used** Key materials and components include • Moisture, temperature, and relative humidity sensors. • **Digital moisture meter** (Model: RiceterL, accuracy: ±0.2%). • **Digital anemometer** (Model: Testo 416, accuracy: ±0.2 m/s). • Diesel engine (12 hp), blower, and screw conveyor. • Locally available materials like MS sheet, SS sheet (16 gauge), galvanized wire mesh, flywheel, and chain sprockets. **Design Considerations** The dryer design incorporated the following considerations • **Cost efficiency**: Use of locally available materials to minimize fabrication costs. • **Uniform drying**: Ensure even distribution of hot air for consistent drying. • **Portability**: Mobile design for easy transport between farms. • **Ease of maintenance**: Simple assembly for easy repair and maintenance. • **Automation**: Sensors to monitor moisture, temperature, and relative humidity.  **Fig. 15.** Designed recirculating type dryer **Working Principle** Grain is fed into a hopper, which directs it to a screw conveyor powered by a diesel engine. Hot air from a blower and heating source is passed through the grain to remove moisture. The dried grain is automatically collected at the outlet.	• **Inner bin**: Diameter 22 inches, height 72 inches. • **Outer bin**: Diameter 48 inches, height 72 inches. • **Hopper**: Funnel-shaped device for feeding grain. **Heating Elements** • **Heating chamber**: Diameter 22 inches, height 36 inches, constructed with 10 mm thick steel. **Blower**: Axial flow blower with a fan diameter of 12 inches and air delivery opening of 4 x 5 inches, operating at 1000 rpm **Key Findings:** • **Uniform drying**: Hot air circulation ensured consistent drying across all grain layers. • **Drying rate**: Efficient processing of 500 kg batches in optimal time. • **Cost efficiency**: The pay-back period and BEP showed the system's affordability for small-scale farmers.

	 Inner bin of the grain chamber, Upper cover of the grain chamber  Outer bin with cover. Bin placed in the basement **Fig. 16**. Grain holding unit  **Diagram 4.** Power transmission system of the recirculating dryer	

PROJECT 4: PRECISION AGRICULTURE

Title of the Experiment 4.1: Design and development of a BRRI solar power bird repellent

Principal Investigator: Md. Mizanur Rahman
CI: Md. Mofazzel Hossain, Hafizur Rahman, Subrato Paul, Md. Durrul Huda

Objectives

- Design and develop a solar-powered smart bird repellent
- Implement real-time bird activity detection using machine learning
- Repel birds using non-harmful sound deterrents (e.g., predator calls)
- Ensure autonomous operation with minimal human intervention

Achievement/Progress:

Sl. No.	Activities to Achieve the Objective(s)	Output/Findings
1	The solar-powered bird-repellent system was developed and tested at the Farm Machinery	**First Version: Ultrasonic Sensors-Based Bird Repellent**

and Postharvest Technology (FMPHT) Division, Bangladesh Rice Research Institute (BRRI), Gazipur, Bangladesh.

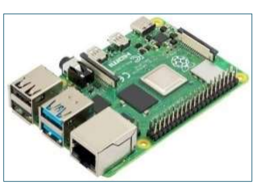
Design Considerations

- **Sustainability**: Use eco-friendly materials and renewable solar energy to reduce environmental impact.
- **Non-toxic deterrents**: The system uses sound and visual cues (simulated predator calls) to scare birds without harming ecosystems.
- **Simple design**: The system is designed for easy fabrication, assembly, and relocation.
- **Cost-effectiveness**: Made from inexpensive, locally available materials to ensure affordability for farmers.
- **Programmable features**: Adjustable sound intervals to avoid habituation by birds.

Key Components of the Bird Repellent System

The bird-repellent system consists of two main units: a bird-repellent unit and a solar power system.

- **Bird-repellent unit**: This uses a Raspberry Pi 4 processor, a camera, and machine learning to detect birds and activate sound deterrents.
- **Solar Power Unit**: This unit provides continuous power and consists of a solar panel, charge controller, battery, and inverter.



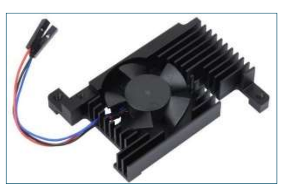
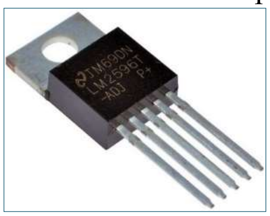


Plate 18. Raspberry Pi 4 Model B; **Plate 19**. Cooling Fan

The first version used Ultrasonic sensors for motion detection (**Plate 24**). Ultrasonic sensors are generally made of piezoelectric material, where the ultrasonic transmitter transmits the ultrasonic wave, which travels through the air until it reaches an object. When motion was detected, the system emitted pre-programmed deterrent sounds. However, this version had limitations:

- The detection range was limited to 2 meters, making it less effective for larger areas.
- The sensors could not distinguish between birds and other moving objects (e.g., humans).

Plate 24. Ultrasonic Sensor-Based Bird Repellent

	  **Plate 20.** Raspberry Pi 3 NOIR Camera; **Plate 21.** 15-Watt Speaker   **Plate 22.** Voltage Regulator; **Plate 23.** Motor driver	
2	**Second Version: Raspberry Pi 4 and YOLOv8n-Based Bird Repellent** The second version **(Plate 25)** overcame the limitations of the PIR-based system by incorporating **Raspberry Pi 4**, a camera module, and the **YOLOv8n** machine-learning model. This version provided • Improved detection range and the ability to distinguish between birds and other objects. • The camera, mounted on a stepper motor, allowed for dynamic area scanning. Enhanced accuracy in detecting birds, activating deterrent measures based on real-time data.	 **Plate 25.** Raspberry Pi 4 and YOLOv8n-Based Bird Repellent

Title of the Experiment 4.2: Development of Mat-Type Seedling Using Hydroponic Technique

Principal Investigator: Hafijur Rahaman
Co-investigators: MMA, MAH, MK, BCN, MGKB

Objectives
- To develop a mat-type seedling using hydroponic techniques.
- To evaluate the performance of the developed seedlings for use with a rice transplanter.

Achievement/Progress:

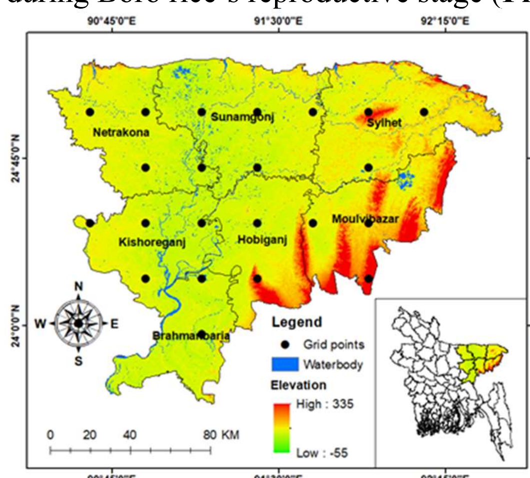
Sl. No.	Activities to Achieve the Objective(s)	Output/Findings
1	A folding vertical tray chamber was fabricated to cultivate seedlings in a space-efficient manner. The chamber could be folded during the off-season to save space. The experiment was conducted during T. Aman 2024 using the BRRI dhan103 rice variety. Two types of media (no media and rice husk), three types of solution rates (X1, X2, and X3 Yoshida solution), and four seed rates (120 gm, 150 gm, 180 gm, 210 gm) were tested in a randomized complete block design (RCBD) with three replications. **Seedling Preparation and Management** Seeds were cleaned and pre-soaked overnight to ensure high germination rates (>95%). After incubation, seedlings were transferred to plastic trays for hydroponic growth. The seedlings were monitored for growth parameters, including height, stem thickness, and mat strength. **Experimental Design** The experiment was conducted with three factors (**Table 17**) • **Factor A**: Media type (without any media, rice husk). • **Factor B**: Solution rate (X1, X2, and X3 Yoshida solution). • **Factor C**: Seed rate (120 gm, 150 gm, 180 gm, 210 gm).	The experiment aimed to develop a mat-type seedling using a hydroponic technique and evaluate its performance with a rice transplanter. The experiment was conducted at BRRI farm, Gazipur, during July-November/2024 in the T Aman season. The study utilized BRRI dhan103 for 126 days. The hydroponic technique for mat-type seedling development demonstrated notable outcomes across key performance indicators.  **Plate 26.** Seedling mat
2	**Data Collection** • Seedling Height (cm) and Stem Thickness (measured with a Vernier caliper). • Mat Quality (rated from 1 to 10 based on the ability to roll the mat without cracks (**Plate 26**). • Mat Strength (measured by pulling capability in Kg).	Missing hills accounted for 10.8%, while mechanically damaged hills and buried hills were recorded at 8.8% and 3.32%, respectively, indicating effective hill establishment. Floating hills were minimal at 4%, and the average transplanting depth was 4.80 cm, ensuring consistent placement. Plant heights at 15, 30, 45, and 60 days averaged 22.16 cm, 73.66 cm, 117.5 cm, and 138.83 cm, respectively, with tiller counts progressively increasing to 18.66 by 60 days. An average of 15.66 practical tillers/hill and a panicle length

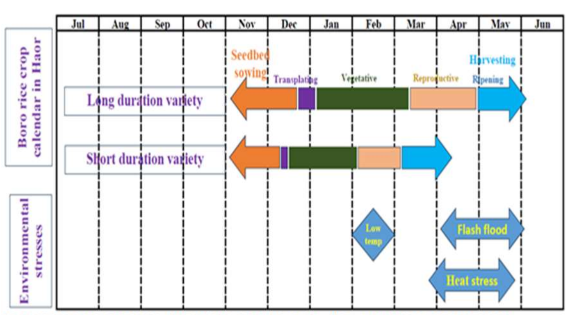
		of 26.66 cm, with 203.16 filled grains/ panicle and minimal unfilled grains/panicle 27.33. The 1000-grain weight averaged 23.33 g, contributing to an average grain yield of 5.93 t/ha, signifying the potential of hydroponic mat seedlings to enhance crop productivity.

Title of the Experiment 3.3: Future Thermal Stress Impacts on Boro Rice Cultivation in the Northeastern Haor Region of Bangladesh: Projections from CMIP6 Multi-Model Ensemble

Principal Investigator: Dr. Mohammad Kamruzzaman Milon
Co-investigators: Dr. Md. Sazzadur Rahman

Achievement/Progress:

Sl. No.	Activities to Achieve the Objective(s)	Output/Findings
1	**Study Area** The northeastern Haor basin, comprising districts like Sylhet, Sunamganj, and Habiganj, is a critical rice-growing area. The region's unique hydrology and climate make it prone to cold and heat stress during Boro rice's reproductive stage (**Fig. 19**).  **Fig. 19.** Digital elevation map (DEM) with grid points of the northeastern *haor* region of Bangladesh.	This study assesses the impacts of future thermal stress on Boro rice cultivation in the northeastern haor region of Bangladesh using CMIP6 multi-model ensemble projections. Four key thermal stress indices—three consecutive cold days (CCD3), six successive cold days (CCD6), hot days (HD), and consecutive hot days (CHD)—were analyzed under moderate (SSP2-4.5) and high (SSP5-8.5) emission scenarios. **Cold Stress (CCD3 and CCD6)** • **CCD3:** Historical trends indicate a reduction of 2.37 days/decade. Projections show further decreases of 0.30 days/decade under SSP2-4.5 and 0.35 days/decade under SSP5-8.5. By 2100, CCD3 is expected to decline by up to 9 days, signaling reduced risks from cold temperatures but potential challenges for cold-tolerant rice varieties **CCD6:** While historical data showed no significant changes, future projections estimate declines of 0.23 days/decade under SSP2-4.5

		and 0.24 days/decade under SSP5-8.5. CCD6 is projected to drop by up to 8 days by 2100 **Heat Stress (HD and CHD)** **HD:** Historical trends were non-significant; however, future projections reveal increases of 1.12 days/decade under SSP2-4.5 and 2.41 days/decade under SSP5-8.5. HD is projected to increase by up to 12 days by 2100, posing significant risks during the reproductive phase of rice **CHD:** Projections indicate significant rises, with increases of 0.61 days/decade under SSP2-4.5 and 1.36 days/decade under SSP5-8.5. By 2100, CHD is expected to rise by up to 7 days, further heightening heat stress risks during critical stages such as anthesis
2	**Data** ERA5 reanalysis datasets and 15 CMIP6 GCMs (**Table 24)** were employed for thermal stress projections. The historical period (1995–2014) served as the baseline, and forecasts were analyzed for near (2021–2040), mid (2041–2060), and far (2061–2100) futures under SSP2-4.5 and SSP5-8.5. **Thermal Stress Indices** The study focused on four thermal stress indices: CCD3, CCD6, HD, and CHD. These indices were selected for their direct impact on rice phenology and productivity, particularly during the sensitive reproductive phase  northeastern *haor* region of Bangladesh **Statistical Downscaling and Bias Correction**	Results indicate a significant decline in cold stress indices, with CCD3 and CCD6 decreasing by up to 9 days and 8 days, respectively, by 2100 under SSP5-8.5. In contrast, heat stress indices show substantial increases, with HD rising by 12 days and CHD by up to 7 days during the same period. The projected rise in maximum temperatures above 35°C during the rice reproductive phase suggests severe risks to spikelet fertility, potentially reducing yields. These findings underscore the urgent need for adaptive measures, including developing heat-tolerant rice varieties and adjusting planting schedules to safeguard rice production under escalating thermal stress conditions.

Raw GCM outputs were downscaled and bias-corrected using Simple Quantile Mapping (SQM) to align with observed ERA5 data. This method significantly improved the accuracy of thermal stress projections.

Trend Analysis

Thermal stress trends were analyzed using the Modified Mann-Kendall (MMK) test, which accounts for autocorrelation in climate data. Multimodel ensemble (MME) averages were used to reduce projection uncertainty.

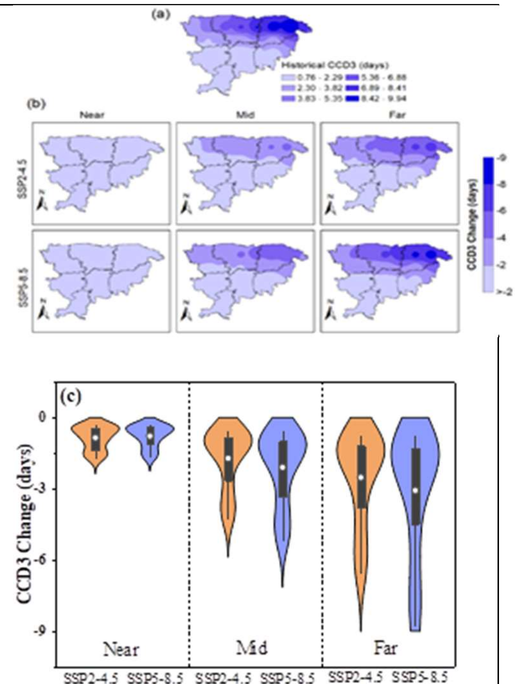


Fig. 21. The spatial (a) historical, (b) projected, and (c) temporal changes in three consecutive cold days (CCD3) for SSP2-4.5 and SSP5-8.5 in the near, mid, and far futures.

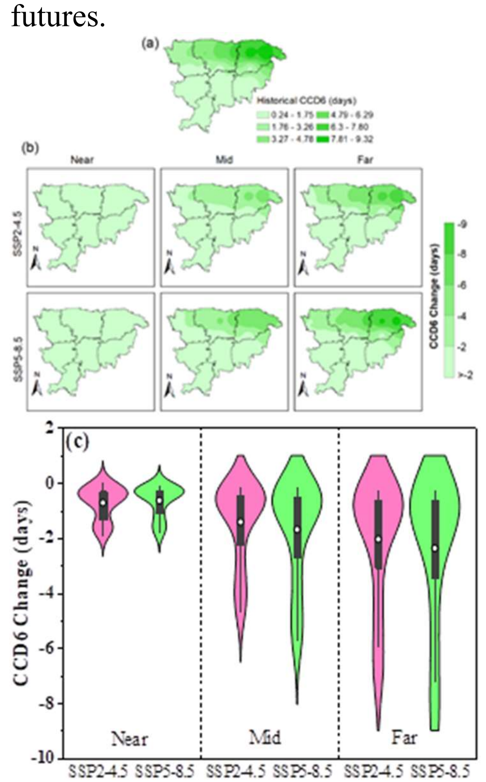


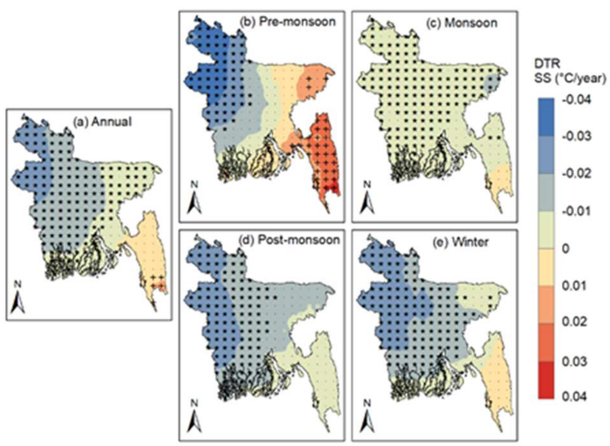
		Fig. 22. The spatial (a) historical, (b) projected, and (c) temporal changes in six consecutive cold days (CCD6) for SSP2-4.5 and SSP5-8.5 in the near, mid, and far futures.

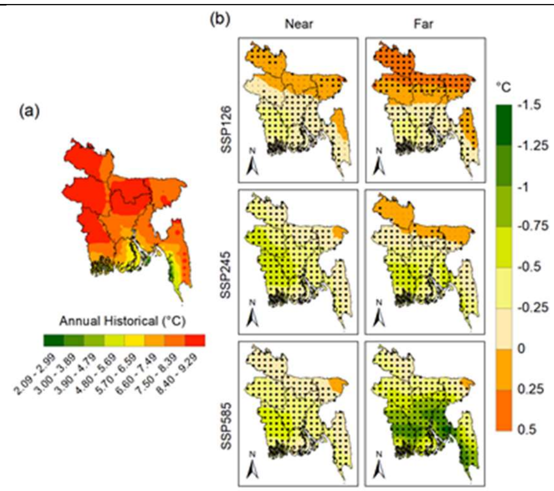
Title of the Experiment 4.4: Cropland Exposure to Diurnal Temperature Range Under Future Climate Change in Bangladesh

Principal Investigator: Dr. Mohammad Kamruzzaman Milon
Co-investigators: Dr. Md. Sazzadur Rahman

Achievement/Progress:

Sl. No.	Activities to Achieve the Objective(s)	Output/Findings
1	**Reanalysis Data:** ERA5 reanalysis data (1980–2021) was used for observed trends due to its high spatial resolution (0.25° × 0.25°) and superior performance in the region **(Hersbach et al., 2020)**. **Climate Models:** CMIP6 multi-model ensemble (MME) was selected for future projections. Five models—ACCESS.CM2, ACCESS.ESM1.5, EC-Earth3, MRI-ESM2-0, and UKESM1.0. LL—were chosen based on their ranking and ability to simulate ERA5 Tmax and Tmin climatology • **DTR Calculation:** DTR was derived as the difference between Tmax and Tmin, aggregated on monthly, seasonal, and annual scales. Trends were analyzed using the Modified Mann-Kendall (MMK) test for significance (Hamed and Ramachandra Rao, 1998). • **Bias Correction:** The statistical quantile mapping (SQM) method corrected biases in the raw CMIP6 data to align it with ERA5 observations, improving projection reliability (Chen et al., 2013). • **Exposure Assessment:** Cropland exposure to DTR was calculated by multiplying cropland area (km²) by annual DTR values. The total change in exposure was derived as: $E = DTR \times Crop$ ……………………(1)	This study evaluates historical trends (1980–2021) and future projections of Bangladesh's Diurnal Temperature Range (DTR), emphasizing cropland exposure under CMIP6 SSP scenarios. Historical data from ERA5 revealed a significant DTR decline (-0.23°C per decade), particularly in the northwest, driven by rapid nighttime warming. Projections indicate contrasting futures: SSP1-2.6 shows stabilization (+0.05°C by 2100), while SSP5-8.5 forecasts a sharp decline (-0.63°C by 2100). Narrowing DTR poses critical challenges for agriculture, particularly C3 crops, due to increased nighttime respiration and heat stress. Adaptive strategies, such as heat-tolerant crops and optimized irrigation, are necessary to mitigate risks.

	Here, E is the total annual cropland exposure to DTR. DTR is the annual value of DTR and $Crop$ is the annual C3 cropland area in km^2. To calculate total exposure, change the following equation is used in multiple studies $$\Delta E = DTR_j \times Crop_j - DTR_i \times Crop_i \quad ......(2)$$ Where, ΔE represents total change in cropland exposure. DTR_i and $Crop_i$ represents DTR and crop land area in i period or historical period and DTR_j and $Crop_j$ represents precipitation and cropland area data in the j period. *In* this study, it is the future period. **Uncertainty Analysis:** Standard deviations and 95% confidence intervals were used to evaluate the uncertainty across SSP scenarios using the MME approach	
2	 **Fig. 25.** Spatial distribution of the trends in DTR for annual and seasonal timeframes. Star (*) denotes the significant negative, plus (+) denotes the significant positive, and dot (.) denotes the no trend at a 95% confidence interval.	**Historical Trends** Analysis of ERA5 data from 1980 to 2021 reveals a significant decline in DTR (-0.10°C per decade annually), with the most substantial reductions in the northwestern region of Bangladesh. Seasonal trends show the most significant declines during post-monsoon (-0.14°C per decade) and winter (-0.13°C per decade) seasons. **Future Projections** Future projections under CMIP6 scenarios indicate divergent trends in DTR based on emission pathways: • **SSP1-2.6:** A slight increase in DTR (+0.05°C by 2100) suggests potential stabilization under low-emission scenarios. Seasonal projections highlight minor increases during pre-

	 **Fig. 26.** (a) Historical annual Diurnal Temperature Range (DTR) across Bangladesh, with warmer colors indicating higher historical DTR values. (b) Projected changes in DTR for the near (left) and far (right) future under SSP1-2.6, SSP2-4.5, and SSP5-8.5 scenarios. The color scale represents the magnitude of DTR change, with green indicating a decrease and orange indicating an increase in DTR. Areas marked with "•" indicate regions where changes are statistically significant at the 95% confidence level.	monsoon (+0.005°C/decade) and monsoon (+0.002°C/decade) periods **SSP5-8.5:** A sharp decline (-0.63°C by 2100) underscores significant risks for agriculture and health, particularly during post-monsoon (-0.018°C/decade) and winter (-0.009°C/decade) seasons. These reductions are spatially pronounced in northwestern and southwestern Bangladesh, regions critical for agriculture

PROJECT 5: INDUSTRIAL AND FARM-LEVEL EXTENSION OF AGRICULTURAL MACHINERY

Title of the Experiment 5.1: Training in Operation and Maintenance of Farm Machinery

Agricultural mechanization is critical for improving rural productivity and income-generating activities (IGA). However, the lack of skilled operators and inadequate machine maintenance knowledge hinders effective utilization. To address this, the Sustainable Farm Mechanization for Rural Areas (SFMRA) project, under the Farm Machinery and Postharvest Technology Division of the Bangladesh Rice Research Institute (BRRI), conducted 40 batches two-day residential training programs in Gazipur, Chuadanga, Bottoil of Kushtia, and Dinajpur districts. The training focused on equipping participants with practical skills in operating and maintaining BRRI-developed and other agricultural machinery.

Objectives

- Introducing BRRI-developed and other agricultural machinery to farmers.
- Develop skilled operators for farm machinery operation.
- Build awareness about the benefits of mechanization.

Training Overview

- **Participants:** 20 participants per batch, selected in collaboration with BRRI regional stations and DAE offices, prioritizing those with prior machinery experience.
- **Methodology:** Combination of lectures and practical sessions delivered by BRRI scientists, DAE personnel, and academicians.
- **Activities:** Pre-evaluation, hands-on practice, post-evaluation, and feedback collection.

Machinery and Techniques Covered

- Seedling raising for mechanical rice transplanters.
- Operation and maintenance of
    - Mechanical rice transplanters.
    - BRRI prilled urea applicators.
    - BRRI manual and power weeders.
    - Whole-feed combine harvesters.
    - Self-propelled rice/wheat reapers.
    - BRRI open and closed drum threshers.
    - BRRI winnowers.
- Repair and maintenance of diesel engines.
- Practical field operation of machinery.

Outcomes

- **Total Batches:** 40
- **Participants Trained:** 815 (550 males, 265 females)
- Trainees gained hands-on experience in machinery operations, starting with no-load conditions and advancing to field operations (**Plate 27**).
- Participants received certificates, informational leaflets, and toolkits.

Plate 27 (a) Inauguration of training programme

Plate 27 (b) Operation of manual seed sower machine

	
Plate 27(c) Introduction of rice transplanter	**Plate 27**(d) Introduction of reaper and reaper binder
Plate 27. Pictorial View of Hands-On Training	

Plate 27 showcases participants engaging in practical sessions, gaining critical hands-on experience in agricultural machinery operation and maintenance.

Conclusion

The training program successfully enhanced the technical capacity of rural operators, promoting sustainable mechanization and improving agricultural productivity. Expanding such initiatives to more regions can further bridge the mechanization gap in rural farming.

Recommendations

- Scale up training programs to cover additional regions and participants.
- Incorporate advanced modules on emerging agricultural technologies.
- Ensure follow-up support to sustain and enhance the skills imparted.

Title of the Experiment 5.2: Training on Operation and Maintenance of BRRI Prilled Urea Applicator

Principal Investigator: Dr. Mohammad Kamruzzaman Milon
Co-investigators: Dr. Md. Mozammel Haque (Soil Science Division); Md. Mizanur Rahman

The FMPHT Division of the Bangladesh Rice Research Institute (BRRI), with support from the PUAD Project and NCC Bank, organized a series of training sessions on the operation and maintenance of the BRRI Prilled Urea Applicator (PUA). This training aimed to improve farmers' adoption of efficient fertilizer application practices to increase agricultural productivity while minimizing input costs.

Objectives:

- To train farmers on the operation of the BRRI Prilled Urea Applicator (PUA)
- To provide hands-on demonstrations and practical knowledge on the maintenance of the applicator.
- To promote the adoption of the PUA for improved fertilizer application in rice cultivation.

Training Overview:

A total of 8 training sessions were held across 4 different sites, including Vararul (Gazipur), Dhohar (Dhaka), Shibchar (Madaripur), and Baliakandi (Rajbari). Each site hosted 2 training batches, with 20 participants in each batch, resulting in 80 participants. The training aimed to equip farmers with the skills and knowledge required to operate the BRRI Prilled Urea Applicator efficiently while emphasizing the importance of regular maintenance for optimal performance (**Plate 28**).

Training Methodology

The training sessions were conducted through a combination of theory and hands-on practical demonstrations**:**

- **Introduction to BRRI PUA:** Overview of the importance of efficient urea application in rice cultivation and the benefits of using the PUA for uniform distribution of prilled urea.
- **Operation Demonstration:** A step-by-step demonstration of how to use the applicator in the field, including how to calibrate, adjust, and operate the equipment.
- **Maintenance and Troubleshooting:** Farmers were trained on routine maintenance procedures, including cleaning, checking for wear and tear, and basic troubleshooting of the applicator.
- **Interactive Q&A Session:** An open forum for participants to discuss their challenges, ask questions, and share experiences with PUA usage.

Training Results

The training successfully educated farmers about the correct BRRI Prilled Urea Applicator usage and maintenance. Key outcomes include:

- Farmers gained a deeper understanding of how to operate the PUA, ensuring efficient and effective fertilizer application.
- Participants demonstrated increased confidence in performing maintenance tasks to ensure the longevity and optimal performance of the applicator.
- The training also contributed to building a sense of community among farmers, enabling them to share knowledge and experiences.

Plate 28. Field trial and training programme of Pilled urea applicator

Conclusion and Recommendations:

The training sessions have contributed significantly to farmers' adoption of the BRRI Prilled Urea Applicator. To further improve the impact, we recommend:

- Continuous follow-up and support for farmers to ensure consistent use of the applicator.
- Expanding the training program to reach more farmers, particularly in remote areas.
- Additional resources such as instructional manuals or video guides should be provided to reinforce the training.

In collaboration with the PUAD Project and NCC Bank, this initiative has provided farmers with essential tools for improving fertilizer efficiency, which is crucial for increasing rice production in Bangladesh.

Title of the Experiment 5.3: Report on Field Day: Aman Rice Harvesting Using Reduced Urea Fertilizer by BRRI Prilled Urea Applicator

Principal Investigator: Dr. Mohammad Kamruzzaman Milon
Co-investigators: Dr. Md. Mozammel Haque (Soil Science Division); Md. Mizanur Rahman

Under the PUAD Project, with support from NCC Bank, three field days were organized in Shibchar (Madaripur), Baliakandi (Rajabri), and Vararul (Gazipur) to demonstrate the use of the BRRI Prilled Urea Applicator in Aman rice cultivation. The aim was to showcase the application of reduced urea fertilizer for improving rice yields and promoting sustainable farming practices.

Objectives:

- To demonstrate the use of the BRRI Prilled Urea Applicator for reduced urea fertilizer application in Aman rice.
- To engage farmers, experts, and stakeholders in discussions on efficient fertilizer use and its impact on rice productivity.

Program Overview:

Opening Session:

The Director General of BRRI emphasized the importance of reducing fertilizer wastage and improving efficiency in rice farming.

Demonstration:

Farmers were observed harvesting Aman rice using reduced urea fertilizer applied by the BRRI Prilled Urea Applicator. Experts explained the applicator's benefits, highlighting its uniform fertilizer distribution and environmental advantages.

Q&A Session:

Farmers had the opportunity to ask questions about technology, fertilizer application, and its benefits, with answers provided by BRRI scientists and DEA personnel.

Outcomes:

Improved Fertilizer Efficiency:

The applicator allowed for more precise application of reduced urea, ensuring better fertilizer efficiency and reduced waste.

Better Rice Yields:

Fields using reduced urea showed healthier, more uniform rice growth, indicating potential yield improvements.

Environmental Sustainability:

Reduced urea fertilizer helped minimize nitrogen runoff, contributing to more sustainable farming practices.

Conclusion and Recommendations: The field days successfully demonstrated the benefits of the BRRI Prilled Urea Applicator (**Plate 29**). It is recommended that farmers continue training on its use, expand adoption across rice-growing areas, and conduct further research into its long-term benefits. The event successfully highlighted the role of sustainable technology in enhancing rice productivity while reducing environmental impact.

Plate 29. Crop cut programme and Field Day of BRRI dhan103 using PUA

Program Area: Socio-Economic and Policy

Farm Management Division

Table 2: Research Progress 2024-2025

Sl. No.	Research Progress	Expected output
Program area: Socio-economic and Policy		
03. **Farm Management Division**		
3.1. Project: Rice Production Management		

<table>
<tr>
<td></td>
<td>Expt. 1. Influence of different dates of transplanting on growth, yield performance and quality of fine rice varieties

Treatments:
<table>
<tr><th>Factor A: Transplanting date</th><th>Factor B: Variety</th></tr>
<tr><td>T_1 = 15 July</td><td>V_1= BRRI dhan34</td></tr>
<tr><td>T_2 = 30 July</td><td>V_2= BRRI dhan90</td></tr>
<tr><td>T_3 = 15 August</td><td>V_3= Binadhan-13</td></tr>
<tr><td>T_4 = 30 August</td><td></td></tr>
<tr><td>T_5 = 15 September</td><td></td></tr>
<tr><td>T_6 = 30 September</td><td></td></tr>
</table>
Progress: In variety: BRRI dhan90 produced the highest grain (4.0 t ha^{-1}) than BRRI dhan34 (3.47 t ha^{-1}) and lowest in Binadhan-13 (3.06 t ha^{-1}) at 15 August transplanting .
In different dates of transplanting: 15 August transplanting was produced the height grain yield than 30 August transplanting and lowest in 15 July transplanting.

..</td>
<td>15 to 30 August transplanting might be produced better yield for fine rice variety.</td>
</tr>
</table>

<table>
<tr>
<td></td>
<td>Expt. 2. Influence of weed inference management method on the performance and profitability of BRRI dhan89
Treatment:
<table>
<tr><td>W_1 = No weeding (control)</td></tr>
<tr><td>W_2 = Weed free condition (at 12-15 DAT/25-30 DAT/40-45 DAT)</td></tr>
<tr><td>W_3 = Pree emergence herbicides (Bensulfuran methyl + Actachlor) at 3-4 days after rice transplanting + 1 hand weeding (HW) at 45 DAT (After 2nd urea top dress),</td></tr>
<tr><td>W_4 = Post emergence herbicides (Phenoxlum240 SC) a spraying after 1-2 leaves of weeds + 1 hand weeding (HW) at 45 DAT (After 2nd urea top dress)</td></tr>
<tr><td>W_5 = Pree emergence herbicides (Pretilachlor 50% EC) at 3-4 days after rice transplanting + Post emergence herbicides (Bispyribac sodium) at spraying after 1-2 leaves of weeds</td></tr>
<tr><td>W_6 = BRRI mechanical weeder at 15 DAT + 1 hand weeding (HW) at 45 DAT</td></tr>
</table>
Progress: The effective weed control method Pree emergence herbicides (Bensulfuran methyl + Actachlor) at 3-4 days after rice transplanting + 1 hand weeding (HW) at 45 DAT (After 2nd urea top dress) (W_3) treatment was the most effective in terms of weed suppression and maximize rice yield.</td>
<td>Pree emergence herbicides (Bensulfuran methyl + Actachlor) at 3-4 days after rice transplanting + 1 hand weeding (HW) at 45 DAT (After 2nd urea top dress) was the most effective in terms of weed suppression and maximize rice yield.</td>
</tr>
<tr>
<td></td>
<td>Expt. 3. Efficiency of different baits for live trap to control rat in rice field
Treatments:
<table>
<tr><td>Name of the different types of rat baits</td></tr>
<tr><td>T_1 = Cocunut meat</td></tr>
<tr><td>T_2 = Pitha (Telerpitha)</td></tr>
<tr><td>T_3 = Aromatic rice (paddy)</td></tr>
<tr><td>T_4 = Dry fish (Shutki)</td></tr>
<tr><td>T_5 = Wheat grain</td></tr>
<tr><td>T_6 = Cookies biscuits</td></tr>
<tr><td>T_7 = Cheese</td></tr>
<tr><td>T_8 = Paddy</td></tr>
</table>
Progress: The experiment was conducted during Boro 2024-25. The results of experiment cookies biscuits might be the best bait for rice field followed by coconut meat and paddy. Wheat grain and cheese might be the lowest performer rat bait in rice field.</td>
<td>Suitable rat control techniques in rice field.</td>
</tr>
</table>

Expt. 1. Influence of different dates of transplanting on growth, yield performance and quality of fine rice varieties

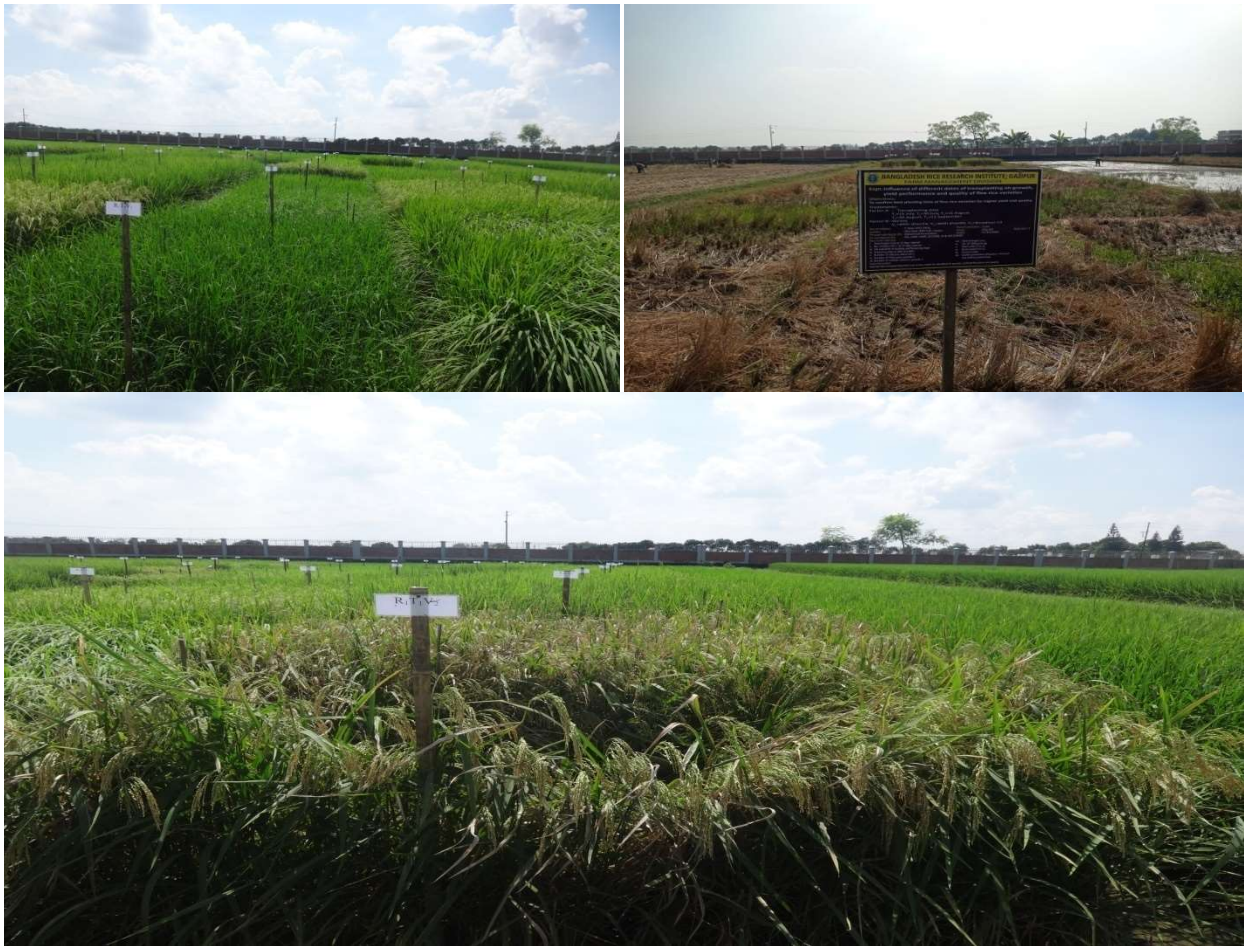


Fig. 1. Influence of different dates of transplanting on growth, yield performance and quality of fine rice varieties

Expt. 2. Influence of weed inference management method on the performance and profitability of BRRI dhan89

Fig. 2. Influence of weed inference management method on the performance and profitability of BRRI dhan89

Expt. 3. Efficiency of different baits for live trap to control rat in rice field

Fig. 3. Efficiency of different baits for live trap to control rat in rice field

Program Area: Technology Transfer

Training

Research Progress 2024-2025

Sl. No.	Research Progress	Expected Output
I	Program Area: Technology Transfer Program Performing Unit : Training Division	

	1. Technology Transfer through training	Knowledge and skill of the trained personnel of the subject matter will be increased.
	1.1Training on modern rice production Participants: BRRI Scientists, SAAO of DAE Duration: 3 days and 5 days Progress: Completed Total batch: 31 Total Participants: 926	Trained scientists and SAAO will be able to identify and solve field problems of rice cultivation and help the farmers to increase productivity.
	1.2 Hybrid rice and seed production technology training course Participants: BRRI Scientists and SAAO of DAE Duration: 5 days Progress: Completed Total batch: 13 Total Participants: 358	Knowledge and skill of the participants on Hybrid rice seed production will be improved.
	1.3 Research data management using spread sheet. Participants: BRRI Scientists Duration: 6 days Progress: Completed Total batch: 1 Total Participants: 30	Knowledge and skill of the participants on • Proper data collection methods and • Organize and analyzed data properly using spread sheet will be improved.
	1.4 Training on bioinformatics for future rice Participants: BRRI Scientists. Duration: 14 days Progress: Completed Total batch:1 Total Participants: 30	After completion of the training program the scientists can- ▪ Create databases to store experimental data. ▪ Predict the way that proteins fold up and ▪ Create models on how all the chemical reactions in a cell interact with each other.
	1.4 Modern rice production, data collection and entry training course Participants: SA/SSA of BRRI Duration: 14 days Progress: Completed	Trained SA/ SSA will be able to identify and solve field problems of rice cultivation and help the scientists properly. They can also learn, how data will be collected accurately from the research field and how the data were organize properly for further analysis.

	Total batch:3 Total Participants: 90	
	1.5 Training course on safe use of agrochemicals Participants: Seed/ fertilizer/ pesticide dealers Duration: 3 days Progress: Completed Total batch: 10 Total participants: 300	The participants will learn about the judicious use of pesticides and also get knowledge about harmful effect of the pesticides on human health and the environment.

Program Area: Regional Station

Regional Station, Gopalganj

Progress 2024-25

Sl No	Experiment Title and Research Progress of 2024-25	Major Output
1	Expt. 1: Assesment of anaerobic tillering capacity of local rice germplasm collected from Gopalgonj areas of Bangladesh.	Some genotypes gave higher tillaring even 12 Inch og water depth.
2	Expt. 2: Regional Yield Trail (RYT) for Favourable Boro Rice (Barishal), Boro 2024-25 Among the five genotypes, the highest yield (9.14 ton/ha) was revealed in line no. BRBaNGR994-1.	Line no. BRBaNGR994-1 were performed better.
3	Expt. 3: Regional Yield Trail (RYT-1) for Development of Salt Tolerant Rice, Boro 2024-25 Among the twenty genotypes, the highest yield (9.16 and 9.21 ton/ha) was revealed in line no. BR13207-4R-28 and BR13201-4R-298. Line number BR11276-4R-196 and BR12265-4R-71 showed higher no of tillers (14 and 14.5) than the check varieties.	Four genotypes performed better among the twelve.

4	Expt. 4: Regional Yield Trail (RYT-2) for Development of Salt Tolerant Rice, Boro 2024-25 Line number BR13197-4R-24 showed the highest no of tillers (14.5). Plant height of all genotypes showed more or less similar to the check variety. Lowest growth duration (131 days) was found in the line BR12650-4R-55.	Line number BR13197-4R-24 and line BR12650-4R-55 performed better.
5	Exp. 5: Regional Yield Trail (RYT), Breeding for Basmati Rice (Rangpur), Boro 2024-25 Among the four genotypes, the highest yield was revealed in line no. BRrang55-RGA-40-1-1-1. Highest plant height (126 cm) was revealed in the line BRrang55-RGA-44-5-1-1. Growth duration was found more or less similar in the four lines and check variety.	Line no. BRrang55-RGA-40-1-1-1 performed better.
6	Expt. 6. ALART for Salt Tolerant Rice (STR-Long Duration Photosensitive) Among the three advanced lines, BR12465-4R-61 produced a higher grain yield (5.31 t/ha) as like as the check BR23 (yield 5.72 t/ha) than the other. The shortest growth duration was observed in the BR12465-4R-231 advanced line (124 days).	One line designated BR12465-4R-61 performed better.
7	Exp. 7: Regional Yield Trial (RYT), Breeding for Premium Quality Rice (PQR-Rangpur), T. Aman, 2025 Among the four genotypes, the highest grain yield was observed in the line designated as BRrang35-3-1-2-1-1 (4.10 t/ha) but lower than the check variety, line BRrang57-5-2-2-2 also exhibited a shorter growth duration than the others.	One line designated as BRrang35-3-1-2-1-1 performed better
8	Exp. 8: Regional Yield Trial (RYT),Breeding for Second Generation Rice (SGR), T. Aman, 2025	One line designated as BRrang30-8-2-1-1-1 showed comparatively better performance.

	Among the three genotypes and one check variety, the highest grain yield was observed in the check BRRI dhan103 and line designated as BRrang30-8-2-1-1-1 exivited second most highest yield (5.12 t/ha), line BRrang30-10-1-1-1-1 also exhibited a shorter growth duration than the others.	
9	Exp.9: Regional yield trial (RYT-1) Development of Salt Tolerant Rice (STR 1), T Aman 2025 Among the twenty two genotypes, the highest grain yield was observed in the line designated as BR13115-4R-136 (5.82 t/ha), line BR13105-4R-72 also exhibited a shorter growth duration (108 days) than the others.	One the line designated as BR13115-4R-136 performed better.
10	Exp.10 : Regional yield trial (RYT-1) Development of Salt Tolerant Rice (STR 2), T Aman 2025 Among the ten genotypes, the highest grain yield was observed in the line designated as IR22LT1698 (5.77 t/ha); line IR22LT1603 also exhibited a shorter growth duration (113 days) than the others.	One line designated as IR22LT1698 performed better.