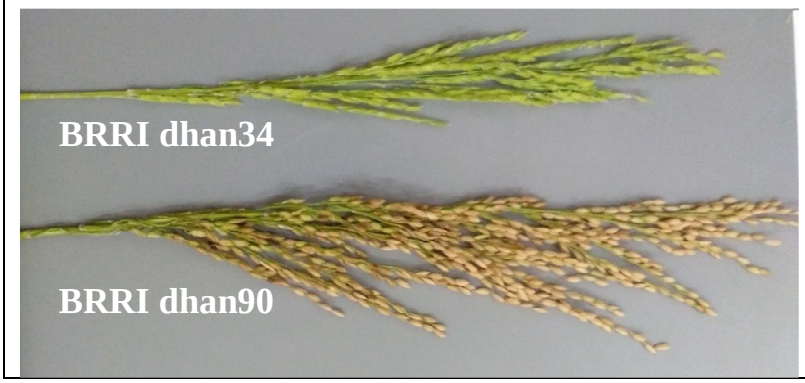
Research Achievement 2018-2019

Plant Breeding Division

Table-1
Research Achievement 2018-2019
(Technology Developed)

Technology Developed	How Country/Farmer/User will be benefited
Program Area: Varietal Development program (VDP)	
BRRI dhan90: BRRI dhan90 was released as a premium quality rice (PQR) in T. Aman season. It produced more than 1.0 t/ha higher yield than BRRI dhan34 with three weeks earlier growth duration.   	BRRI dhan90 is a short-bold small grain with high (10.3%) protein and 23.2% amylose. The variety has strong stem with lodging tolerance. It is photo-insensitive variety with three weeks earlier than popular variety BRRI dhan34. It is a premium quality rice variety with national standard for domestic use and suitable for the preparation of festival cuisines like *polao* and *paes*.

BRRI dhan91: BRRI dhan91 was released as deep water rice variety for semi-deep flooded B. Aman areas. It is weakly photo-sensitive with growth duration 152-156 days, 10-15 days earlier than local deepwater cultivar. It performed 1.33 t/ha higher yield than the check variety Fulkore in Broadcast Aman season.  	BRRI dhan91 is a variety for Semi-deepwater environment. It has very strong stem with 185 cm plant height and lodging tolerance. It possesses kneeing ability, submergence tolerance and moderate stem elongation having stem cutting vegetative propagation ability as like as grasses. The variety is suitable for cultivating in 1.0 m depth shallow deep-water field in the deep water areas of Bangladesh.

Biotechnology Division

Table 1
Research Achievement 2018-19

Sl. No.	Technology Developed	How country/ Farmer/ User will be benefited
1	The proposed line BR(Bio)9686-BC2-59-1-2 was approved by National Seed Board of Bangladesh as **BRRI dhan89**. This is a high yielding rice variety for Boro season. The average yield of BRRI dhan89 is 8.0 ton/ha with growth duration 3-4 days earlier than BRRI dhan29.	This high yielding Boro rice variety will be grown by the farmers that ultimately benefit the farmers as well as the whole country.
2	The proposed line BR(BE)6158RWBC2-1-2-1-1 was approved by National Seed Board of Bangladesh as **BRRI dhan92**. This is a high yielding water saving rice variety for Boro season. The average yield of BRRI dhan92 is 8.5 ton/ha with similar growth duration of BRRI dhan29	Boro rice variety suitable for cultivation all over the Bangladesh and alternate variety of BRRI dhan29. This variety is more suitable for cultivation in dry areas of the country as this variety is low water required in comparison with the BRRI dhan29.
3	During Boro 2018-19 one advanced line BR(Bio)9787-BC2-63-2-2 developed from yield enhancement QTL was evaluated as PVT.	These lines will be used to develop high yield Boro rice variety that ultimately benefits the farmers
4	Bacterial Blight (BB) gene pyramided three BRRI dhan29 rice lines having two BB resistant genes (*Xa4* and *Xa21*) were evaluated as ALART in Boro 2018-	These lines will be used to developed bacterial blight resistant variety that ultimately benefits the farmers.

Sl. No.	Technology Developed	How country/ Farmer/ User will be benefited
	19 and among them one line was selected for further evaluation. On the other hand, in Boro/2018-19, BB gene pyramided five BRRI dhan28 rice lines having three BB resistant genes (*Xa4*, *xa13* and *Xa21*) were evaluated as RYT and among them two lines were selected depending on yield performance, duration and BB resistance.	
5	For gene cloning study, cDNA was synthesized from RNA of treated *P. coarctata* and amplified with vacuolar ATPase (PVA) primer. After confirmation, PCR product was clone into TOPO TA cloning vector and confirmed by PCR. PVA construct was prepared using Gateway cloning technique followed by transformation into *Agrobacterium* LBA4404.	Salt tolerant transgenic rice variety will be developed that ultimately benefits the farmers
6	A study on validation of a simple functional marker for fragrance in non-Basmati fragnant rice varieties was done to distinguish the alleles of major fragrance gene in local aromatic rice and to examine the potential of this functional marker among Basmati, non-Basmati aromatic and non aromatic rice varieties. That is why a cross between BRRI dhan28 and Kalizira was made to develop F_2 population. Aroma detection was carried out with 41 F_2 progenies of this cross by panel test as well as genotyping for differentiating aromatic and non aromatic progenies. Forty one F_2 progenies were screened against functional marker of fragrance gene *BADH2*. Among them 9 were identified as aromatic. Same result was found when used KOH for aroma testing.	Information generated from this study will be applicable for Marker Assisted Selection studies for aromatic rice variety development that ultimately benefits the farmers.

Genetic Resources and Seed Division (GRSD)

Table – 1
Research Achievement 2018-2019
(Technology Developed)

Sl. No.	Technology Developed	How Country/Farmer/User will be benefited
Program Area 01: Varietal Development Program (VDP)		
3	**Sub-program area: Rice Germplasm and Seed**	
3.1 3.1.1	**Project: Rice germplasm conservation and management** **Germplasm Collection:** 119 rice germplasm including 04 Aus, 100 Jhum rice, 14 T. Aman and 01 Boro varieties were collected from different districts of Bangladesh.	These germplasms would be utilized in breeding program for varietal improvement.

Sl. No.	Technology Developed	How Country/Farmer/User will be benefited
3.1.2	**Morphological Characterization:** Characterization of 103 germplasm was performed against 53 morpho-agronomic characters. Rejuvenation and storage of 1,951 accessions were performed and 342 new germplasm were registered (from accession 8237 to 8578) in BRRI Genebank. Besides, characterization of 70 local B. Aman germplasm was conducted and six superior genotypes were selected for boosting yield through trait discovery in changing climatic conditions.	Characterized and as well as conserved germplasm would be utilized in trait specific breeding program.
3.1.3	**Molecular characterization:** Molecular characterization of 48 T. Aman germplasm using 54 SSR markers under PBRG-NATP-2 project along with 94 red and black Aus rice germplasm using 61 SSR markers were performed. The highest PIC values were found in RM 207 (0.76) out of 54 and RM289 (0.71) out of 61 SSR markers and confirmed them as the best markers for the studied germplasm, respectively.	Characterized germplasm would be protected regarding varietal identification and intellectual property rights (IPR's).
3.2	**Project: Seed production and variety maintenance** During the reporting year, 226.86 tons of breeder seed were produced and 183.89 tons of breeder seed were distributed among 873 (GO, NGO and PS) 'Rice Seed Network' partners.	Faster dissemination of produced quality seed, as well as its variety to the end users and increased production of rice accordingly.
3.3 **3.3.1** **3.3.2** **3.3.3** **3.3.4**	**Project: Exploratory and genetic studies** Fifty-nine Jhum rice germplasm were characterized in T. Aus 2018 through ten morpho-agronomic and yield contributing characters with a objective to develop low amylose content variety. Preliminary Yield Trial (PYT) of popular rice of four Jirasail accessions was conducted. The highest grain yield (30 g/hill) was observed in HRC (Path) Jirasail, Bogura. PYT of ten aromatic landraces accessions was conducted. The maximum yield/hill was found in Ranisalute (35 g). PYT of seven popular Balam, Jesso-Balam and Sadamota accessions was conducted and after evaluation, one Balam (Acc. 516), two Jesso-Balam TAPL (Acc. 2464 and 2472) and one Sadamota (Acc. 7888) germplasm were selected.	The genetic variability and relationships i.e. genetic makeup of the studied germplasm could be well understood. Characterized germplasm would be utilized in trait specific breeding program. Besides, the evaluated germplasm would be released as new BRRI variety (s) during the process.
3.4	**Documentation of technology:** During the reporting year, 1,000 accessions were documented in computer through *Microsoft Office Excel* program with collected available information.	Characterized information of the germplasm could be utilized for selecting parent(s) in breeding program.

Hybrid Rice Division

Table-1

Research Achievement 2018-2019

(Technology Developed)

Sl. No	Technology Developed	How country/farmer/user will be benefited
01.	A total of 12445 kg of parental lines (A & R) and hybrid seeds of six released hybrid varieties distributed to 22 seed companies, department of agricultural extension along with 80 farmers	Popularization of BRRI released hybrid varieties.
02.	One potential hybrid combination (IR75608A/BRRI31R) has been registered to SCA as BRRI hybrid dhan7 for T Aus season having slender grain with yield potentiality 6.5-7.0 t/ha and growth duration within 105-110 days. First year evaluation result was declared and performed well. Hopefully it will be released in next year.	Newly released BRRI hybrid dhan7 has immense yield potentiality with desirable grain quality will fulfill farmers demand for Aus season.
03.	Publishes leaflet of cultivation and seed production technologies of BRRI released hybrids	It will helpful for farmer and small entrepreneurs to understand technology easily.
04.	Seven promising restorer lines (FengleR, Win1R, Win2R, CTR-1, EL254R, EL255R & EL260R) were selected from collected restorer lines for higher heterotic effect and seed production potentiality	Hybrid combinations with these selected restorer lines performed well both in T. Aman and Boro season. New desired potential hybrids will come up from these combinations and fulfill farmers' demand.
05.	F_1 seed production package development of the selected hybrids	Seed production of the newly selected hybrids have been fine tuning and farmers can easily make seed production with this combination

Grain Quality and Nutrition Division

Table-1

Research Achievement 2018-2019

(Technology Developed)

Sl.	Technology Developed	How Country/farmer/user will be benefited
1.	On the basis of physicochemical and cooking properties, only 12 lines from 133 breeding lines were suggested for further research.	Breeders
2.	1. Under transforming rice breeding program a total of one thousand five hundred twenty four (1524) transforming breeding lines were evaluated for physicochemical and	Breeders

Sl.	Technology Developed	How Country/farmer/user will be benefited
	cooking properties for superior quality. Based on the performance on grain quality, we recommend 15 (BR8448-14-2-1-1-1-25; IR92466-SUB-SUB-59-1-B; IR13F458; IR13F45; IR13F548; BR9649-9-2-1; IR65482-4-136-2-2 ; BR9006-54-1-3-2 ; BR8781-16-1-3-2-P2; IR16F1153; BR9159-10-2-1-2-5-1-B1; BR9175-9-2-1-12-5; BR9175-9-1-3-20-3; IR13F458-5; IR13F458) lines for further advancement. 2. Under evaluation of physicochemical properties of newly released BRRI varieties, BRRI website were updated from BR1 to BRRI dhan77 including BRRI Hybrid dhan1to 6.	
3.	1. Mineral profiling of 68 HYVs from BR1-BRRI dhan69). 2.Vitamin profiling of 35 BRRI HYVs.	Breeders
4.	Formulation of gluten free rice biscuit.	Consumers
5.	RB and DORB samples were found positive for bacteria, yeast and mold population, and aflatoxin B1 for fresh (0), 7, 14 and 21 days after storage at ambient temperature. RB and DORB samples for 28 days after storage found lower load in bacteria, yeast and mold load but completely negative for aflatoxin B1. We have examined all the above mentioned quality parameters for RBO and found negative for bacteria, yeast and mold load and even aflatoxin B1. In addition, no trace heavy metals were present in either crude or refined RBO samples. Since acute toxicity experiment on animal health, toxins and heavy metal toxicity in RBO samples found negative, so refined RBO is safe and will bring benefit to health for Bangladeshi population.	Rice bran oil miller/Feed miller/consumer
6.	It was observed that 25% replacement of BRRI recommended fertilizer dose with SBE does not compromise yield component at all. This replacement percentage of BRRI recommended dose can further be extended up to 50% at best in extended multilocation field trials in Bangladesh. Since SBE is very cheap (only Tk 1-2 per kg SBE) and available in refined edible oil mills in Bangladesh, so it could possibly save significant amount of currency in return and lower agricultural cost indeed.	Farmers
7.	Puffed, popped and flattened rice were produced from 10 BRRI varieties to evaluate the quality products. Comparing few parameters (fully puffed rice, length and breadth increase percentage) with BR16 (Std), it is ascertained from the results that BRRI dhan72 is better in producing whole puffed rice followed by BRRI dhan70. Considering physical parameters, BRRI dhan70 and BRRI dhan71 show excellent performance for whole, partial broken, broken and unpopped rice. Among the tested varieties, in terms of weight of whole, partial broken and broken flattened rice as well as percentage of length increased, BRRI dhan74 showed the best performance	Consumers

Sl.	Technology Developed	How Country/farmer/user will be benefited
	comparing with BR16.	

Agronomy Division

Research Achievement 2018-2019

(Technology Developed)

Table-1

Sl. No.	Technology Developed	How Country/Farmer/User will be benefited
	Not yet completed.	

Plant Physiology Division

Table - 1

Research Achievement 2018-2019

(Technology Developed)

Sl.	Technology Developed	How country/Farmer/User will be benefited
	Not applicable	

Soil Science Division

Table-1

Research Achievement 2018-19

Scientific Information Developed	How country/Farmers/User will be benefited

Scientific Information Developed	How country/Farmers/User will be benefited
➢ Alternate wetting and drying (AWD) irrigation reduced global warming potential by about 25-30% compared to conventional practices in Boro season. ➢ Application of urea-HA nano-fertilizer as N source may curtail 50% urea use during dry (Boro) rice season in terrace paddy soil of Gazipur, Bangladesh. ➢ Application of bio-organic fertilizer (1-2 t ha^{-1}) can supplement 25-30% chemical N and 100% TSP fertilizer requirement for rice production. Bio-organic fertilizer improved rice yield in saline soil as well. ➢ Deeper application of PU or USG by applicator would save around 57 kg N ha^{-1} as well as protect environmental pollution. ➢ In case of premium quality rice varieties i.e. BRRI dhan50 and BRRI dhan63, organic and inorganic fertilizer (INM) can save around 50% chemical fertilizers. ➢ In the first, second and third crop cycle, AEZ based chemical fertilizer seemed enough to obtain potential yield for each crop under both four crops cropping patterns. In all cases, incorporation of crop residue had some positive impact on yield than chemical fertilizer alone. ➢ Soil available P levels may decrease tremendously if P fertilizer is not applied for a long time. Despite the variations in soil P levels, application of recommended P fertilizer might be useful to recover the rice yield loss. ➢ Micronutrients specially, Zn and Mn are essential to apply in Rangpur soil not only to achieve good yield but also maintain soil health**.** ➢ Long-term omission of N, P, K and S adversely affected rice yield, while S and Zn omission had no negative impact on rice yield in Grey Terrace soil of Gazipur. Long-term application of IPNS based fertilizers showed increasing trend in rice yield. ➢ 50% soil test based (STB) plus mixed manure at the rate of 2 t cow dung and 1 t ash per ha is good option for sustainable intensive rice cultivation. ➢ Deep placement of UB significantly increased rice	The developed scientific information will be useful to the researchers and scientific personnel related to agriculture in home and abroad. The farmers in our country will also be benefited.

Scientific Information Developed	How country/Farmers/User will be benefited
yield and NUE compared to broadcasted PU under AWD and CSW conditions in Boro season. ➢ Deep placement of UB significantly reduced floodwater NH_4^+-N and NH_3 volatilization compared to broadcast PU. ➢ AWD condition significantly reduced cumulative CH_4 emission compared to CSW at Gazipur site. ➢ Shorter duration rice varieties are one of the important key factors to reduce greenhouse gas emission with sustainable rice yield. ➢ Lead content in grain sample was found lower (0.13 mg/kg) than the maximum permissible limit (0.2 mg/kg). ➢ Rice Crop Manager (RCM) seems superior tools for nutrient management in coastal region of Bangladesh.	

Irrigation and water management

Table-1
Research Achievement 2018-2019
(Technology Developed)

Sl. No.	Technology Developed	How Country/Farmer/ User will be benefited
1	**Multipurpose use of portable solar panel driven surface water irrigation system** Electricity can be produced by portable solar panel to operate surface irrigation pump in Boro season. The panel can also be used to thresh paddy and to supply household electricity after irrigation season. A 1.5 kW low-lift pump (LLP) can irrigate surface water to Boro rice field at a rate of 10-12 L/s by using the produced electricity from portable solar panel. After the irrigation season, a 1.5 kW open drum thresher can also be operated by this solar panel, by which two labour can thresh 250-350 kg paddy per hour. The solar panel can produce	Multipurpose utilization of portable solar panel can reduce agriculture production related irrigation and postharvest cost which helps to decrease the total production cost. Farmer will be financially benefited by this reduction.

	enough electricity which can fulfill the demand of three to four households.  Figure: Multipurpose use of produced electricity by portable solar system **Technological benefit:** (a) Surface water can be withdrawn by 1.5 kW LLP at a rate of 10-12 L/s. (b) Two labour can thresh 250-350 Kg paddy per hour. (c) Electricity can be supplied to 3-4 household.	

Plant Pathology

Table-1
Research Achievement 2018-2019
(Technology Developed)

Sl No.	Technology Developed	How Country/Farmer/User will be benefited
1	**Identification of existing races/pathotypes of *Xanthomonas oryzae* pv *oryzae* and study on its diversity** A total of 350 bacterial blight infected samples were collected from the 26 different districts of Bangladesh. From the collected samples, 150 bacterial blight isolates were isolated and preserved. Among 50 isolates, 10 physiological races were identified based on the reaction pattern against BB resistant NILs.	In this study *Xa21, xa13* & *Xa8* identified as effective gene, which can be used to develop bacterial blight resistance variety.

2	**Evaluation of effective chemicals against Sheath Blight disease of rice** Eighteen fungicides with a standard check were tested by artificial inoculation at BRRI Gazipur and Rajshahi farm. Among 18 fungicides, four were identified as effective fungicides against sheath blight disease.	Minimize sheath blight disease infestation.
3.	**Evaluation of new chemicals against rice blast disease** This study was conducted to evaluate eleven fungicides with standard check during the last two consecutive years (2018 and 2019) at the Blast Nursery of Plant Pathology Division, BRRI, Gazipur by artificial inoculation. Among those fungicides, five were recommended for blast diseases management.	For blast disease management.
4.	**Management of Sheath blight disease utilizing *Trichoderma harzianum*** Tricho-compost (previously prepared by plant pathology division) was used in field of BRRI dhan70 and BRRI dhan75 varieties in T. aman season. A total of six treatments – T1 (Recommended dose of fertilizer, RDF with Trichocompost), T2 (75% RDF + 25% vermicompost), T3 (RDF), T4 (75% RDF+ 25% poultry manure), T5 (RDF with DAP) and T6 (Control without fertilizer) were used. BRRI dhan48 in T. Aus and BRRI dhan72 in T. Aman season were used in field of Irrigation Division, BRRI to find out the efficacy of this compost in reducing sheath blight disease. A total of six treatments were applied at the same time adjacent to the compost trial for comparison. Recommended dose of fertilizers with Tricho-compost reduced % relative lesion height of sheath blight disease.	Effective to reduce sheath blight disease and increase yield.

Entomology Division

Table 1
Research Achievement 2018-19
(Technology Developed)

Sl. No.	Technology Developed	How Country/Farmer/User will be benefited
01	Significantly higher natural enemies and parasitism were observed in rice field surrounding by flowering plants on bunds, indicating enhanced ecosystem could increase natural enemies and parasitism activity in the rice field. So, farmers should avoid the toxic and hazardous insecticides to control the insect pests by growing nectar-rich flowering plants on the bunds surrounding rice crops.	• Conservation of natural enemies in rice field will reduce dependency on insecticidal control.
02	BRRI developed sex pheromone showed significant	• Use of synthetic pheromone blend

Sl. No.	Technology Developed	How Country/Farmer/User will be benefited
	reduction of leafroller moth in rice field (upto 571 moth/trap/week). Not only that, higher leaf damaged by leafroller larvae was observed in three times insecticide treated plot ($P < 0.01$) compared to pheromone trap treated plot. This finding indicated that pheromone trap is more effective than chemical insecticide for reducing larval population and damaged intensity. 	with BRRI pheromone traps in rice field showed effective tool for controlling and monitoring leafroller in Bangladesh. • The pheromone trap reduces insecticide use and save environment from insecticidal pollution.
03	A total of 200 field demonstrations were conducted in 15 districts with eco-friendly insect pest management i.e., refrained from insecticide use up to 30-40 days after transplanting to enhance and conserve natural enemies in rice field, perching, sweeping and need base insecticide application. As a result rice production done without or one time use of insecticide.	• These eco-friendly insect management systems will reduce environmental pollution. • Farmers will get more benefit by no or less use of insecticide without any yield penalty.
04	Pilot scale researches on solar light traps were conducted in rice field of six different locations in Bangladesh. Significant numbers of insect pests were caught in each trap in all locations. So, solar light traps would be promising tools for insect monitoring and control.	• Farmers could easily use this trap as no need manpower to operate the trap. • Reduce insecticide use and save environment from insecticidal pollution.
05	Mahogany oil fume caused significant mortality to rice weevil (54 to 91.11%) and angoumois grain moth (84.20 to 92.12%) compared to the control. The study result indicated that mahogany oil would be an effective product for controlling stored grain insect pests.	• Farmers will be using this eco-friendly product to control stored grain pests.
06	The following materials were found moderately resistance/susceptible against different insect pests: Against BPH: i. IR 11L433 (score 5) ii. Latabalam (score 5) iii. IR96321-1099-402-B-4-1-2 (score 5) iv. IR96321-1447-428-B-1-1-1 (score 5) v. BR9675-68-5-1 (score 3) vi. IRBPHN SVIN036 (score 3-5) vii. IRBPHN SVIN352 (score 5) viii. Accession 489 (score 3)	• This material has been given to Plant Breeding Division for resistance breeding programme. • Reduce insecticide application • Helps conservation of natural enemies • Reduce production cost

Sl. No.	Technology Developed	How Country/Farmer/User will be benefited
	Against GLH: i. IR11N202 (score 3) ii. IR04A428 (score 5) iii. IR96321-1099-402-B-4-1-2 (score 5) Against WBPH: i. BR8521-30-3-1, (score 5) ii. IR 11L433) and GLH (score 5) iii. BR9675-68-5-1, (score 5) iv. BR8562-11-2-6-1-1-1, (score 5) v. BR8562-11-2-6-2-5-2 (score 5) vi. BRRI dhan29-SC3-2816-10-6-HR6(Com) (score 5) vii. HR1-(Gaz)-P8 (Hbj) (score 5) viii. BR8862-29-1-5-1-3(score 5)	
07	A total of 132, 09, 10 and 4 commercial formulations of insecticides were evaluated against brown planthopper, yellow stemborer, rice leaffolder and rice weevil respectively. Among them 124, 03, 03 and 04 were found effective against brown planthopper, yellow stemborer, rice leaffolder and rice weevil respectively and recommended to PTASC for registration. Among all the tested insecticides 36 bio-pesticides were found effective against different insects.	• Farmers will be benefitted by using these insecticides after approval of PTAC.

Rice Farming System Division

Table-1

Research Achievement 2018-2019

(Technology Developed)

Sl. No.	Technology Developed	How Country/ Farmer/User will be benefited
01	Wheat/Onion-Jute/Aman (Relay) cropping pattern for Shallow flood prone ecosystem Main feature of the technology: Main jute containing cropping pattern in Bangladesh is Rabi-Jute-T. Aman. However, in flood prone areas flood makes T. Aman cultivation difficult after jute and cropping pattern turns into Rabi-Jute-Fallow. In this new improved cropping pattern in shallow flood prone areas, one month before harvest the jute, Aman rice is direct seeded into jute as relay crop and hence Aman establishment in shallow flood prone areas becomes possible. New Aman rice varieties with better fertilizer management improved of the total cropping pattern	Inclusion of Aman is possible in this cropping pattern as a relay crop with jute under the prescribed management and it increase crop intensity. Farmers can get about 3.5 t/ha of extra Aman yield out of it and increase the total production of this cropping system.

Sl. No.	Technology Developed	How Country/ Farmer/User will be benefited
	yield. The varieties are BRRI dhan72 as relay crop with jute (JRO-524) and BARI Onion-2 as Rabi crop.	
02	Development of Vegetables, fish and fruit system in derelict pond The main components of this system are growing aroid (Panikachu-3) and fish (Telapia) in the pond as mixed crop in the rainy season and winter vegetables, summer vegetables and Papaya (Shahi) on the surrounding bank of pond throughout the year. Panikachu- and Telapia fish mixed cropping was found highly productive.	There are about 2, 20,000 derelict ponds throughout country mostly in homestead. Farmers can practice this mixed production system and can successfully get more carbohydrate, proteins, vitamins and minerals all together from the pond system than terrestrial ecosystem. Integrated culture of aroid-fishes with year-round vegetables and papaya on the bank of surrounding pond give 6 times higher economic return than the existing only fish culture. Annually 1000 kg different winter and summer vegetables and 2500kg year-round papaya can be produced from100 m^2 surrounding pond-bank.

Agricultural Economics Division

Table – 1
Research Achievement 2018 – 2019
(Technology Developed)

SL. No.	Title	Achievement/ Key findings	How Country/Farmer/User will be benefited
1	Farm level Adoption and Evaluation of Modern Rice Cultivation in Bangladesh	• In Aus season, overall adoption of modern varieties was 84.95% of which BRRI varieties' coverage was about 70%. BRRI dhan48 ranked the top position (31.50%) in terms of area coverage followed by BRRI dhan28 (11.19%) in this season. • Overall adoption of modern varieties (MVs) in T. Aman season was about 81% of which BRRI varieties' coverage was 53%. Though overall adoption of BRRI varieties seemed apparently low (52.53% in this season, but in some regions, it was substantially higher (61-77%). BRRI dhan49 (15.03%) and BR11 (5.33%) were the mostly adopted BRRI varieties in T. Aman season and the coverage of Indian varieties was more than 19%. • In Boro season was adoption of modern varieties about 100%, of which coverage	• Breeders may use the information of the study for developing climate resilient region specific popular modern varieties. • Researchers, extensionists' and policy makers may also use this information to formulate appropriate policy for enhancing food grain production.

SL. No.	Title	Achievement/ Key findings	How Country/Farmer/User will be benefited
		of BRRI varieties was about 67%. BRRI dhan28 and BRRI dhan29 were the most dominant varieties covering 50% areas in Boro season. • BRRI dhan48 produced the highest yield (4.03 ton/ha) in Aus season whereas in T. Aman season, BRRI dhan49 was the top yielder (4.87 ton/ha), followed by BRRI dhan52 (4.57 ton/ha). BRRI dhan29 was the highest yielder (6.26 ton/ha) followed by BRRI dhan58 (6.10 ton/ha) in Boro season. • Average yield of hybrids was 7.09 ton/ha whereas BRRI developed hybrids yielded 7.05 ton/ha in Boro season.	
2	Estimation of Costs and Return of MV Rice Cultivation at Farm Level	• In Boro season, yield was comparatively higher due to better cropping environment, good management practices and use of better genotypes; consequently, secured higher gross return. • In T. Aman season gross and net return was higher due to lower costs of production and better market price. • Overall, rice cultivation was profitable at current years' yield and price in terms of gross margin income and only the T. Aman rice was profitable in terms of net income.	• The findings would help policy makers to fix the public procurement price, guarantee the support prices as well as provide the input subsidies to promote the rice production for farmers' wellbeing.
3	Value Chain Analysis of Aromatic Rice (Tulshimala) in Bangladesh	• Tulshimala growers obtained higher benefit. • Share of net profit earned by miller was 42.75% which was highest among all other actors of value chain and side by side, it was also observed that marketing costs was also higher for millers. • Producer's share was 63.53% of consumer's paid price which seemed not sufficient compared to other actors of the value chain.	• Finding of the study will help the researcher and policymaker to develop an export-oriented supply chain of aromatic rice in Bangladesh
4	Status and Drivers of Adoption Indian Varieties in Boro Season in North-West Bangladesh: A Case of	• Adoptions of Indian cultivars were 82%, 95% and 87% of total area of Boro season, respectively in Nandigram, Adamdighi, and Mohadebpur Upazila. In Nandigram, adoption of Indian cultivar namely Minicate was about 71% of total Boro area. • Likewise, adoptions of Indian cultivar, for	• Rice breeders can use the information from this study to develop and disseminate suitable varieties to replace the Indian rice varieties in the concern areas.

SL. No.	Title	Achievement/ Key findings	How Country/Farmer/User will be benefited
	Bogura and Naogaon Districts	instance Zirasail were 86% and 83% of total Boro areas in Adamdighi and Mohedebpur, respectively. • Apparently Zirasail and Minicate are same cultivar named as different in the different locations. • The key drivers of adoption Indian cultivar are resistance to pest, better yield performance, grain quality, higher market demand and price.	
5	Preference of T. Aman rice varieties in the south-west coastal areas in Bangladesh	• BRRI dha76 was the most preferred variety to the farmers in Dacope due to the suitability of transplanting in the fields with over a feet depth of water, higher growth rate and longer growth duration so that matured after drainage out the stagnant water from the fields. It was also popular to the growers for less or no infestation of disease and long panicle size with large number of grains. • On the other hand, BRRI dhan77 was the most preferred variety at Amtali because of higher yield than local checks. Besides, this variety matured about 15-30 days earlier than check varieties, which is beneficial for food scared period in this region. • BBRI dhan73 was least preferred variety both in Dacope and Amtali.	• Researchers, extension personnel and policy makers may use this information to formulate appropriate policy for increasing food grain production in the coastal belt of Bangladesh
6	Assessing the Impact of BRRI Released Modern Wet Season Rice Technology Adoption on Farmers' Well-being in Bangladesh	• BRRI released wet (Aman) season rice technology has positive effect on small farmers' welfare in Bangladesh as measured by the level of increases in per capita household real income, increases in real rice income, and also increases in yield, and decreases both in poverty gap and squared poverty gap over the time. • The marginal and near landless farmers have not gained significantly through adopting BRRI released modern rice technology over non-adopters. • However, only yield of BRRI released wet (Aman) season rice technology has positive and significant impact for the marginal and near landless farmers. • Overall, there was large scope for enhancing adoption of BRRI released rice technology in order to reduce the level of	• The government, policy makers, researcher and extension workers may use this information to formulate appropriate policy to disseminate BRRI released Aman rice technology which will help to increase farmers income and reduce rural poverty.

SL. No.	Title	Achievement/ Key findings	How Country/Farmer/User will be benefited
		poverty in rural areas. Thus, it is necessary to develop rice technology targeting to increase the level of income and as well as reduce the poverty of the resource poor marginal and near landless farmers.	
7	Economics of Jhum Cultivation in Bangladesh	• Rice area covered by Jhum in hilly areas was 16% and in Valley about 45%, 32% and 7% areas were occupied by T. Aman, Boro and Aus rice, respectively. • Per hectare return from Jhum was Tk. 276887 where costs incurred Tk. 100879, indicating Jhum cultivation is profitable (Tk. 176008/ha.) in the hilly areas. • Local rice varieties used in Jhum are resistant to insects and diseases. • Drought, insects and diseases resistant tall plant HYV can be grown in the Hills • Coarse rice is widely accepted by Hilly people. • BRRI varieties that are suitable in other places, also suitable for valley	• Rice breeders can use the information from this study to develop and disseminate suitable Jhum varieties to replace the local varieties. • Researchers, extensionists' and policy makers may use this information to formulate appropriate policy to increase rice cultivation in these areas.

Agricultural Statistics Division

Table-1
Research Achievement 2018-2019
(Technology Developed)

Technology Developed	How Country/Farmer/ User will be benefited
● Stability Analysis of BRRI varieties Description: Among T. Aman varieties, BRRI dhan49 were found stable while BR3, BR5, BRRI dhan33, BRRI dhan34, BRRI dhan37, BRRI dhan38, BRRI dhan39, BRRI dhan56, BRRI dhan70 and BRRI dhan77 appeared to be below average stable. BR 4, BR10, BR 11, BR 22, BR23, BR25, BRRI dhan30, BRRI dhan31, BRRI dhan32, BRRI dhan40, BRRI dhan41, BRRI dhan44, BRRI dhan46, BRRI dhan51, BRRI dhan52, BRRI dhan53, BRRI dhan54, BRRI dhan66, BRRI dhan71, BRRI dhan72, BRRI dhan73, BRRI dhan75, BRRI dhan76, BRRI dhan78, BRRI dhan79, BRRI dhan80, BRRI dhan87, BRRI hybrid dhan4 and BRRI hybrid dhan6 were found having average stability among T. Aman varieties. No unstable variety was found in T. Aman season. In Boro season, among the non- aromatic varieties BRRI dahan29 and BRRI Hybrid dhan5, BRRI Hybrid dhan3 and	From the results of the analysis, researcher comes to know which variety is still stable and which variety is losing its stability that's why needs to replacement for any particular variety and set up their research strategy eventually which strength the future food security.

Technology Developed	How Country/Farmer/ User will be benefited
BRRI Hybrid dhan2 were found as stable rice varieties. BR26, BRRI dhan27, BRRI dhan28, BRRI dhan29, BRRI dhan30, BRRI dhan31, BRRI dhan32, BRRI dhan33, BRRI dhan34, BRRI dhan35, BRRI dhan36, BRRI dhan37, BRRI dhan38, BRRI dhan39, BRRI dhan40, BRRI dhan41, BRRI dhan42 were found as below average stable where others varieties were found as average stable. BRRI dhan50 which is aromatic rice variety, stability index is 1.06 and falls under average stable.	
● Study on G X E interaction of BRRI varieties Description: The development of rice varieties is affected by the environment, genotype and their interaction. Yield performance of different varieties varies across testing environments and its grain yield performance is a function of genotype (G), environment (E) and genotype × environment interaction (GEI). The structure of GEI is very important in plant breeding programs because a significant GEI can seriously impair efforts in selection of superior genotypes in relation to new crop introductions and cultivar development programs leads to successful evaluation of stable genotype, which could be used for general cultivation	From the results of the analysis, researcher comes to know which variety is suitable in which environment and locations. That the researcher can take initiative to replacement for any particular variety and set up their research strategy eventually which strength the future food security.
● Region specific BRRI variety adoption: A simple way of increasing national rice production Description: To increase national production of rice we adopt the potential yielded variety at the respected season and region with best crop management practice (BRRI recommended) than total clean rice production will increase 24.22% then present production. In case of the highest yielding variety it will increases 11.03% but for wrong selection of variety (lowest yielding variety) production will decreases more than 50%.	From the results of the analysis, farmers and researcher comes to know which variety is potential yielded in which season and region with the best crop management practice. That the researchers and farmers can take initiative to introduce particular variety for those regions.
● Seasonal weather forecasting for rice production Description: Weather forecast based rice crop management system were enable farmers/researchers/decision makers to make effective decisions on rice crop supervision for different weather conditions, well ahead of time.	From this activity, it is not only reducing the risk but also enables to maximize the benefit from favorable weather conditions. And also has potential for increasing the rice yield, avoiding insect and disease outbreaks, proficient use of pesticides, herbicides & fertilizer application and efficient agricultural water management, thus, reducing the overall production cost as well.

Technology Developed	How Country/Farmer/ User will be benefited
● Suitability mapping of newly released BRRI rice varieties Description: Among the BBRI dhan80-86 and BRRI hybrid dhan6 most of the varieties are suitable in North-western side of Bangladesh except BRRI dhan85 which is suitable in north eastern and central eastern side of Bangladesh. Productivity will be increase, if we cultivate rice varieties according to their suitable area.	Farmers and researchers comes to know the suitable area for BRRI dhan80, BRRI dhan82, BRRI dhan83, BRRI dhan84, BRRI dhan85 and BRRI dhan86 also BRRI hybrid dhan6 and adobe particular variety in suitable area i.e. best use of land and maximizing production.
● Online Application System of BRRI Description: The online application system for recruitment is an ideal portal for Government. BRRI wants to manage their recruitment related activities through online. So BRRI will introduce this online system to decrease hassles of applicants/students for Job Application.	This application system will be reduced time and labor of Job applications processing for employer. Applicants will get all kinds of information (applicant list, exam center name and date, recruitment result etc.) through this web and SMS based application.

Technology Developed	How Country/Farmer/ User will be benefited
● Rice Knowledge Bank (RKB) mobile app Description: Rice Knowledge Bank (RKB) is a dynamic mobile application and also mobile base knowledge bank. RKB application has been developed with the information of BRRI released rice varieties, modern rice cultivation and agricultural machinery technologies. Everyone can free download it from **" Google Play Store "**. It is an auto update application. Anyone one can free distribute the apps using SHAREit without internet connection.	From this app, farmer's extension personnel researchers, teachers as well as student comes to know the modern rice cultivation methods, rice pest management (insect & diseases), Soil and fertilizer management, Irrigation and water management, Quality rice seed production management etc. As a result, it is playing a significant role to increase the rice yield.
● BRRI Rice Doctor Mobile and Web Application Description: 'BRRI Rice Doctor' mobile and web application is an ICT-based agricultural solution which help and identify problems in rice crop and provide actionable advice how to manage them. It supports diagnosis of insect pests and diseases and enables farmers to make timely decisions for better pest management. It is available at *Google Play Store* of any android mobile phone. Anybody can download and then install this app. Otherwise; anyone can share this app through *SHAREit* app from one smart phone to another phone through offline	From this app, farmer's extension personnel researchers, teachers as well as student comes to know the Identify disease, insects and other criteria as a diagnostic tool through asking question. Question wise push notification/SMS to give feedback about specific problem for user. Also Global push notification and Bangla content reader (Text to speech). As a result, it is playing a significant role to increase the rice yield.

Farm Management Division

Table 1

Research achievement 2018-2019

(Technology Developed)

SL. No.	Technology Developed	How Country/ Farmers/User will be benefited
	Program Area: Socio-Economics and Policy	
03	Farm Management Division	
	3.1. Productivity and profitability of different short duration rice variety as affected by spacing. Among the T. Aman varieties BRRI dhan75 gave the highest grain yield. The spacing (15cmX 15cm) and (20cm X15cm) may be considered for obtaining better yield of short duration rice variety in T. Aman season. During Boro season 20cm X 20cm spacing is the best for short duration Boro varieties and among the varieties BRRI dhan84 produced the highest grain yield.	This finding may be useful for the rice growers and researchers.
	3.2. Effect of organic matter on soil properties and yield of rice This study indicates organic matter from 3 to 4 t ha^{-1} is not sufficient for rice cultivation. We need to increase the organic matter dose for good yield or used combined fertilizer management for good yield of rice.	This finding may be useful for the rice growers and researchers/ production farm.
	3.3. Laborers' wage rate in rice production farm: Survey and monitoring of laborers' wage rate at different locations around BRRI HQ such as Joydebpur, Chowrasta, Salna, Board Bazar, Konabari, Tongi were conducted throughout the year. The average wage rate day^{-1} varies from Tk. 447-491. The wage rate day^{-1} during the peak periods of the year Tk. 490 to 540 in May, Tk. 480 to 505 in July-August and Tk. 455 to 510 in December -January were existed. The wage rate varied between Tk. 395-420, 375-435, 425-490, 390-450, 430-465, 425-490, 385-425 and 435-485 at Habiganj, Rangpur, Rajshahi, Barisal, Sonagazi, Comilla, Satkhira and Khulna, respectively.	The Laborers' wage rates will help to estimate rice production cost and thus determine the retailer price of rice for the market.

Farm Machinery and Postharvest Technology Division

Table - 1
Research Achievement 2018-2019

(Technology developed)

Sl	Technology developed	How country/farmers/user will be benefited
1	BRRI Rice Transplanter cum mixed fertilizer applicator 	The farmers of Bangladesh normally apply urea fertilizer as prilled formed by hand broadcasting. The deep placement of urea (either granule or prilled form) in transplanted rice field is an efficient and environmentally safe as compared with the traditional method of urea application. In addition, farmers need additional one machine for fertilizer application. Under this condition, mixed fertilizer deep placement technology has been incorporated (suitable for either urea alone or combination of urea, TSP, MoP and Gypsum together) to the existing mechanical rice transplanter (walking type) without sacrificing the merit of transplanting ensuring transplanting and fertilizer deep placement simultaneously. Urea fertilizer along with TSP, MoP and Gypsum fertilizer can be placed and covered in 6-8 cm soil depth during mechanical transplanting. The fuel consumption is 1.0-1.25 litter/h and field capacity of the machine is 35-40 decimal/h. Transplanting and fertilizing can be done in one operation which is suitable for all over the country. Mechanical transplanting along with mixed fertilizer deep placement (80% of the recommended dose of urea) produced significantly higher yield and BCR compared to the mechanical and manual transplanting along with hand broadcasting of fertilizers.

Workshop Machinery and Maintenance

Table-1

Research Achievement 2018-19

(Technology Developed)

Sl. No.	Technology developed	How Country/Farmer/User will be benefited
1	Solar power used in threshing operation Photovoltaic system consists of 850 W solar panel were installed at BRRI automobile workshop to operate BRRI thresher. Pedal thresher was modified to use solar energy in threshing of paddy. Motor of 1 hp was used as power transmission system. Its performance was evaluated in Boro and Aman season 2018. Revolution per minute (RPM) of it was 300. Two operators can thresh paddy simultaneously. Capacity of paddy threshing in modified pedal thresher using solar energy was found 320 kg/hr. Solar energy was used to thresh paddy at BRRI threshing yard in Aman 2018 and Boro 2019 successfully.	Using renewable to replace conventional fossil fuels can prevent the release of pollutants into the atmosphere and help combat global warming.

Adaptive Research Division

Table 1

Research Achievement 2018-2019

(Technology Developed)

Sl. No.	Technology Developed	How Country/Farmer/User will be benefited
	Adaptive Research Division (ARD) works in technology validation and dissemination, not directly in technology development. However, ARD conducts Advanced Lines Adaptive Research Trial (ALART) at farmers' field in different agro-ecological zones of Bangladesh in different seasons, which is an important step before releasing any new variety. In this sense, ARD was involved in developing BRRI dhan87, BRRI dhan88, BRRI dhan89, BRRI dhan90, BRRI dhan91, BRRI dhan92, BRRI dhan93, BRRI dhan94 and BRRI dhan95 through validation in farmers' field.	Suitable genotypes are selected through the validation trials that would have significant role to increase rice production and maintain sustainable food security of Bangladesh.

Training Division

Table-1

Research Achievement 2018-19

(Technology Developed)

Sl.No.	Technology Developed	How country/farmer/User will be benefited
	Program Area: Technology transfer Program Performing Unit: Training division	
	1. Capacity Building and Technology transfer through training	Knowledge and skill of the trained personnel on the subject matters were increased
	Total training conducted : 49 No. of Participants: 1271 Duration: 1 days to 2 months	1. Knowledge and skill of the participants on different aspects on rice production technologies were enriched. 2. Rice yield and production of the country will be increased.

Regional Station, Sagardi, Barishal

Table – 1

Research Achievement 2018-19

(Technology Developed)

Technology Developed	How country /Farmers/Users will be benefited
01. Insecticide free Rice Production in Barishal Region	Farmer losses about 24% Aus, 18% Aman and 13% Boro yield due to rice insect damage. Generally rice farmers using on an average 3(three) times insecticides in a single season to control yellow stem borer, leaf folder, rice hispa, brown planthopper and rice hispa. Three times insecticides uses cost about 1000-1500 tk per bigha. Using this technology farmers can be saved about 1000-1500 tk per bigha of rice production. Long lasting environmental and economical effects to farmers and consumers.

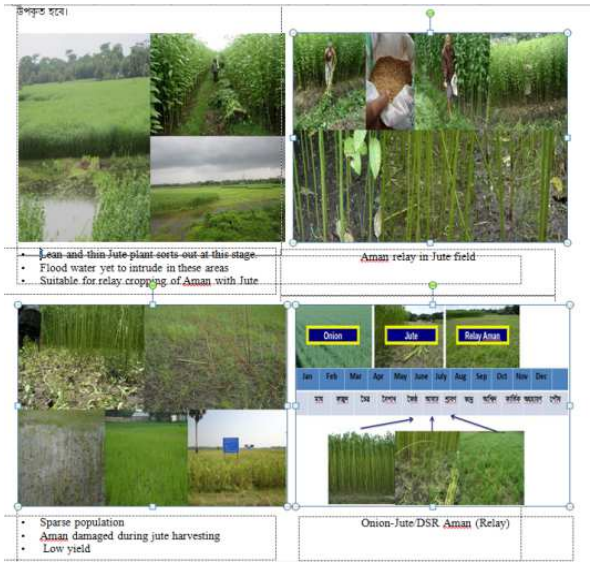
BRRI Regional Station, Bhanga, Faridpur

Table-1

Research Achievement 2018-2019

(Technology Developed)

Sl. No.	Technology Developed	How Country/Farmer/User will be

		benefited
	Jute/Aman (Relay) Cropping Pattern for Shallow Flood Prone Ecosystem **Description:** Jute containing cropping pattern in Bangladesh is Rabi-jute-Aman. However in flood prone areas flood water makes T.Aman cultivation difficult after jute and cropping pattern turns into Rabi-Jute-Fallow. Under this new improved cropping pattern in shallow flood prone areas, one month before the harvest of jute, Aman rice is direct seeded into jute as relay crop and hence Aman establishment in shallow flood prone areas becomes possible. In this improved cropping pattern, new Aman rice varieties and better fertilizer management improved the total cropping pattern yield.	**Technological benefit** • Inclusion of Aman rice is possible in shallow flood prone areas. • Increase cropping intensity and crop diversity. • Increase total production under the cropping systems. Farmers can get about 3.5 t/ha of extra Aman yield. **Beneficiaries** **Farmers:** Farmers of Faridpur Region will be benefited by obtaining higher Aman rice yield by using BRRI dhan71, BRRI dhan72, BRRI dhan75 as relay crop with jute (JRO-524), BARI Onion-2 in Rabi Season in Onion-Jute/Aman cropping pattern. 

Regional Station, Cumilla

Table-1

Research Achievement 2018-2019

(Technology Developed)

Sl.	Seasons	Technology developed	How Country/Farmer/User Will be benefited
Pest management			
1.	T. Aman 2018	Blast disease management technology for aromatic rice varieties in Cumilla region during T. Aman season	By following this technology, farmers can reduce as well as prevent neck blast disease upto 99% and farmers can increase rice yield by combating neck blast disease of aromatic rice upto 57%. Farmers cost of fungicide for spraying two times is 600 taka, which can secure about 11900 taka rice equivalent to yield per bigha. By this way, farmers can protect their aromatic rice yield from neck blast disease and can get more yields, which

			may take role in the development of the farmer's socio-economic condition and ultimately contribute to food security of the country.

BRRI Regional Station, Habiganj

Table-1

Research Achievement 2018-19

(Technology developed)

Sl. No.	Technology developed	How Country/Farmer/User will be benefited
1	Integrated nutrient management as a tool for reducing fertilizer cost.	Farmers able to save 50% chemical fertilizers cost by using cow dung @ 2 t ha^{-1}.
2	Double transplanting of Boro rice is a good technology for escaping flash flood in haor areas.	Double transplanted rice matures 7-10 days earlier than normal transplanted rice. It can save Boro rice from early flash-flood in haor areas without sacrificing yield.
3	Wet-direct seeding crop establishment technique for reducing growth duration	Wet direct seeding rice reduces about 5-7 days growth duration than normal transplanting in haor areas.

Regional Station, Kushtia

Table-3

Research Achievement 2018-19

(Technology Developed)

Sl. No.	Technology Developed	How Country/Farmer/User will be benefited
	Not applicable	

Regional Station, Rajshahi

Table 1

Research Achievement: 2018-2019

(Technology Development)

Technology Developed	How country /Farmers/Users will be benefited
Provided major contribution in development of BRRI dhan93, BRRI dhan94 and BRRI dhan95	Out the three, BRRI dhan93 and BRRI dhan94 developed from the pure line selection of locally cultivated swarna type varieties. BRRI dhan95 also developed from swarna. As Swarna type varieties are popular in this region, these varieties can be cultivated in Barind region. As result, the yield of rice will be increased and farmers will be

Un-puddled transplanting of Aman rice by rice transplanter followed by sowing of wheat and mungbean by Bed planting/strip tillage system could be an alternate crop management options Bamboo made trap could be an easy and cost effective trap for rat control	benefitted. Compared with conventional (Puddled transplanting of Aman rice followed by conventional broadcasting of wheat and mungbean), un-puddled transplanting of Aman rice by rice transplanter followed by sowing of wheat and mungbean by Bed planting/strip tillage under Aman rice-wheat-mungbean cropping pattern increased the rice equivalent yield, gross return and gross margin (About Tk. 7500/ha could be saved). The cost for rat control as well as crop loss due to rat attack could be reduced.

Regional Station, Satkhira

Table-1
Research Achievement 2018-19
(Technology Developed)

Sl. No.	Technology Developed	How Country/Farmer/User will be benefited
01.	Improvement the productivity of gher system	By adopting this technology two times more benefit can be achieved than existing practice.
02.	BRRI dhan93	BRRI dhan93 might be an alternate option for replacing Indian Swarna-5 and Ranjit Swarna.
03.	BRRI dhan94	BRRI dhan93 might be an alternate option for replacing Indian Swarna-5 and Ranjit Swarna.
04.	BRRI dhan95	BRRI dhan93 might be an alternate option for replacing Indian red Swarna.

Regional Station, Sonagazi, Feni

Table-1
Research Achievement 2018-19
(Technology Developed)

Sl. No	(Technology Developed)	How Country/Farmer/User will be benefited
	Not yet developed	

Regional Station, Rangpur

Table-1

Research Achievement, 2019-2020

(Technology Developed)

Sl. No.	Technology Developed	How Country/Farmer/User will be benefited
	Not yet developed	

Regional Station, Gopalganj

Table-1

Research Achievement 2018-2019

(Technology Developed)

SL.NO.	Technology Developed	How Country/Farmer / User will be benefited
	It is a new station, The station Started journey in 16.04.2019 with a single man power. No research program and progress yet during 2019-20.	

Regional Station, Sirajganj

Table-1
Research Achievement 2018-2019

(Technology Developed)

SI. No.	Technology Developed	How country/ Farmer/User will be benefitted
1	Reduction of "LUNA SYMPTOM" in char land: In charland, plant growth reduced or dropped sporadically due to infiltration of soil nutrients in cultivated rice field is locally known as "LUNA SYMPTOM". Development of charland soil is very important to sustain food security in Bangladesh. Basically char land can be divided into temporary and permanent charlands. Permanent char is mostly used for agricultural production to improve the livelihood and economic development of char land people compared to temporary one. Plant growth reduced or dropped sporadically in the field due to leaching of soil nutrients during the cultivation of crops. Therefore, the growth of the crops stunted, plants become yellowing and finally, the yield reduced. Locally it is called "LUNA Symptom"	**How to address the charland soil:** The main problems of the permanent and temporary char land are their less water holding capacity. Initially, the residual plant parts of cultivated rice or other crops are mixed with sandy -loam soils to improve their water holding capacity at a certain level. For this, cowdung, different organic fertilizers, charcoals / biochar etc are mixed with soil at a certain depth (below six inches depth in different doses / mixtures of organic maters) to improve physic-chemical properties of sandy loam soil. Thereby, applied nutrients are stored in organic soil for a long time. Therefore, the tendency of "LUNA Symptom" in rice field is reduced gradually by applying nutrients from different sources. Farmers in char land ecosystem can follow this process to improve their field soil. It is expected that the result received from the research field is helpful for permanent charland. This process will increase the rice yield at certain level.
2	**Control of rice field rat using owl watching tower (OWT)** Owl watching towers are effective from dusk to down. It can be used as perching device during day time. Net is used to collect the owl regurgitate pellets for analysis. Collected and observed pellets of owl from watching tower confirmed the rat predation by owl.	Newly developed burrows become inactive around 50 dia meter areas. One pair adult with 2-3 offsprings can feed around 1000 rats per breeding cycle. Thereby, rat damage will be reduced both in field and in storage, where farmers keep their ultimate products.